

THE NEW ENCYCLOPÆDIA; OR, MODERN UNIVERSAL DICTIONARY OF ARTS AND SCIENCES.

ON A NEW AND IMPROVED PLAN.

IN WHICH ALL THE RESPECTIVE SCIENCES ARE ARRANGED INTO

COMPLETE SYSTEMS,

THE ARTS DIGESTED INTO

DISTINCT TREATISES,

And Philosophical Subjects introduced in separate Dissertations.

ALSO,

The DETACHED PARTS of KNOWLEDGE ALPHABETICALLY ARRANGED, and COPIOUSLY EXPLAINED, according to the BEST AUTHORITIES.

Including all the material Information that is contained in

CHAMBERS'S CYCLOPÆDIA, the ENCYCLOPÆDIA BRITANNICA,

AND THE

FRENCH ENCYCLOPÉDIE.

The Whole containing a copious DIGEST and DISPLAY of the complete THEORY and PRACTICE of the

LIBERAL AND MECHANICAL ARTS.

AND COMPRISING AN UNIVERSAL

Repository of Ancient and Modern Literature,

Freed from the Obscurities, Errors, and Superfluities of other DICTIONARIES.

And including all the NEW IMPROVEMENTS and LATEST DISCOVERIES made in the ARTS and SCIENCES, particularly

Acoustics	Belles-Lettres	Conics	Entomology	Geometry	Laws	Military Affairs	Ornithology	Rhetoric
Aerology	Book-keeping	Cosmography	Ethics	Grammar	Logic	Mineralogy	Painting	Rites
Aerostation	Botany	Criticism	Farriery	Gunnery	Magnetism	Midwifery	Perspective	Sculpture
Agriculture	Brewing	Dialling	Fencing	Handicrafts	Mammalia	Musick	Pharmacy	Surgery
Algebra	Catoptrics	Dioptrics	Financing	Heraldry	Mathematics	Mythology	Philosophy	Surveying
Amphibiology	Chemistry	Distillation	Fluxions	History	Mechanics	Navigation	Physic	Tactics
Anatomy	Chronology	Drawing	Fortification	Husbandry	Medicine	National Affairs	Physiology	Theology
Annuities	Commerce	Dyeing	Fossils	Hydraulics	Mensuration	Natural History	Pneumatics	Trade
Architecture	Comparative	Electricity	Gardening	Hydrography	Merchandize	Naval Affairs	Poetry	Trigonometry
Arithmetic	Anatomy	Engineering	Gauging	Hydrostatics	Metallurgy	Optics	Politics	Vermeology
Astronomy	Cosmology	Engraving	Geography	Ichthyology	Metaphysics	Oratory	Projectiles	Zoology, &c.

By the New and Improved Plan of incorporating COMPLETE SYSTEMS on the SCIENCES, and DISTINCT TREATISES on the respective ARTS, this Work comprises, independent of the Alphabetical Arrangement,

A GENERAL CIRCLE OF SCIENCE;

AND FORMS THE MOST COMPREHENSIVE

LIBRARY OF UNIVERSAL KNOWLEDGE

THAT WAS EVER PUBLISHED IN THE ENGLISH LANGUAGE.

IN THREE VOLUMES.

By WILLIAM HENRY HALL, Esquire.

The Second Edition.

Revised, corrected, and enlarged, with considerable Additions, Improvements, and modern Discoveries,

By THOMAS AUGUSTUS LLOYD,

Assisted by Gentlemen of Scientific Knowledge.

NON SIBI, SED PATRIÆ. CATO.

VOL. III.

Illustrated with upwards of One Hundred and Fifty large superb Copper-Plates, accurately descriptive of the different Subjects to which they refer.

LONDON: PRINTED FOR C. COOKE, No. 17, PATERNOSTER-ROW; AND SOLD BY THE BOOKSELLERS OF
BATH, BRISTOL, BIRMINGHAM, CANTERBURY, CAMBRIDGE, COVENTRY, CHESTER, DORSET, EXETER,
GLOUCESTER, HEREFORD, HULL, IPSWICH, LEEDS, LIVERPOOL, LEICESTER, MANCHESTER,
NEWCASTLE, NORWICH, NOTTINGHAM, NORTHAMPTON, OXFORD, READING,
SALISBURY, SHEBORN, SHEFFIELD, SHREWSBURY, WORCESTER,
WINCHESTER, YORK; AND BY ALL OTHER
BOOKSELLERS IN ENGLAND,
SCOTLAND, AND
IRELAND.

THE UNIVERSITY OF CHICAGO

LIBRARY

1890

CHICAGO

1890

CHICAGO

1890

CHICAGO

1890

CHICAGO

1890

CHICAGO

1890

CHICAGO

1890

CHICAGO

1890

M A liquid consonant, and the 12th letter of the alphabet. The sound of this letter is formed by shutting the lips, and thereby intercepting the breath, as it is strongly expressed through the mouth and nostrils jointly. Its sound is always the same in English, it suffers no consonant after it in the beginning of words and syllables, unless in some derived from the Greek, as *amnesis*, &c.

MACACO, or **MACAUO**, in zoology, a species of the third genus *Lemur*. See **LEMUR**. For a representation, see plates of **MAMMALIA**, Genus III.

MACAW, **MACCAW**, or **MACAO**, in ornithology, the English name of a species of the genus *Psittacus*. See **PSITTACUS**.

MACCABEES, two apocryphal books of Scripture; so called from Judas the son of Mattathias, surnamed *Maccabæus*, either on account of his valour, or because he bore on his standard the first letters of a sentence in Exodus, which, joined together, form the name *Maccabee*. The Hebrews call them *The books of the Asmoneans*, because (according to Josephus and Eusebius) Mattathias was the son of *Hosamoneus*, or *Asmoneus*, which was the name of the family. The first book of the Maccabees is an excellent history; and comes nearest to the style and manner of the sacred historians of any extant. The second book does not by any means equal the accuracy and excellency of the first.

There is also a third book of *Maccabees*, containing the history of the persecution of Ptolemy Philopater against the Jews in Egypt, and their sufferings under it; and seems to have been written by some Alexandrian Jew in the Greek language, not long after the time of Siracides. It is in most of the ancient manuscript copies of the Greek Septuagint, particularly in the Alexandrian and Vatican, but was never inserted into the vulgar Latin version of the Bible, nor consequently into any of our English copies. Moreover, Josephus's History of the Martyrs that suffered under Antiochus Epiphanes, is found in some manuscript Greek Bibles, under the name of the fourth book of the *Maccabees*.

MACE, the second coat or covering of the kernel of the nutmeg, is a thin and membranaceous substance, of an oleaginous nature, and a yellowish colour; being met with in flakes of an inch or more in length, which are divided into a multitude of ramifications. It is of an extremely fragrant, aromatic, and agreeable flavour; and of a pleasant, but acrid, oleaginous taste. Mace is carminative, stomachic, and astringent; and possesses all the virtues of nutmeg, but has less astringency. The oils of mace and nutmeg, whether prepared by distillation or expression, are so much of the same nature, that they may be indiscriminately used for one another on all occasions. They give ease in cholics, and often in nephritic cases, taken internally from one drop to five or six of the distilled oil, or an equal quantity of the expressed; and externally, they are of use to rub paralytic limbs: they also assist digestion; and will often stop vomitings and hiccoughs, only by being rubbed on the region of the stomach. The nurses have a custom of applying oil of mace by expression to childrens' navels to ease their gripes, and that often with success; and we are assured, by authors of credit, that, when rubbed on the temples, it promotes sleep.

MACKREL, in ichthyology, the English name of a well known sea-fish of the scomber kind: it is a species of the genus *Scomber*. See **SCOMBER**.

MADDER, in botany, the English name of the genus *Rubia*. See **RUBIA**. The culture of that species of *madder* which is used by the dyers and callico printers, and which grows naturally in the Levant, is an article of considerable advantage to the Dutch, inasmuch that at an average of several years past they have received from us more than 180,000*l.* per annum. It might be prosecuted here with equal success. For the method of cultivation, see the **System of AGRICULTURE**, Sect. VIII. See also the **Treatise on DYEING**, Sect. II. It appears from the calculations of an ingenious writer, that, supposing the land to be worth 40*s.* per acre, and excluding the original price of the plants, the whole expence of cultivating it with *madder*, is 15*l.* 18*s.* 2*d.* and that the produce of it is 52*l.* 12*s.* 2*d.* so that the clear profit is 36*l.* 14*s.* The root of the common *madder*, cultivated for the use of the dyers, is an excellent aperient and diuretic. It is prescribed with great success in obstructions of the liver and spleen, in suppressions of the menses and urine, and in dropsies, jaundices, and cachexies. It is also recommended as a vulnerary, and said to be peculiarly excellent in the dissolving coagulated blood. The college of Edinburgh makes it an ingredient in the icteric decoction, which is prepared by boiling an ounce of *madder*, the same quantity of turmeric, and the same quantity of the roots and leaves of celandine, in three pints of water to a quart, to which, when strained and cooled, the juice of two hundred millepedes is added: a quarter of a pint of this liquor is taken twice a day, or oftener. The dyers prepare a red colour with it, and use it also as a first tint for several others.

MADNESS, *mania*, in medicine. See the **System**.

MAGI, or **MAGIANS**, an ancient religious sect in Persia, and other Eastern countries. Their priests were the most skilful mathematicians and philosophers of the ages in which they lived, No. 98. VOL. III.

inasmuch that a learned man and a magian became equivalent terms. The vulgar looked on their knowledge as supernatural; and hence those who practised wicked and mischievous arts, taking upon themselves the name of *magians*, drew on it that ill-signification which the word magician now bears among us. This sect still subsists in Persia under the denomination of *gaurs*, where they watch the sacred fire with the greatest care, and never suffer it to be extinguished.

MAGIC Lantern, an optic machine contrived by Kircher, (see his *Ars Magna Lucis et Umbrae*, p. 768, 769,) by means whereof little painted images are represented on an opposite wall of a dark room; magnified to any bigness at pleasure. See the **System of OPTICS**.

MAGICAL Picture, in electricity, first contrived by Mr. Kinnersley. For a copious description, see the **System**, Sect. II. Art. III. Exp. IV.

MAGNA Charta, the great charter of the liberties of Britain, and the basis of our laws and privileges. This charter may be said to derive its origin from king Edward the Confessor; who granted several privileges to the church and state by charter: these liberties and privileges were also granted and confirmed by king Henry I. by a celebrated great charter now lost; but which was confirmed or re-enacted by king Henry II. and king John. Henry III. the successor of this last prince, after having caused 12 men to make enquiry into the liberties of England in the reign of Henry I. granted a new charter; which was the same as the present magna charta. This he several times confirmed, and as often broke; till, in the 37th year of his reign, he went to Westminster-hall, and there, in the presence of the nobility and bishops, who held lighted candles in their hands, magna charta was read, the king all the time holding his hand to his breast, and at last solemnly swearing faithfully and inviolably to observe all the things therein contained, &c. Then the bishops extinguishing the candles, and throwing them on the ground, they all cried out, "Thus let him be extinguished, and stink in hell, who violates this charter." It is observed, that, notwithstanding the solemnity of this confirmation, king Henry, the very next year, again invaded the rights of his people, till the barons entered into a war against him; when, after various success, he confirmed this charter, and the charter of the forest, in the 52d year of his reign.

This charter confirmed many liberties of the church, and redressed many grievances incident to feudal tenures, of no small moment at the time; though now, unless considered attentively, and with this retrospect, they seem but of trifling concern. But, besides these feudal provisions, care was also taken therein to protect the subject against other oppressions, then frequently arising from unreasonable amercements, from illegal distresses, or other process for debts or services due to the crown, and from the tyrannical abuse of the prerogative of purveyance and preemption. It fixed the forfeiture of lands for felony in the same manner as it still remains; prohibited for the future the grants of exclusive fisheries; and the erection of new bridges so as to oppress the neighbourhood. With respect to private rights, it established the testamentary power of the subject over part of his personal estate, the rest being distributed among his wife and children; it laid down the law of dower, as it hath continued ever since; and prohibited the appeals of women, unless for the death of their husbands. In matters of public police and national concern, it enjoined a uniformity of weights and measures; gave new encouragement to commerce, by the protection of merchant strangers; and forbade the alienation of lands in mortmain. With regard to the administration of justice, besides prohibiting all denials or delays of it, it fixed the court of common-pleas at Westminster, that the suitors might no longer be harassed with following the king's person in all his progresses; and at the same time brought the trial of issues home to the very doors of the freeholders; by directing assizes to be taken in the proper counties, and establishing annual circuits; it also corrected some abuses then incident to the trials by wager of law and of battle; directed the regular awarding of inquests for life or member; prohibited the king's inferior ministers from holding pleas of the crown, or trying any criminal charge, whereby many forfeitures might otherwise have unjustly accrued to the exchequer; and regulated the time and place of holding the inferior tribunals of justice, the county-court, the sheriff's torn, and court-leet. It confirmed and established the liberties of the city of London, and all other cities, boroughs, towns, and ports of the kingdom. And lastly, (which alone would have merited the title that it bears of the *great charter*;) it protected every individual of the nation in the free enjoyment of his life, his liberty, and his property, unless declared to be forfeited by the judgment of his peers or the law of the land. This excellent charter, so equitable, and beneficial to the subject, is the most ancient written law in the kingdom. By the 25th Edward I. it is ordained, that it shall be taken as the common law; and by the 43d Edward III. all statutes made against it are declared to be void.

MAGNET, *magones*, the loadstone; a sort of ferruginous stone, in weight and colour resembling iron ore, and very hard and heavy; endued with divers extraordinary properties, attractive

M A G

tractive, inclinatory, &c. The *magnet* is indeed a true iron ore, from which a considerable portion of iron may be extracted, and is usually found in iron mines, and sometimes in very large pieces, half magnet, half common ore. Its colour is different, white, blue, red, black, but mostly ferruginous, according to the different countries it is brought from. The ancients reckoned five kinds of magnets, different in colour and virtue; the Ethiopic, Magnesian, Boeotic, Alexandrian, and Natolian. They also took it to be of two kinds, male and female; but the chief use they made of it was in medicine; especially for the cure of burns, and defluxion on the eyes. The moderns, more happy, take it to conduct them in their voyages. See **NAVIGATION**.

The most distinguishing properties of the *magnet* are, that it attracts iron, thus serving the purposes of the chymist in discovering or separating small particles of iron, mixed with other matters, and that it points to the poles of the world; and in other circumstances, also, dips or inclines to a point beneath the horizon, directly under the pole; and that it communicates these properties, by touch, to iron. On which foundation are formed the mariners' needles; both the horizontal, and the inclinatory, or dipping-needles.

Variation of the MAGNET. The cause of the variation of the needle has remained hitherto without any demonstrative discovery; yet since its declination, and inclination, or dipping, do both of them manifestly indicate the cause to be somewhere in the earth, it has given occasion to philosophy to frame hypotheses for a solution, which makes the earth a large or general magnet or loadstone, of which all the lesser ones are but so many parts or fragments, and being possessed of the same virtue, will, when left to move freely, have the same disposition and similarity of position, and other circumstances. The most considerable of these hypotheses is that of the late sagacious Dr. Halley, which is this: the globe of the earth is one great magnet, having four magnetical poles or points of attraction, near each pole of the equator two; and that in those parts of the world which lie near adjacent to any one of those magnetical poles, the needle is chiefly governed thereby, the nearest pole being always predominant over the more remote one. Of the north poles, that which is nearest to us he supposes to be in the meridian of the land's end, which governs the variations in European Tartary and the North Sea; the other he places in a meridian passing through California, about 15 degrees from the north pole of the world, which governs the needle in North America, and the oceans on either side. In like manner he accounts for the variations in the southern hemisphere. See **DIPPING NEEDLE**.

The variation of the needle has, within a century past, undergone a remarkable alteration; for at London it was observed by Mr. Burrows, in the year 1580, to be $11^{\circ} 15'$ east: after that, in the year 1622, it was observed by Mr. Gunter to be but 6° east. In the year 1634, Mr. Gellibrand observed it to be $4^{\circ} 5'$ east. In 1657, it was observed by Mr. Bond to be nothing at all, that is, the needle pointed directly to the north. After this, in the year 1672, Dr. Halley observed it to be $2^{\circ} 30'$ westward; and again, in the year 1692, he found it 6° west. Since then, in the year 1722, Mr. Graham, by most accurate experiments, found it to be $14^{\circ} 13'$, and at present it is between 19 and 20 degrees; and in some places it has been found to be 23° westward.

The ingenious Muschenbroek has, with indefatigable pains and application, made experiments of the attractions and repulsions of loadstones in respect to iron and to each other; but could never find any regular proportion in the increase of attraction in their approach to, or decrease of attraction in their recess from, one another; only that the force of the magnetic virtue did increase in the approach to, and diminish in the recess from, the stone, but not exactly as the distance, nor as the square or cube of the distance reciprocally, nor in any proportion reducible to numbers; and therefore he very reasonably conjectures, that the repulsions and attractions disturb one another, so as to confound the proportion; nor are we able to hope for any other rule concerning this matter, till a way be found, if ever it can be, of separating the attracting from the repelling parts. The poles of a loadstone are not to be looked upon as two such invariable points as never to change place; for, according to Mr. Boyle, the poles of a little bit of magnet may be changed by applying them to the more vigorous poles of another, as has been confirmed by Dr. Knight, who can change at pleasure the poles of a natural magnet, by means of iron bars magnetically impregnated. Upon gently cutting a magnet through the middle of its axis, each piece becomes a complete magnet; for the parts that were contiguous under the equator before the magnet was cut, become poles, and even poles of different names; so that each piece may become equally a north or south pole, according as the section was made nearer the south or north pole of the large magnet; and the same thing would happen in any other sub-divisions. But upon cutting a magnet longitudinally, there will then be four poles, the same as before the cutting; only that there shall be formed in each piece a new

M A G

axis parallel to the former, and more or less in the inside of the magnet. We find, by experience, that two magnets attract each other by the poles of different denominations; whereas, on the contrary, the two similar poles repel each other. By a great number of experiments we also learn, that the force of a magnet, in attraction and repulsion, reaches sometimes farther, sometimes not so far. The activity of some reaches to fourteen feet, and that of others is insensible within eight or nine inches; the sphere of activity is greater on certain days than other, without its even appearing that the heat, moisture, or drought of the air contribute any thing to this effect.

In order to communicate the magnetic virtue effectually, these methods are made use of: 1. It has been discovered that iron rubbed upon one of the poles of the magnet, acquires a great deal more virtue than from any other part thereof, and this is more considerable from an armed than a naked magnet. 2. The more gently the iron is pressed, and the more it is pressed against the pole, the more magnetical it becomes. 3. It is more convenient to impregnate iron on one pole than on both successively. 4. The iron is much better impregnated by pressing it uniformly, and in the same direction, according to its length, than by rubbing it by the middle; and the extremity which touches the pole last retains the most virtue. 5. A piece of polished steel, or a bit of pointed iron, receives more virtue than a simple piece of iron of the same figure; and, *ceteris paribus*, a piece of iron that is long, small, and pointed, is more strongly impregnated than that of any other form. The communication of the magnetic virtue does not sensibly impair that of the loadstone; though it has been observed that some magnets have communicated a greater power to iron to raise weights, than they had themselves, but without impairing their own force, or adding any thing to the weight of the iron.

Artificial MAGNETS, are steel bars impregnated with the virtues of the magnet, so that they possess all the properties, and may be used instead of, the natural loadstone.

MAGNETISM, the virtue or power that the magnet has of attracting iron, &c. The primary properties of magnetism are as follows: 1. Every loadstone has two points or poles, which emit the magnetic virtue most copiously. 2. One of those poles attracts, the other repels iron, but no other body. 3. Their virtue is communicated to iron by the touch, which renders it magnetic. 4. A piece of iron, so touched by the loadstone, and nicely suspended on a sharp point, will be determined to settle itself in a direction nearly north and south. 5. The end of the needle touched by the south pole of the stone will point northwards, and the contrary. 6. Needles touched by the stone will dip below the horizon, or be directed on the touched part to a point within the earth's surface. This is called the dipping-needle. 7. This virtue is also to be communicated to iron, by a strong attrition all one way; whence files, drills, &c. are always to be found magnetical. 8. Iron rods or bars acquire a magnetic virtue, by standing long in one position. 9. Fire totally destroys this virtue, by making the stone or iron red-hot. 10. This power is exerted sensibly to the distance of several feet. 11. It is sensibly continued through the substance of several contiguous bodies or pieces of iron, as keys, &c. 12. It pervades the pores of the hardest bodies; and, 13. equally attracts the iron in vacuo as in open air. To the above properties of the loadstone we shall add the following, viz. That the same pole of the stone will communicate to a piece of iron the power of attracting or repelling the same end of a touched needle, by drawing it different ways thereon: or thus, if a piece of iron be drawn to the right hand, and attracts, it will repel if drawn to the left, which is not a little wonderful. By a smart stroke of a hammer on the untouched end of the dipping-needle, the magnetic virtue may be caused to come all to that end from the other, so as to make it dip on that side, as much as it did on the other side before; and, on the contrary, by such a stroke, sometimes, it may be made to dip much more on the touched end than before. Again, sometimes by striking it, the needle which dipped before, will be restored to its equilibrium, as if the virtue had made its escape, or were uniformly diffused over all the needle. So capricious are the phenomena of this amazing power.

Animal MAGNETISM, a sympathy lately supposed by some persons to exist between the magnet and the human body; by means of which the former became capable of curing many diseases in an unknown way, something resembling the performances of the old magicians.

The fanciful system, to call it by no worse name, of animal magnetism, appears to have originated, in 1774, from a German philosopher, named *Father Hehl*, who greatly recommended the use of the magnet in medicine. M. Mesmer, a physician of the same country, by adopting the principles of Hehl, became the direct founder of the system; but, afterwards deviating from the tenets of his instructor, he lost his patronage, as well as that of Dr. Ingenhousz, which he had formerly enjoyed. Mesmer had already distinguished himself by "A Dissertation on the Influence of the Stars upon the Human Body," which he publicly defended in a thesis before the university of Vienna; but he was so unable to stand before the opposition of Hehl and Ingenhousz

Ingenhousz, that his system fell almost instantly into disrepute. Mesmer appealed to the academy of sciences at Berlin; but they rejected his principles as destitute of foundation, and unworthy of the smallest attention. He then made a tour through Germany, publishing every where the great cures he performed by means of his animal magnetism, while his enemies every where pursued him with detections of the falsehood of his assertions.

Mesmer, still undaunted by so many defeats, returned to Vienna; but meeting there with no better success than before, he retired to Paris in the beginning of the year 1778. Here he met with a very different reception. He was first patronized by the author of the *Dictionnaire des Merveilles de la Nature*; in which work a number of his cures were published, Mesmer himself receiving likewise an ample testimony of his candour and solid reasoning. Our physician soon collected some patients; and in the month of April, 1778, retired with them to Creteil, from whence he, in a short time, returned with them perfectly cured. His success was now as great as his disappointment had been before. Patients increased so rapidly that the Doctor was soon obliged to take in pupils to assist him in his operations. These pupils succeeded equally as well as Mesmer himself; and so well did they take care of their own emolument, that one of them, named M. Deslon, realized upwards of 100,000l. sterling. In 1779, Mesmer published a memoir on the subject of Animal Magnetism, promising afterwards a complete work upon the same, which should make as great a revolution in philosophy as it had already done in medicine.

The new system now gained ground daily; and soon became so fashionable, that the jealousy of the faculty was thoroughly awakened, and an application concerning it was made to government. In consequence of this a committee was appointed to enquire into the matter, consisting partly of physicians, and partly of members of the royal academy of sciences, with Dr. Benjamin Franklin at their head. This was a thunderstroke to the supporters of the new doctrine.—Mesmer himself refused to have any communication with the committee; but his most celebrated pupil Deslon was less scrupulous, and explained the principles of his art in the following manner:

1. Animal magnetism is a universal fluid, constituting an absolute plenum in nature, and the medium of all mutual influence between the celestial bodies and betwixt the earth and animal bodies.

2. It is the most subtle fluid in nature; capable of a flux and reflux, and of receiving, propagating, and continuing all kinds of motion.

3. The animal body is subjected to the influences of this fluid by means of the nerves, which are immediately affected by it.

4. The human body has poles and other properties analogous to the magnet.

5. The action and virtue of animal magnetism may be communicated from one body to another, whether animate or inanimate.

6. It operates at a great distance without the intervention of any body.

7. It is increased and reflected by mirrors; communicated, propagated, and increased by sound; and may be accumulated, concentrated, and transported.

8. Notwithstanding the universality of this fluid, all animal bodies are not equally affected by it; on the other hand, there are some, though but few in number, the presence of which destroys all the effects of animal magnetism.

9. By means of this fluid nervous disorders are cured immediately, and others mediately; and its virtues, in short, extend to the universal cure and preservation of mankind.

From this extraordinary theory, Mesmer, or M. Deslon, had fabricated a paper, in which he stated that there was in nature but one disease and one cure, and that this cure was animal magnetism; and lastly, M. Deslon engaged, 1. To prove to the commissioners, that such a thing as animal magnetism existed: 2. To prove the utility of it in the cure of diseases: after which he was to communicate to them all that he knew upon the subject. The commissioners accordingly attended in the room where the patients underwent the magnetical operations. The apparatus consisted of a circular platform made of oak, and raised about a foot and a half from the ground; which platform was called the *baquet*. At the top of it were a number of holes, in which were iron rods, with moveable joints, for the purpose of applying them to any part of the body. The patients were placed in a circle round, each touching an iron rod, which he could apply to any part of the body at pleasure; they were joined to one another by a cord passing round their bodies, the design being to increase the effect by communication. In the corner of the room was a piano forte, on which some airs were played, occasionally accompanied with a song. Each of the patients held in his hand an iron rod ten or twelve feet long; the intention of which, as Deslon told the commissioners, was to concentrate the magnetism in its point, and thus to render its effects more sensible. Sound is another conductor of this magnetism; and in order to communicate the magnetism to the piano forte, nothing more is necessary than to bring the iron rod near it. Some magnetism is also furnished by the person who plays it; and this magnetism is transmitted to the patients

No. 98. Vol. III.

by the sounds. The internal part of the platform was said to be so contrived as to concentrate the magnetism, and was the reservoir whence the virtue diffused itself among the patients. Its structure, however, is not mentioned; but the committee satisfied themselves, by means of a needle and electrometer, that neither common magnetism nor electricity was concerned.

Besides the different ways of receiving the magnetism already mentioned, viz. by the iron, cord, and piano forte, the patients also had it directly from the Doctor's finger, and a rod which he held in his hand, and which he carried about the face, head, or such parts of the patient as were diseased; observing always the direction of what he called the poles. The principal application of magnetism, however, was by pressure of the hands or fingers on the hypochondria or lower regions of the stomach.

The effects of these operations upon Deslon's patients were very different. Some felt nothing, neither had the magnetism any effect whatever upon them. Some spit, coughed, sweat, and felt, or pretended to feel, extraordinary heats in different parts of the body. Many women, but very few men, had convulsions, which Deslon called their crises, &c. The commissioners at last found that they could come to no satisfactory conclusion while they attended in this public way, and therefore determined to try the experiments themselves privately. As the fluid itself, however, was totally imperceptible by any of the senses, they could only ascertain themselves of its existence by ultimately curing diseases, or by its observable effects upon the human body. Being well assured, however, that, though many diseases were cured, it would not amount to any proof of the existence of animal magnetism, they determined to observe its effects on the animal economy. For this purpose they made the following experiments:

1. They tried it upon themselves, and felt nothing.

2. Seven of Deslon's patients were magnetised at Dr. Franklin's house, four of whom felt nothing; three felt, or affected to feel, something.

3. Several persons in a higher sphere of life were magnetised, and felt nothing.

4. The commissioners, now determined to discover what share imagination had in this business, blindfolded several of the common people, and made them sometimes think that they were magnetised, at other times they magnetised them without letting them know that they did so; the consequence was, that when they supposed themselves magnetised, the patients likewise thought they felt something, and *vice versa*.

5. A magnetised tree was said to produce convulsions; a young man, blindfolded, fell into convulsions when he imagined himself near the tree, though he was really at a considerable distance from it. Deslon accounted for this on the principle of all trees being magnetic: but in this case, every one, susceptible of magnetism, would be seized with convulsions when he approached a tree. The same influence of imagination was observed in a woman accustomed to have convulsions when magnetised. They came on when nothing was done to her, on being told, when blindfolded, that she was magnetised.

Other instances are given, from which it was evident, either that the patients were impostors, or in such a most wretched state of debility both of mind and body, that the most trifling effects of the former had the most powerful effects on the latter. The commissioners therefore entirely disapproved of the whole. The touch, imitation, and imagination, they concluded, were the great causes of the effects produced by Mr. Deslon's operations; and by means of these they supposed that convulsions, which in themselves are a very violent disorder, might be spread much farther than could be wished, even through a whole city. It was observed that the operator sometimes pressed strongly, and for a length of time, upon different parts of the body, particularly the hypochondria and pit of the stomach; and it is well known that a strong pressure on these parts will produce disagreeable sensations in those who enjoy perfect health.

It is needless to add more upon this subject, than that Mesmer complained of the report of the commissioners, petitioned parliament, was by them commanded to discover the mysteries of his doctrine, and that it is now exploded by every man of sense. The conclusion of the academicians concerning it was, that it is not entirely useless even to philosophy; as it is one *fait* more to be consigned to the history of the errors and illusions of the human mind, and a signal instance of the power of imagination.

MAGPYE, in ornithology, the English name of a well known species of the Genus *Corvus*, or the *corvus pica*, in the Linnaean system. For the classification, see the system. For the description, see *CORVUS*.

MAHOGANY, a species of the Genus *Cedrus*. For a description, see *CEDRUS*.

MAHOMETANISM, MAHOMETISM, MOHAMMEDISM; the system of religion broached by *Mahomet*, and still adhered to by his followers. *Mahomet* was born at Mecca in Arabia, in the year of Christ 571 or 572, according to the most probable opinion: in the thirty-eighth year of his age he began to withdraw himself into a solitary cave near Mecca, called the cave of Hira, for the purpose of forming his system of imposture; the propa-

gation of which he commenced in the fortieth year of his age, when he assumed the title of the apostle of God: and having gained nine disciples, some of whom were the principal men of the city, in the forty-fourth year of his age he openly published his imposture to the people of Mecca, and declared himself a prophet sent by God to recover them from Paganism, and to teach them the true religion. However, he was obliged to abandon Mecca, and to settle at Medina, on the 16th of July, A. D. 622, the year of the hegira, or *Mahometan* epocha: here his party considerably increased, and having made several successful excursions against the Arab tribes, and constrained them by force to embrace his religion, his sovereignty was established in 628, and he united in himself the sacred character of chief pontiff of his religion, as well as the royal; both which characters he transmitted to all his successors, who, by the title of caliphs, reigned after him. But they were afterwards deprived of the regal authority; first by the governors of the provinces, who, about the year of the hegira, 325, assumed it to themselves, and made themselves kings in their respective governments; and then by others who arose on this distraction of the empire to usurp upon them, till at last they had nothing left but the name and shadow of what they had once been. In the year of Christ 629, *Mahomet*, at the head of an army of ten thousand men, reduced Mecca, and extended his conquests, with his religion, through most parts of Arabia: and the remaining Arabs submitted and embraced his imposture in 631. In the next year he died at Medina, being, according to some historians, sixty-three years of age.

Mahometanism is embraced by the Turks, Persians, and several nations among the Africans, and many among the East Indians. Brerewood says, that if we divide the known countries of the earth into thirty equal parts, five of them are Christians, six Mahometans, and nineteen Pagans. The system of *Mahometanism* is contained in the Koran, commonly called the Alcoran. See the article ALCORAN.

The first and chief article of the *Mahometan* creed is, that there is no other God but one God; which they have from the Koran, where these words are repeated incessantly: *there is no other God but he. Your God is the only God. I am God, and there is no other God but I.* This grand axiom of their theology seems to have been taken from the Jews, who were continually rehearsing those words of Deuteronomy, *Hear, O Israel! the Lord our God is One.*

For this reason the *Mahometans* account all such as own any thing of number in the divinity to be infidels or idolaters. And accordingly, one of the first lessons they teach their children is, that God is neither male nor female, and consequently can have no children. The second article of *Mahometanism* consists in this, that *Mahomet* was sent from God. By which they exclude all other religions; under pretence that their prophet was the last and greatest of all the prophets that God would ever send, and that as the Jewish religion ceased with the coming of the Messiah, so likewise the Christian religion was to be abrogated with the coming of *Mahomet*. Not but they own Moses and Jesus Christ to have been great prophets; but *Mahomet* they hold to be *The Prophet*, by way of excellence, commissioned to purge the holy scriptures of the Old and New Testament, which they allow, from the corruption introduced in them by Jews and Christians, and to restore the law of God to its original purity; and the paraclete or comforter promised in the scriptures.

The *Mahometans* call their religion *Islam*, denoting, as some say, *resignation* or *submission* to the service and commands of God; but, according to others, formed from the root *salama*, signifying to be saved, and therefore the same with the religion or state of *salvation*; and they divide it into two distinct parts, viz. *mian*, i. e. *faith* or *theory*; and *din*, i. e. *religion* or *practice*: and teach, that it is built on five fundamental points, one belonging to faith, and the other four to practice. Under the confession of faith already recited, they comprehend six distinct branches, viz. belief in God; in his angels; in his scriptures; in his prophets; in the resurrection and day of judgment; and in God's absolute decree and predestination both of good and evil. The four points relating to practice, are prayer, under which are comprehended those washings or purifications which are necessary preparations required before prayer; alms; fasting; and the pilgrimage to Mecca. The *Mahometans* are taught by the Koran, that God, in divers ages of the world, gave revelations of his will in writing to several prophets, the whole, and every word of which, it is absolutely necessary for every good Moslem to believe. *Mahomet* acknowledges the divine authority of the Pentateuch, Psalms, and Gospels, and often appeals to the consonancy of the Koran with those writings, and to the prophecies which he pretended were contained concerning himself, which the Jews and Christians have suppressed. At death, they maintain, that the bodies of those who believe the unity of God, and the mission of *Mahomet*, rest in peace, and are refreshed with the air of Paradise: otherwise they are grievously tormented. The souls of the former are conveyed to heaven, where a place is assigned them according to their merit and degree; those of the wicked are tormented, till they are rejoined to their bo-

dies at the resurrection; the approach of which will be known by certain signs that precede it.

They maintain that infidels only will be liable to eternal punishment; but the Moslems or believers will be delivered thence, after they have expiated their crimes by their sufferings. This place of punishment is separated from paradise by a wall, so small in breadth as to admit the blessed and damned to converse together. The righteous will be refreshed by drinking at the pond of their prophet, and then admitted into paradise, situated in the seventh heaven, and next to the throne of God; where they will feed on the most delicious fruits; be clothed in the most splendid silken garments; refreshed with rivers of water, wine, milk and honey; and entertained with the most delightful music, and the ravishing girls of paradise with black eyes, the enjoyment of whose company will be a principal felicity of the faithful.

It appears from the Koran, that women as well as men will not only be punished for their evil actions, but also receive the rewards of their good deeds, and that both will enjoy a perpetual youth. The orthodox doctrine with respect to predestination is, that every thing which happens in this world proceedeth entirely from the divine will, and is irrevocably fixed from all eternity. As to the four fundamental points of religious practice, *Mahomet* is said to have declared, that the practice of religion is founded on cleanliness, which is one half of the faith, and the key of prayer, without which it will not be heard by God. Such is the opinion which the *Mahometans* entertain of cleanliness, that it is purely on this account they seem to have adopted circumcision, though it be not mentioned in the Koran. *Mahomet* has obliged his followers to pray five times every twenty-four hours, at certain stated times, turning their faces towards the temple at Mecca, which is pointed by a niche in their mosques: the life and spirit of prayer, they hold as the inward disposing of the heart; nor do they ever perform this duty in sumptuous apparel, nor suffer their women to attend them on these occasions. Alms among the *Mahometans* are legal and voluntary; the giving of which is frequently inculcated in the Koran. Fasting is called, by *Mahomet*, the gate of religion; and his followers are expressly required to fast during the month of Ramadan; which they observe by abstaining from meat, drink, and women, from day-break till sun-set. Besides this, they have several other voluntary fasts. The pilgrimage to Mecca is so necessary a point of practice, that, according to a tradition of *Mahomet*, he who dies without performing it, may as well die a Jew or a Christian; and it is expressly commanded in the Koran. The various ceremonies prescribed to those who perform this pilgrimage are extremely absurd and ridiculous, and appear to be relics of idolatrous superstition.

Besides the fundamental points of faith and practice above recited, the *Mahometans* are required by the Koran to abstain from wine, gaming, usury, divining by arrows, the eating of blood and swines' flesh, and whatever dies of itself, or is slain in honour of any idol, or strangled, or killed by an accident, or by any other beast. The Koran allows Polygamy within certain limits; forbidding any man to have more than four, whether wives or concubines; but *Mahomet* had the privilege of marrying as many wives, and keeping as many concubines as he pleased. It allows also of divorce; but severely punishes fornication and adultery.

The rapid success which attended the propagation of this religion, was owing to causes that are plain and evident, and must remove, or rather prevent, our surprise, when they are attentively considered. The terror of *Mahomet's* arms, and the repeated victories which were gained by him and his successors, were, no doubt, the irresistible arguments that persuaded such multitudes to embrace his religion, and submit to his dominion. Besides, his law was artfully and marvellously adapted to the corrupt nature of man; and, in a more particular manner, to the manners and opinions of the eastern nations, and the vices to which they were naturally addicted: for the articles of faith which it proposed were few in number, and extremely simple; and the duties it required were neither many nor difficult, nor such as were incompatible with the empire of appetites and passions.

MAJOR, in logic, is understood of the first proposition of a regular syllogism. It is called *major*, because it has a more extensive sense than the *minor* proposition, as containing the principal term. See the System, Part III. Sect. V.

MALACHI, the *Prophecy* of, is one of the canonical books of the Old Testament, written by *Malachi*, who was probably contemporary with Nehemiah, and lived about 428 years before Christ. The chief corruptions which he charges upon the Jews are the same with those for which they were reproved by Nehemiah; he forbids them to expect any farther succession of prophets, exhorts them to observe the law of Moses, and predicts the coming of Elias, or John the Baptist, as the forerunner of the Messiah.

MAMMALIA, a name given by Linnaeus to his first or principal class, of animals, which comprehends not only all the animals generally styled quadrupeds, but also the cetaceous order, and the human species.

M A M M A L I A.

THE authors who have written on quadrupeds are numerous, and many of them very ancient; their accounts also are proved to be in many cases imaginary or fabulous. Later authors have much improved the science; and many valuable works are published in various languages on this subject. But as it would be impossible to do justice to the merits of each, we shall content ourselves with mentioning principally those of our own countrymen, which are chiefly in English, to which we shall subjoin a list of the scientific works that are most in use. Our valuable and much respected naturalist Ray's Synopsis of Quadrupeds, printed in London in 1693, is an excellent work. Edwards's Natural History of Birds, published in 1750, and his Gleanings of Natural History, 1758, 1760, and 1764, contain some excellent figures of quadrupeds. The History of Animals by Dr. Hill, in folio, 1752, is not destitute of merit. The Natural History of Carolina, by Mr. Catesby, contains some few animals; but we are more particularly indebted to Mr. Pennant for his British Zoology, in folio, 1766; in 8vo. 1768; Pennant's Indian Zoology, 4to, 1769. Synopsis of Quadrupeds, October 1771. To these we may add the Outlines of Natural History of Great Britain and Ireland, by Dr. Berkenhout; and the History of the Earth, and animated Nature, by Dr. Goldsmith; and above all, a general History of Quadrupeds, with wooden figures, engraved by T. Bewick, published lately at Newcastle upon Tyne; a work that must immortalize the name of the engraver, and give an excellent outline to the reader of this branch of knowledge. And much useful information may be acquired from the Elements of Natural History, by our Botanic Professor at Cambridge, Mr. Thomas Martin, B. D.

The system of Mr. Ray obtained very generally among naturalists, till, in the year 1735, Linnæus first published his System. This was followed by several others, varying in the arrangement of the animal kingdom, even to the last edition of 1767. Under the class, which he denominates MAMMALIA, he comprehends not only all the animals which we call quadrupeds (the lizard genus, or rather the reptiles pedati excepted) but also the cetaceous order, or whales, cachalots, and porpoises; justifying this arrangement of whales with quadrupeds, from the agreement of these animals in the structure of the heart, in the respiration by means of lungs, in their having moveable eye-lids and ears, in being viviparous, furnished with teeth, and other particulars, by which they differ so materially from fishes, as more than to counterbalance their living with them in the same element.

Mr. Pennant, in his Synopsis of Quadrupeds, and professor Martin, in his Elements of Natural History, by including some animals that were unknown to Linnæus, and giving the rank of species to several that were considered by him as varieties, have extended the number of mammalia to two hundred and eighty-nine species. Mr. Klein, in 1751, published a new system of quadrupeds, intitled *Quadrup. Dispositio brevisque Hist. Natur.* in which he distributes them into two orders; the first comprehending those whose feet are terminated by one or more hoofs, and the second those which are digitated; and each of these orders is subdivided into five families or classes. In his first order he follows the general arrangement of Mr. Ray, which he has considerably improved: but in the second, by a servile regard to a method founded on the number of toes, he has combined very opposite animals; the camel and the sloth, the mole and the bat, the glutton and the ape.

Mr. Pennant has introduced some useful alterations in his History of Quadrupeds: this ingenious naturalist has followed Mr. Ray in his greater division of animals into hoofed and digitated; but, after the manner of Mr. Klein, he has formed separate genera of the rhinoceros, hippopotamus, tapir, and musk. The apes are continued in the rank in which Mr. Ray placed them, and are followed by the maucos. The carnivorous animals are arranged according to the system of Linnæus, omitting the seal, mole, shrew, and hedge-hog. The herbivorous or frugivorous quadrupeds occupy the class assigned them, by Mr. Ray, to which he has allotted likewise the shrew, the mole, and the hedge-hog. The fourth section of digitated quadrupeds consists of those which are absolutely destitute of cutting teeth, such as the sloth and armadillo. The fifth section is formed of those which are destitute of teeth of every kind, such as the manis and ant-eater. The third and fourth orders or divisions which Mr. Pennant has added, are the pinnated and the winged quadrupeds; the first comprehends the walrus, the seals, and (in conformity to preceding writers) the manati. But these, he observes, seem as the links between the quadrupeds and the cetaceous animals. The bats are winged quadrupeds, and form the next gradation from this to the class of birds. See Pennant's Hist. of Quadrupeds, ed. 8vo. 1781. Preface.

Some naturalists object to the method adopted by Ray and others, of dividing animals into sanguineous, or such as have blood, and exsanguineous, or such as have no blood; alledging, that all animals are sanguineous, since all have a vital fluid circulating through veins and arteries, though it be not of a red colour in all. The essential character of the blood is not in its crimson colour, but in its office: in which view every fluid, by whose motion through vessels the life of an animal is sustained, may be denominated blood. But this is rather a dispute about words than things.

M. Brisson in 1756 published a system, in which he has arranged animals by the number or defect of their teeth; beginning with those that are toothless, such as the ant-eater, and ending with those that have the greatest number, such as the opossum. By this arrangement, some quadrupeds, very distant from each other in their manners, are too nearly connected. We shall say nothing of M. Buffon's History of Quadrupeds, though it contains much information; as he has disregarded systematic arrangement.

The branch of natural history now under our consideration is the most comprehensive of all others, extending not only throughout that part of the animal kingdom, generally termed Quadrupeds, (the lizard tribe excepted,) but including also the cetaceous order, or whales, and the human species. This class at first sight appears to unite animals, not only totally dissimilar in their outward appearance, but in no respect analogous in their habits and dispositions. A more nice inspection, and closer examination, will, however, soon convince us of their similarity and near alliance. The outward appearance indeed affords an astonishing variety, but the inward structure is nearly alike in all the genera. They breathe through lungs, are viviparous, and suckle their young by means of mammillæ, or teats, which differ in situation, and are more or less, in proportion to the number of young brought forth by each species.

If we take the pains to examine the internal structure and wonderful mechanism of the human frame, and compare it with that of beasts, as exemplified in our Systems of Anatomy and Comparative Anatomy, we shall find an astonishing similarity and agreement: composed of the same materials, furnished with the same organs, which are acted upon exactly in the same manner; they are equally liable to accident, decay, and putrefaction. It appears evident that we are a connecting link of that great chain by which all beings are united, and it is possible that we are much further removed from the first great mover of all things, than from the most minute and apparently trifling part of the creation.

CLASSICAL CHARACTERS.

The term mammalia has been adopted by Linnæus in preference to any other, as being more expressive; for although all that class of animals called quadrupeds, the lizard tribe excepted, are arranged in this class, yet it also comprehends the cetaceous order, as whales, porpoises, &c. and also the human species; all of which are furnished with mammæ, or breasts, and universally suckle their young, which is their distinguishing characteristic.

The heart has two auricles, and two ventricles; with a warm red blood. They breathe by means of the lungs reciprocally. Their jaws are incumbent, covered, furnished with teeth. The males have an external penis. The females a clitoris and nymphæ; are viviparous and suckle. The organs of sense are the tongue, nose, eyes, ears, papillæ. The covering (a few genera and the whole of order 7 excepted) is hair. They are supported by four legs (order 1, 7 and 8 excepted.) The body is terminated by a tail in most of the species. The neck has seven vertebrae.

SYSTEMATIC ARRANGEMENT.

There are three particular distinctions in this class of animals: the first is Digitated or Clawed, the second Hoofed, and the third Destitute of Hoofs and Claws; as follows:

I. DIGITATED OR CLAWED.

- ORDER 1. *Primates*. Four teeth, fore canine single.
- ORDER 2. *Bruta*. Fore teeth or cutting teeth none.
- ORDER 3. *Ferae*. Fore teeth, 6, 2, 10, conical, canine single.
- ORDER 4. *Glires*. Fore teeth, two; canine none.

II. HOOFED.

- ORDER 5. *Pecora*. Fore teeth, none above.
- ORDER 6. *Belluæ*. Fore teeth, above and below.

III. DESTITUTE OF HOOFS AND CLAWS.

- ORDER 7. *Cete*. Teeth various in the different genera.

Characteristic Description of the Orders.

ORDER I. PRIMATES.

Four parallel cutting teeth in the upper jaw; sharp; one canine on each side. Two pectoral mammæ. Feet like hands, with flat nails. *Frugivorous*.

ORDER II. BRUTA.

No cutting teeth; feet with strong claws. *The two first genera feed on herbs and fruit, the two last on insects.*

ORDER III. FERÆ.

Six sharp cutting teeth in the upper jaw, one canine on each side; feet digitated with subulate claws: for this order there are exceptions which will be shown under their general characters.

ORDER IV. GLIRES.

Two sharp cutting teeth in each jaw, but remote from the grinders; no canine teeth: feet digitated. *Herbivorous or Frugivorous.*

ORDER V. PECORA.

No cutting teeth in the upper jaw; six or eight in the lower jaw, very remote from the grinders; feet hoofed, cloven; *Herbivorous.*

ORDER VI. BELLUÆ.

Cutting teeth in both jaws obtuse; feet hoofed. *Herbivorous.*

ORDER VII. CETÆ.

Breathing apertures on the head; pectoral fins; tail placed horizontally; no claws. *Food mostly fish, element the water.*

CLASSIFICATION

MAMMALIA.

CLASSIFICATION OF THE GENERIC CHARACTERS.

ORDER I. PRIMATES.

GENUS 1. HOMO. Man. Linnæus has given great offence to many persons by placing man among the brute creation; but we agree with Dr. Pulteney, "that he, though human, stands as an animal in the system of nature, at the head of this order; and as such is here described, with his several varieties, observable in the different quarters of the globe, in a manner, and with an accuracy, peculiar to our author, and which we may venture to say is no where else to be met with. But man is not left by Linnæus to contemplate himself merely as such; but he is led to the consideration of what he ought to be, as an *intelligent and moral being*; in a comment on the *Grecian Sage's* dictate, *Know Thyself*: by the true application of which, he cannot but be sufficiently elevated above every humiliating idea which can otherwise arise from such an association. There are five species of this genus according to Linnæus, viz. Americanus, Europæus, Asiaticus, Afer, Montifrons. See MAN.

GENUS 2. SIMIA. Ape. Cutting teeth 4, above and below close, one canine tooth on each side separate; grinders obtuse. This genus contains 33 species, and is divided into 3 families, viz. The first family are without tails, and called *Aper*, of which there are three species, viz. Satyrus, Sylvanus, Inuus.

The second family have short tails, and are called *Baboons*. There are three species, viz. Nemestrina, Apedia, Sphinx.

The third family have long tails, and are called *Monkeys*. There are 27 species, viz. Maimon, Hamadryas, Veter, Silenus, Faunus, Belzebul, Seniculus, Paniscus, Cynomolgus, Cynocephalus, Diana, Sabæa, Cephus, Trepida, Aygula, Pithecia, Nictitans, Jacchus, Oedipus, Rosalia, Midas, Fatuellus, Apella, Capucina, Sciura, Morta, Syrichta.

GENUS 3. LEMUR. Macaeco. Cutting teeth, 4 above, 6 below; canine one, close; grinders, sublobate; the first longer and sharper. This genus comprehends five species, viz. Tardigradus, Mongox, Macaco, Catta, Volans.

GENUS 4. VESPERTILIO. Bat. Fore toes elongated, and connected by membranes, performing the office of wings. This genus comprehends six species, viz. Vampyrus, Spectrum, Peripicillatus, Spafma, Auritus, Murinus.

ORDER II. BRUTA.

GENUS 5. ELEPHAS. Elephant. Tusks and grinders only; long proboscis. There is only one species of this genus, viz. Elephas.

GENUS 6. TRICHECHUS. Walrus. Tusks above only; grinders formed of a rugged bony substance; hinder feet formed into fins. There are two species of this genus, viz. Rosmarus, Manatus.

GENUS 7. BRADYPUS. Sloth. Grinders only; first grinders long; body hairy. There are two species of this genus, viz. Tridactylus, Didactylus.

GENUS 8. MYMECOPHAGA. Ant-eater. No teeth. Body hairy. This genus comprehends four species, viz. Didactyla, Tridactyla, Jubata, Tetradaactyla.

GENUS 9. MANIS. No teeth, body scaly. There are two species of this genus, viz. Pentadaactyla, Tetradaactyla.

GENUS 10. DASYPUS. Armadillo. Grinders only; no canine teeth; covering of the body crustaceous. This genus comprehends six species, viz. Unicinctus, Tricinctus, Quadricinctus, Sexcinctus, Septemcinctus, Novemcinctus.

ORDER III. FERÆ.

GENUS 11. PHOCA. Seal. Fore-teeth above 6; below 4. There are three species of this genus, viz. Urina, Leonina, Vitulina.

GENUS 12. CANIS. Dog. Fore-teeth 6, and 6; middle ones above; lobated. This genus comprehends nine species. As there are many varieties of the first species, called *Canis Familiaris*, or *Dog*, we have divided them into five families, viz. *Canes Venatici*, or *Dogs of the Chase*; *Canes Autupientes*, or *Fowling Dogs*; *Canes Agrestes*, or *Farm Dogs*; *Canes Hybrides*, or *Mongrel Dogs*; and *Canes Aquatici*, or *Water Dogs*. The other species are the following; Lupus, Hyæna, Vulpes, Alopec, Lagopus, Aureus, Mexicanus, Thous.

GENUS 13. FELIS. Cat. Fore-teeth 6, and 6: lower ones, equal; tongue very rough. This genus comprehends seven species, viz. Leo, Tigris, Pardus, Onca, Pardalis, Catus, Lynx.

GENUS 14. VIVERRA. Civet. Fore-teeth 6, and 6: middle ones below, short. This genus comprehends six species, viz. Ichneumon, Naser, Narica, Putorius, Zibetha, Genetta.

GENUS 15. MUSTELA. Weasel. Fore-teeth 6, and 6, lower ones close together; 2 placed inwards. This genus comprehends eleven species, viz. Lutris, Lutra, Lutreola, Barbara, Gulo, Martes, Putorius, Furo, Zibellina, Erminea, Nivalis.

GENUS 16. URSUS. Bear. Fore-teeth 6, and 6 upper ones hollowed. Toes 5 and 5; walks on the whole heel. Tongue smooth, snout long; nictitating membrane; a bent bone to the penis. This genus comprehends four species, viz. Arctos, Meles, Lotor, Luscus.

GENUS 17. DIDELPHIS. Opossum. Fore-teeth above 10; below 8. Toes 5, and 5; hind-feet like a hand. A false belly in some species. This genus comprehends five species, viz. Marsupialis, Philander, Opossum, Murina, Dorfigera.

GENUS 18. TALPA. Mole. Fore-teeth 6 above; 8 below: fore feet broad, hind small. There are two species of this genus, viz. Europæa, Asiatica.

GENUS 19. Sorex. Shrew. Fore-teeth 2 above; 4 below: ears small, snout long and slender. This genus comprehends five species, viz. Christatus, Minutus, Aquaticus, Murinus, Araneus.

GENUS 20. ERINACEUS. Hedge-hog. Fore-teeth, 2 above, distant; 2 below, nearer together. There are three species of this genus, viz. Europæus, Inauris, Malaccensis.

ORDER IV. GLIRES.

GENUS 21. HYSTRIX. Porcupine. Body covered with quills. This genus comprehends four species, viz. Cristata, Prehensilis, Dorata, Macroura.

GENUS 22. LEPUS. Hare. Fore-teeth above, double. This genus comprehends four species, Timidus, Cuniculus, Capensis, Brasiliensis.

GENUS 23. CASTOR. Beaver. Fore-teeth above truncated, and hollowed. There are three species of this genus, viz. Fiber, Moschatus, Zibethicus.

GENUS 24. MUS. Rat. Fore-teeth above subulated. This genus comprehends twenty-one species, viz. Porcellus, Aguti, Leporinus, Citellus, Lemmus, Paca, Marmota, Monax, Cricetus, Terrestis, Amphibius, Rattus, Musculus, Avellanarius, Quercinus, Gregarius, Sylvaticus, Striatus, Longipes, Jaculus, Volans.

GENUS 25. SCIURUS. Squirrel. Fore-teeth above cuneated; below compressed. This genus comprehends eleven species, viz. Vulgaris, Niger, Cinereus, Flavus, Palmatus, Getulus, Striatus, Glis, Aëruans, Volans, Sagitta.

GENUS 26. NOCTILIO.

There is but one species of this genus, viz. Americanus. We have omitted the description and representation of this genus, as it is the general opinion of naturalists, at this time, that Sebal's figure, from which Linnæus formed it, is only a variety of the Vespertilio or common Bat; at the same time we think it incumbent on us to retain it in the order of classification, as well to avoid confusion, as to preserve an uniform adherence to the system, as laid down by the immortal Linnæus. Had we omitted it, *Camelus* would have been the 26th instead of the 27th genus, and *Moschus* the 27th instead of the 28th, and so on to the close of the System, by which means the whole order from genus 26 would have been perverted, and the System of course greatly deranged.

ORDER V. PECORA.

GENUS 27. CAMELUS. Camel. No horns; fore-teeth in the lower jaw 6, Canine, 3 in the upper, 2 in the lower jaw. Upper lip cloven. Hoofs not divided through. This genus comprehends four species, viz. Dromedarius, Bactrianus, Glama, Pacos.

GENUS 28. MOSCHUS. Musk. No horns; one canine tooth on each side in the upper jaw, standing out of the mouth. There are three species of this genus, viz. Moschiferus, Grima, Pygmaus.

GENUS 29. CERVUS. Deer. Horns solid, branched, deciduous; no canine teeth. This genus comprehends seven species, viz. Camelopardalis, Alces, Elaphus, Taranus, Dama, Capreolus, Guineensis.

GENUS 30. CAPRA. Goat. Horns hollow, erect, bending back; no canine teeth. This genus comprehends twelve species, viz. Hircus, Ibex, Mambrica, Rupicapra, Depressa, Reveria, Gazella, Cervicapra, Bezoartica, Dorcas, Tatarica, Ammon.

GENUS 31. OVIS. Sheep. Horns hollow, wrinkled, spiral; no canine teeth. This genus comprehends three species, viz. Aries, Guineensis, Strepticerus.

GENUS 32. BOS. Ox. Horns hollow, extending outwards, smooth; no canine teeth; a dewlap. This genus comprehends six species viz. Taurus, Bonafus, Bison, Grunniens, Bubalis, Indicus.

ORDER VI. BELLUE.

GENUS 33. EQUUS. Horse. Fore teeth 6 and 6; canine single, remote; hoofs undivided. There are three species of this genus, viz. Caballus, Asinus, Zebra.

GENUS 34. HIPPOPOTAMUS. River Horse. Fore teeth 6 above and 4 below; canine single and truncated. Professor Martin and Mr. Pennant describe this animal as having only four cutting teeth above and below. There is but one species of this genus, viz. Amphibius.

GENUS 35. SUS. Hog. Fore teeth, 4 above, 6 below; canine teeth 2 above and 1 below; the inferior ones standing out of the mouth are called tusks; snout long, truncated. This genus comprehends five species, viz. Scrofa, Porcus, cæcu, Hydrochæris, Barbaryssa.

GENUS 36. RHYNOCEROS. Fore teeth, two in each jaw on both sides; horn solid, conical on the nose. There is but one species of this genus, viz. Unicornis.

ORDER VII. CETE.

GENUS 37. MONODON. Narwal. Two long, straight, spiral, teeth, perforating the upper lip. There is but one species of this genus, viz. Monoceros.

GENUS 38. BALÆNA. Whale. Horny laminae, instead of teeth, in the upper jaw. This genus comprehends four species, viz. Mysticetus, Phyfalus, Boops, Musculus.

GENUS 39. PHYSETER. Cachalot. Teeth in the lower jaw only. This genus comprehends four species, viz. Catodon, Macrocephalus, Microps, Turfis.

GENUS 40. DELPHINUS. Dolphin. Teeth in both jaws. There are three species of this genus, viz. Phocæna, Delphis, Orca.

In this System we have not entered into a general description of all the Animals which compose this part of Natural History, but have confined ourselves to the Classification, in order to comply to our Readers a clearer knowledge of the systematical arrangement. It was therefore deemed more eligible to give their peculiarities under their respective Generic Names. Should any of our Readers wish to have a knowledge of the particulars above alluded to, they are referred to the various Genera of the several Orders, as they are inserted in the course of the Alphabet, in which is included an enumeration of several Species of each respective Genus.

For particular information concerning the Classification of the other branches of Zoology, see the Classes which compose the animal kingdom, under the titles of Ornithology, Ichthyology, Entomology, Vermology, Zoology, &c.

T. LLOYD.

*Classis Mammalia, Order Primates, Genus 1. Homo, Genus 2. Simia.
 Sic System of Mammalia.*

Plate 1



*Genus 1 Homo, Man Variety 1.
 European or European.*



*Genus 2 Simia, Species 2, Variety 2.
 Chimpanzee.*



*Genus 2 Simia, Species 2, Variety 1.
 Orangutan.*



*Genus 2 Simia, Species 3.
 Inuus or Barbary Ape.*



*Genus 2 Simia, Species 6.
 Sphus or Great Baboon.*



*Genus 2 Simia, Species 4.
 Nemestrina or Pro-tailed Baboon.*



*Genus 2 Simia, Species 35.
 Niger or black-faced Monkey.*



*Genus 2 Simia, Species 34.
 Miao or White Monkey.*



*Genus 2 Simia, Species 8.
 Hamadryas or Dog-faced Baboon.*



*Genus 2 Simia, Species 18.
 Sabaia or Green Monkey.*



*Genus 2 Simia, Species 19.
 Cephala or White-capped Monkey.*



*Genus 2 Simia, Species 21.
 Harbus or Striped Monkey.*

*Class 1. Mammalia, Order 3. Fere. Genus 12. Canis, Genus 13. Felis.
See System of Mammalia.*



*Order 3. Genus 12. Species 2.
Lupus or Wolf.*



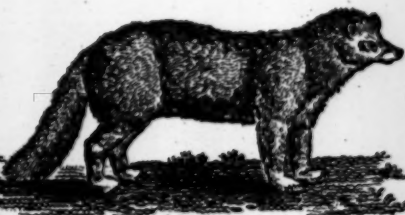
*Order 3. Genus 12. Species 3.
Hyena. Variety 1. Striatus.*



*Order 3. Genus 12. Species 3.
Hyena Variety 2. Maculatus.*



*Order 3. Genus 12. Species 4.
Vulpes or Fox.*



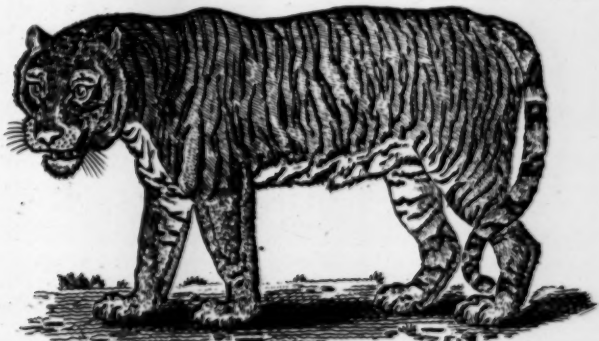
*Order 3. Genus 12. Species 6.
Lagopus or Arctic Fox.*



*Order 3. Genus 12. Species 1.
Aureus or Jackal.*



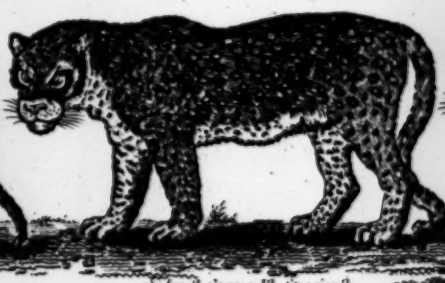
*Order 3. Genus 13. Species 1.
Leo or Lion.*



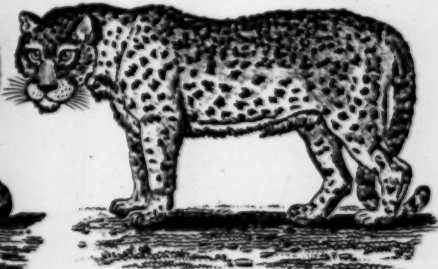
*Order 3. Genus 13. Species 2. Tigris. Variety 1.
Striatus or Striped Tiger.*



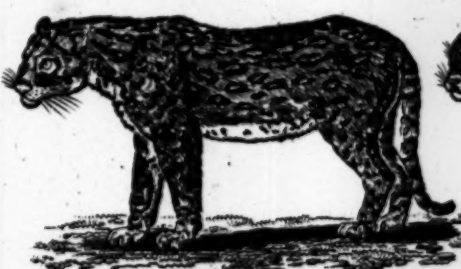
*Order 3. Genus 13. Species 2. Tigris.
Variety 2. Niger or Black Tiger.*



*Order 3. Genus 13. Species 3.
Panther or Panther.*



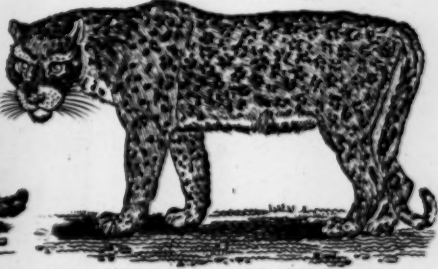
*Order 3. Genus 13. Species 1. Oncia. Variety 1.
Maculatus or Spotted Ounce.*



*Order 3. Genus 13. Species 4. Oncia. Variety 2.
Striatus or Striped Ounce.*



*Order 3. Genus 13. Species 4. Oncia. Variety 3.
Ruber or Red Ounce.*



*Order 3. Genus 13. Species 5. Panthera. Variety 1.
Americana or American Leopard.*



*Order 3. Genus 13. Species 5. Panthera. Variety 2.
Mexicanus or Mexican Ocelot.*



*Order 3. Genus 13. Species 5. Panthera. Variety 3.
Montanus or Mountain Cat.*



*Order 3. Genus 13. Species 1. Variety 1.
Catus Sylvestris or Cat of the Woods.*

Class 1. Mammalia, Order 1. Primates, Order 2. Bruta, Order 3. Fera, Genus 1. Lemur, Genus 2. Vespertilio, Genus 3. Elephas, Genus 4. Trichechus, Genus 5. Bradypus, Genus 6. Myrmecophaga, Genus 7. Manis, Genus 8. Dasypus, Genus 9. Phoca, &c. System of Mammalia.



Order 1, Genus 1, Species 1. *Taithonotus* or Ring-tailed Marmoset.



Order 1, Genus 1, Species 2. *Mongoose* or *Mongoose*.



Order 1, Genus 1, Species 1. *Gutta* or Ring-tailed Marmoset.



Order 1, Genus 1, Species 6. *Flavus* or Yellow Marmoset.



Order 1, Genus 1, Species 6. *Murinus* or Short-eared Bat.



Order 2, Genus 3, Species 1. *Elephas* or Elephant.



Order 2, Genus 6, Species 1. *Manatus* or Sea Horse.



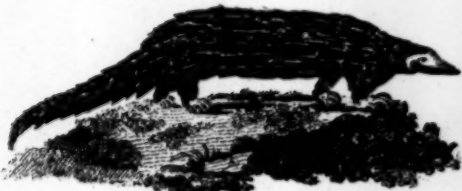
Order 2, Genus 7, Species 1. *Tridactylus* or Three-clawed Sloth.



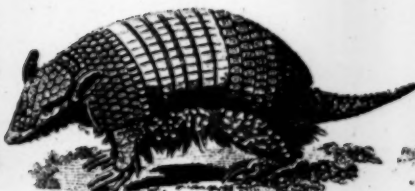
Order 2, Genus 8, Species 1. *Didactylus* or Lesser Ant-eater.



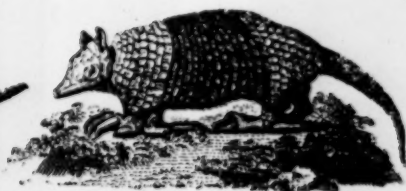
Order 2, Genus 8, Species 3. *Tubata* or Great Ant-eater.



Order 2, Genus 9, Species 1. *Pentadactyla* or Spiny-tailed Lizard.



Order 2, Genus 10, Species 1. *Saxatus* or Six-banded Armadillo.



Order 2, Genus 10, Species 2. *Duodactylus* or Twelve-banded Armadillo.



Order 2, Genus 11, Species 1. *Urina* or Fur Seal or Sea Bear.



Order 2, Genus 11, Species 3. *Vulturna* or Fur Seal or Sea Cat.

b

Class 1. Mammalia. Order 3. Fera. Genus 13. Felis. Genus 14. Viverra. Genus 15.
Mustela. Genus 16. Ursus. See System of Mammalia.



Order 3. Genus 13. Species 6. Felis. Variety 2.
Bengalensis or Cat of Bengal.



Order 3. Genus 13. Species 7. Lynx. Variety 1.
Europaeus or European Lynx.



Order 3. Genus 13. Species 7. Lynx. Variety 2.
Indicus or Persian Lynx.



Order 3. Genus 11. Species 1.
Zibethium.



Order 3. Genus 11. Species 2. Numa.
Coati or Brazilian Mongoose.



Order 3. Genus 11. Species 3. Putorius
or Striped Skunk.



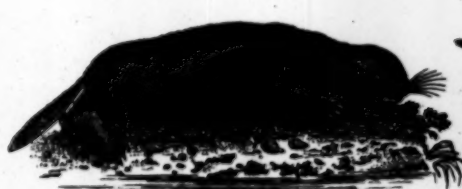
Order 3. Genus 11. Species 3. Zibetha.
Variety 2. Vulgaris or Common Civet.



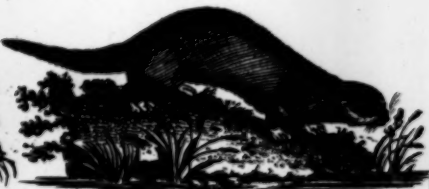
Order 3. Genus 11. Species 3. Zibetha. Variety 1.
Annulatus or Annulated Civet.



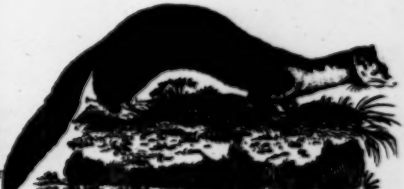
Order 3. Genus 11. Species 6.
Genetta or Genet.



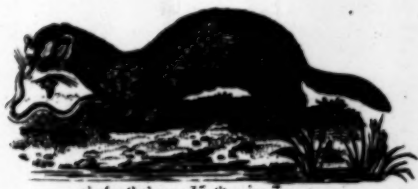
Order 3. Genus 15. Species 1.
Lutra or Sea Otter.



Order 3. Genus 15. Species 2.
Lutra or Common Otter.



Order 3. Genus 15. Species 3.
Martes or Martin.



Order 3. Genus 15. Species 7.
Putorius or Pole Cat.



Order 3. Genus 15. Species 8.
Furo or Ferret.



Order 3. Genus 15. Species 9.
Zibellina or Sable.



Order 3. Genus 15. Species 10. Ermine. Variety 2.
Vulgaris or Common Ermine.



Order 3. Genus 15. Species 10. Ermine.
Variety 1. Albus or White Ermine.



Order 3. Genus 15. Species 11.
Nivalis or Stoat.



Order 3. Genus 16. Species 1. Ursus.
Variety 1. Fuscus or Brown Bear.



Order 3. Genus 16. Species 1. Ursus.
Variety 2. Albus or White Bear.

Ch
C

Class 1. Mammalia, Order 3. Insectivora, Order 4. Glires, Genus 16. Mus, Genus 17. Didelphis, Genus 18. Talpa, Genus 19. Sorex, Genus 20. Erinaceus, Genus 21. Mypitrix. See System of Mammalia.



*Order 3. Genus 16. Species 2.
Mela or European Badger.*



*Order 3. Genus 16. Species 3.
Lor or Raccoon.*



*Order 3. Genus 16. Species 4.
Lusca or Skunk.*



*Order 3. Genus 17. Species 1. Marsupialis
or Marine Opossum.*



*Order 3. Genus 17. Species 3.
Opossum or Sandhog.*



*Order 3. Genus 17. Species 6. Maculatus
or Spotted Opossum.*



*Order 3. Genus 17. Species 7.
Volans or Flying Opossum.*



*Order 3. Genus 17. Species 8. Macquarie
or New Holland Opossum.*



*Order 3. Genus 17. Species 9. Sciurus.
Squirrel-like Opossum.*



*Order 3. Genus 18. Species 1.
Europaeus or European Mole.*



*Order 3. Genus 18. Species 3.
Radiatus or Radiated Mole.*



*Order 3. Genus 19. Species 5.
Araneus or Field Mouse.*



*Order 3. Genus 19. Species 6.
Caveus or Blind Mouse.*



*Order 3. Genus 20. Species 1. Europaeus
or Common Hedge Hog.*



*Order 3. Genus 20. Species 2. Inermis
or Earless Hedge Hog.*



*Order 3. Genus 20. Species 3. Malaccensis
or Malacca Hedge Hog.*



*Order 3. Genus 21. Species 1. Cristata
or Crested Porcupine.*



*Order 3. Genus 21. Species 2. Canadensis
or Canadian Porcupine.*

Class 1. *Mammalia*. Order 1. *Glinis*. Genus 22. *Lepus*. Genus 23. *Faster*. Genus 24. *Mus*.
Genus 25. *Sciurus*. See the System of *Mammalia*.



Order 1. Genus 22. Species 1.
Timidus or *Hare*.



Order 1. Genus 22. Species 2.
Timidus, Variety 1. *Wild Rabbit*.



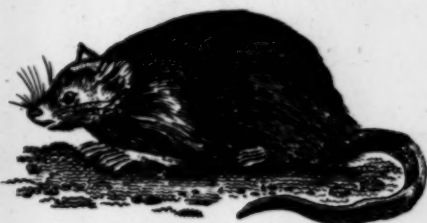
Order 1. Genus 22. Species 2.
Timidus, Variety 2. *Tame Rabbit*.



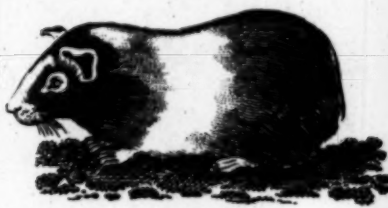
Order 1. Genus 23. Species 1.
Fiber or *Common Beaver*.



Order 1. Genus 23. Species 2.
Moschamus or *Musk Rat*.



Order 1. Genus 23. Species 3. *Zibethicus*,
or *Musk Rat of Canada*.



Order 1. Genus 24. Species 1.
Porcellus or *Guinea Pig*.



Order 1. Genus 24. Species 2.
Apata or *Long nosed Guinea*.



Order 1. Genus 24. Species 5.
Lemmus or *Lapland Marmot*.



Order 1. Genus 24. Species 6.
Paca or *Spotted Guinea*.



Order 1. Genus 24. Species 7. *Marmota*,
Variety 1. *Alpinus* or *Alpine Marmot*.



Order 1. Genus 24. Species 7. *Marmota*,
Variety 2. *Americanus* or *American Marmot*.



Order 1. Genus 24. Species 8.
Monax or *Marmot of Canada*.



Order 1. Genus 24. Species 9.
Grietus or *German Marmot*.



Order 1. Genus 24. Species 10. *Terrestris*
or *Short tailed Field Mouse*.



Order 1. Genus 24. Species 11.
Amphibius or *Water Rat*.



Order 1. Genus 24. Species 12.
Rattus or *Common Rat*.



Order 1. Genus 24. Species 13.
Musculus or *Common Mouse*.



Order 1. Genus 24. Species 14.
Acollinarius or *Dormouse*.



Order 1. Genus 24. Species 15. *Sylvaticus*
or *Long tailed Field Mouse*.



Order 1. Genus 24. Species 20.
Jaculus or *Jerboa*.



Order 1. Genus 25. Species 1.
Vulgaris or *Common Squirrel*.



Order 1. Genus 25. Species 2.
Striatus or *Striped Squirrel*.



Order 1. Genus 25. Species 3.
Volans or *Flying Squirrel*.

Class 1. Mammalia, Order 5. Pecora, Genus 27. Camelus, Genus 28. Moschus,
Genus 29. Cervus, Genus 30. Capra. See System of Mammalia.



Order 5. Genus 27. Species 1.
Dromedarius or Dromedary.



Order 5. Genus 27. Species 2.
Bactrianus or Bactrian Camel.



Order 5. Genus 28. Species 1. Moschus.
Moschivus or Musk animal.



Order 5. Genus 29. Species 1.
Giraffa or Giraffe.



Order 5. Genus 29. Species 2.
Alces or Elk.



Order 5. Genus 29. Species 3.
Elaphus or Red Deer.



Order 5. Genus 29. Species 4.
Tetrax or Roe Deer.



Order 5. Genus 29. Species 5.
Dama or Fallow Deer.



Order 5. Genus 29. Species 6.
Capreolus or Roe Deer.



Order 5. Genus 30. Species 1.
Hircus, Variety 1. Common Goat.



Order 5. Genus 30. Species 1. Hircus.
Variety 2. Angorensis or Goat of Angora.



Order 5. Genus 30. Species 2.
Ibex or Mountain Goat.

Class 1. Mammalia, Order 5. Pecora, Genus 30. Capra, Genus 31. Capra, Genus 32. Bos. See System of Mammalia.



*Order 5. Genus 30. Species 3.
Mouflon or Syrian Goat.*



*Order 5. Genus 30. Species 1.
Rupicapra or Chamois Goat.*



*Order 5. Genus 30. Species 8.
Cervus or Common Antelope.*



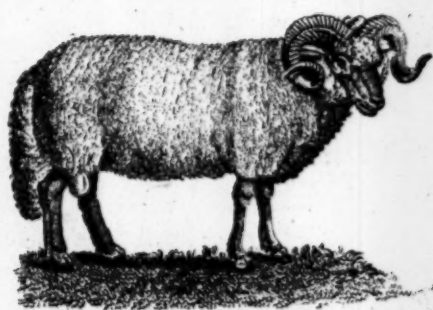
*Order 5. Genus 30. Species 12.
Capra, Annon or Annon.*



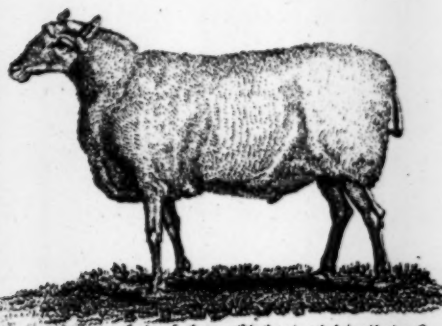
*Order 5. Genus 30. Species 13.
Capra, Bicornis or Gnu.*



*Order 5. Genus 30. Species 14.
Capra, Phoenicea or Pish Goat.*



*Order 5. Genus 31. Species 1.
Ovis, Arvis or Common Ram.*



*Order 5. Genus 31. Species 1. Variation 2.
Lincolnensis or Lincolnshire Ram.*



*Order 5. Genus 31. Species 1. Variation 3.
Leicesterensis or Leicestershire Ram.*



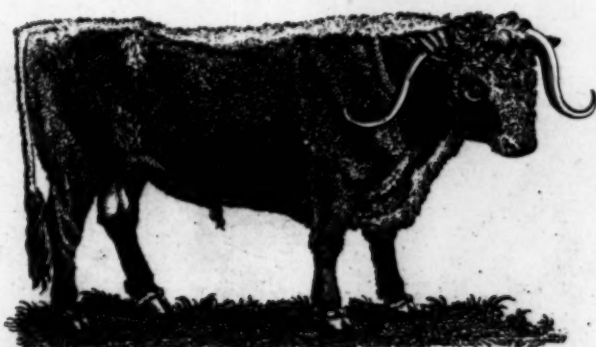
*Order 5. Genus 31. Species 3.
Sibericus or Siberian Sheep.*



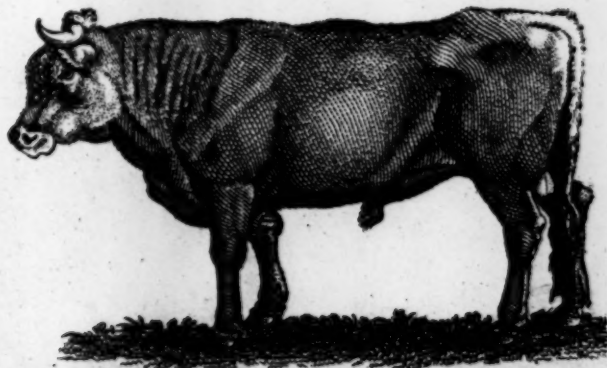
*Order 5. Genus 31. Species 1.
Tartaricus or Tartarian Sheep.*



*Order 5. Genus 31. Species 1. Variation 4.
Many-horned Sheep, extinct.*



*Order 5. Genus 32. Species 1.
Bos, Taurus or Common Bull.*



*Order 5. Genus 32. Species 1. Variation 2.
Lancastriensis or Lancashire Bull.*

*Class 18. Mammalia, Order 5. Rumin. Order 6. Tillon. Genus 32. Equus.
Genus 33. Hippopotamus, Genus 34. Sus, Genus 35. Rhinoceros, &c. System of Mammalia.*



*Order 5. Genus 32. Species 3. Bison
Asiaticus, or Wild Bull of Asia.*



*Order 5. Genus 32. Species 1. Taurus
Europaeus or European Wild Bull.*



*Order 5. Genus 32. Species 5.
Bubalis or Buffalo.*



*Order 6. Genus 33. Species 1. Caballus,
Variety 1. Cursor or Rover.*



*Order 6. Genus 33. Species 1. Caballus,
Variety 2. Venator or Hunter.*



*Order 6. Genus 33. Species 1. Caballus,
Variety 3. Jugalis or Draught Horse.*



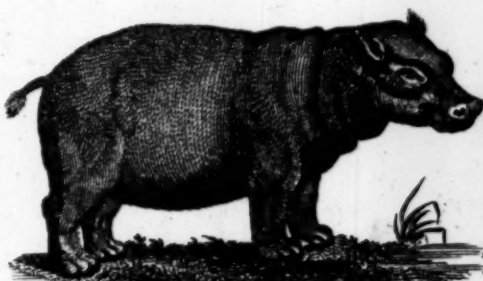
*Order 6. Genus 33. Species 1. Caballus,
Variety 4. Funicular or Cart Horse.*



*Order 6. Genus 33. Species 2. Mimus
Hinnus or British Mule.*



*Order 6. Genus 33. Species 3.
Zebra or African Mule.*



*Order 6. Genus 34. Species 1. Hippopotamus,
Amphibius or Sea Horse.*



*Order 6. Genus 34. Species 2. Hippopotamus,
Narceus or Long-nosed Tapir.*



*Order 6. Genus 34. Species 1. Sus,
Variety 1. Manatus or common Boar.*



*Order 6. Genus 34. Species 1. Sus,
Variety 2. Sylvestris or Wild Boar.*



*Order 6. Genus 34. Species 3.
Tajon or Malayan Hog.*



*Order 6. Genus 34. Species 4.
Hydrochennis or River Hog.*



*Order 6. Genus 34. Species 5.
Babirusa or Babirusa.*

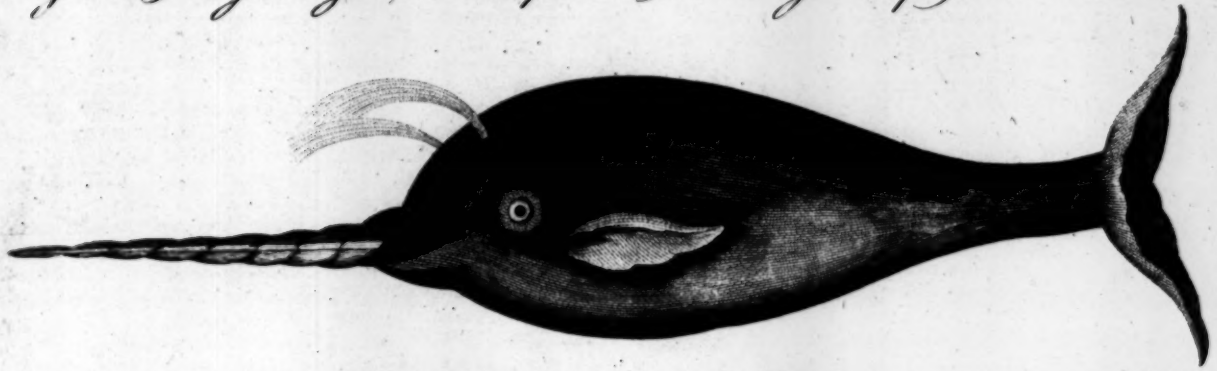


*Order 6. Genus 34. Species 6.
Ethiopian or Ethiopian Boar.*



*Order 6. Genus 35. Species 1. Rhinoceros
or single-horned Rhinoceros.*

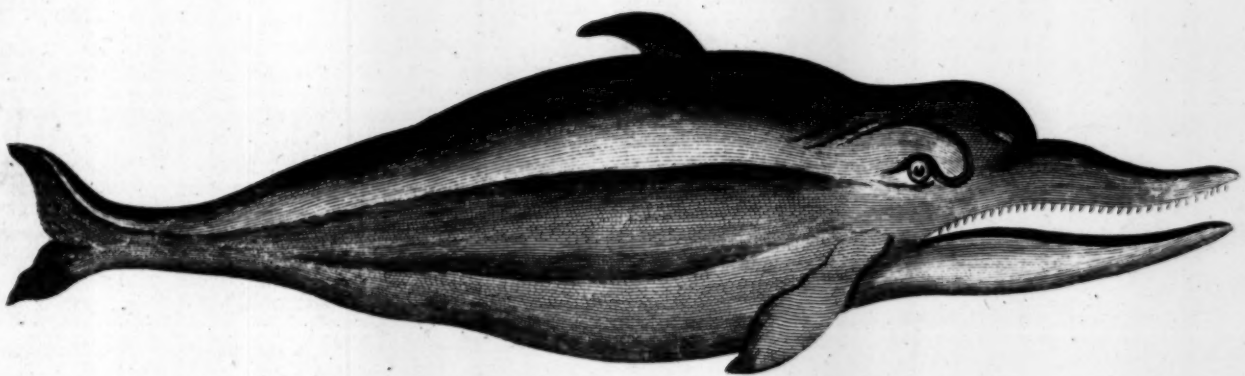
Class 1. Mammalia. Order 7. Cete. Genus 37. Monodon. Genus 38. Balæna.
Genus 39. Physeter. Genus 40. Delphinus. See the System of Mammalia.



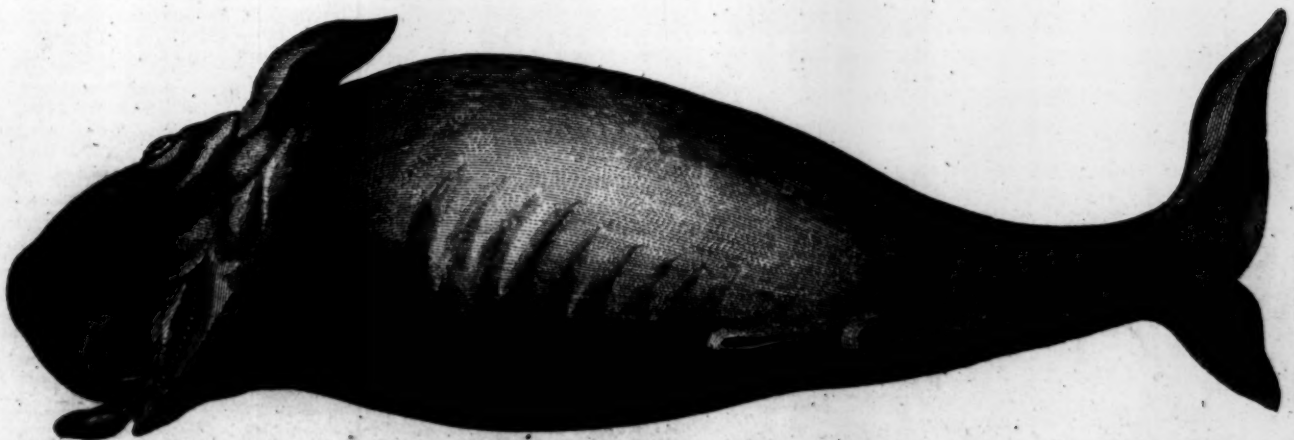
Order 7. Genus 37. Species 1. Monodon or Sea Unicorn.



Order 7. Genus 39. Species 1. Cetodon or Cachalot.



Order 7. Genus 40. Species 1. Phocaena or Porpoise.



Order 7. Genus 38. Species 1. Mysticetus or Common Whale.

MAMMON, the god of riches, according to some authors, though others deny that the word stands for such a deity, and understand by it only riches themselves. Our Saviour says, *We cannot serve God and mammon*; that is, be religious and worldly minded at the same time.

MAMMOTH, or MAMMUTH, the name of a huge animal now unknown, to which are said to have belonged those tusks, bones, and skeletons of vast magnitude, which have been frequently found in different parts of Siberia, as well in the mountains as the valleys; likewise in Russia, Germany, and North America. Many specimens of them may be seen in the Imperial cabinet at Petersburg; in the British, Dr. Hunter's, and the late Sir Ashton Lever's museums, and in that of the Royal Society. A description of the mammoth is given by Muller in the *Recueil des Voyages au Nord*. "This animal, he says, is four or five yards high, and about 30 feet long. His colour is greyish. His head is very long, and his front very broad. On each side, precisely under the eyes, there are two horns, which he can move and cross at pleasure. In walking he has the power of extending and contracting his body to a great degree." Isbrandes Ides gives a similar account; but he is candid enough to acknowledge, that he never knew any person who had seen the mammoth alive. Mr. Pennant, however, thinks it "more than probable, that it still exists in some of those remote parts of the vast new continent impetrated yet by Europeans."

In the year 1767 Dr. Hunter, with the assistance of his brother Mr. J. Hunter, had an opportunity of investigating more particularly this part of natural history, and has evidently proved, that these fossil bones and tusks are not only larger than the generalities of elephants, but that the tusks are more twisted, or have more of the spiral curve, than elephants' teeth; and that the thigh and jawbones differ in several respects from those of the elephant; but what put the matter beyond all dispute was the shape of the grinders, which clearly appeared to belong to a carnivorous animal, or at least to an animal of the mixed kind; and to be totally different from those of the elephant, which is well known not to be of the carnivorous, but graminivorous kind, both by the form of its grinders and by its never tasting animal food.—Some have supposed these fossil bones to belong to the hippopotamus or river-horse; but there are many reasons against this supposition, as the hippopotamus is even much smaller than the elephant, and has such remarkably short legs, that his belly reaches within three or four inches of the ground.

North America seems to be the quarter where the remains in question most abound. On the Ohio, and in many parts farther north, tusks, grinders, and skeletons of unparalleled magnitude, which can admit of no comparison with any animal at present known, are found in vast numbers, some lying on the surface of the earth, and some a little below it. A Mr. Stanley, taken prisoner by the Indians near the mouth of the Tanissee, relates, as Mr. Jefferson informs us, that, after being transferred through several tribes, from one to another, he was at length carried over the mountains west of the Missouri to a river which runs westwardly; that these bones abounded there; and that the natives described to him the animal to which they belonged as still existing in the northern parts of their country.

It is remarkable (continues he) that the tusks and skeletons have been ascribed by the naturalists of Europe to the elephant, while the grinders have been given to the hippopotamus or river-horse. Yet it is acknowledged, that the tusks and skeletons are much larger than those of the elephant, and the grinders many times greater than those of the hippopotamus, and essentially different in form. Wherever these grinders are found, there also we find the tusks and skeleton; but no skeleton of the hippopotamus nor grinders of the elephant. It will not be said that the hippopotamus and elephant came always to the same spot, the former to deposit his grinders, and the latter his tusks and skeleton. For what became of the parts not deposited there? We must agree, then, that these remains belong to each other; that they are of one and the same animal; that this was not an hippopotamus, because the hippopotamus had no tusks nor such a frame, and because the grinders differ in their size as well as in the number and form of their points. That it was not an elephant, I think ascertained by proofs equally decisive. I will not avail myself of the authority of the celebrated anatomist, Hunter, who, from an examination of the form and structure of the tusks, has declared them essentially different from those of the elephant; because another anatomist, D'Aubenton, equally celebrated, has declared, on a like examination, that they are precisely the same. Between such authorities will suppose this circumstance equivocal. But, 1. The skeleton of the mammoth (for so the incognitum has been called) bespeaks an animal of five or six times the cubic volume of the elephant, as M. de Buffon has admitted. 2. The grinders are five times as large, are square, and the grinding surface studded with four or five rows of blunt points; whereas those of the elephant are broad and thin, and their grinding surface flat. 3. I have never heard of an instance, and suppose there has been none, of the grinder of an elephant being found in America. 4. From the known temperance and constitution of the elephant, he could never have existed in those regions where the remains

of the mammoth have been found. For no bones of the mammoth, as I have before observed, have been ever found further south than the salines of the Holston, and they have been found as far north as the Arctic circle. Those, therefore, who are of opinion that the elephant and mammoth are the same, must believe, 1. That the elephant known to us can exist and multiply in the frozen zone; or, 2. That an internal fire may once have warmed those regions, and since abandoned them, of which, however, the globe exhibits no unequivocal indications; or, 3. That the obliquity of the ecliptic, when these elephants lived, was so great as to include within the tropics all those regions in which the bones are found; the tropics being, as is before observed, the natural limits of habitation for the elephant. But if it be admitted that this obliquity has really decreased, and we adopt the highest rate of decrease yet pretended, that is, of one minute in a century, to transfer the northern tropic to the arctic circle, it would carry the existence of these supposed elephants 250,000 years back; a period far beyond our conception of the duration of animal bones left exposed to the open air, as these are in many instances. Besides, though these regions would then be supposed within the tropics, yet their winters would have been too severe for the sensibility of the elephant. They would have had, too, but one day and one night in the year; a circumstance to which we have no reason to suppose the nature of the elephant fitted. However, it has been demonstrated, that if a variation of obliquity in the ecliptic takes place at all, it is vibratory, and never exceeds the limits of nine degrees, which is not sufficient to bring these bones within the tropics. One of these hypotheses, or some others equally arbitrary and inadmissible to cautious philosophy, must be adopted to support the opinion that these are the bones of the elephant. For my own part, I find it easier to believe that an animal may have existed, resembling the elephant in his tusks and general anatomy, while his nature was in other respects extremely different. From the 30th degree of south latitude to the 30th of north, are nearly the limits which nature has fixed for the existence and multiplication of the elephant known to us. Proceeding thence northwardly to 36½ degrees, we enter those assigned to the mammoth. The further we advance north, the more their vestiges multiply as far as the earth has been explored in that direction; and it is as probable as otherwise, that this progression continues to the pole itself, if land extends so far. The centre of the frozen zone then may be the acmé of their vigour, as that of the torrid is of the elephant. Thus nature seems to have drawn a belt of separation between these two tremendous animals, whose breadth indeed is not precisely known, though at present we may suppose it about 6½ degrees of latitude; to have assigned to the elephant the regions south of these confines, and those north to the mammoth, founding the constitution of the one in her extreme of heat, and that of the other in the extreme of cold. When the Creator has therefore separated their nature as far as the extent of the scale of animal life allowed to this planet would permit, it seems perverse to declare it the same, from a partial resemblance of their tusks and bones. But to whatever animal we ascribe these remains, it is certain such a one has existed in America, and that it was the largest of all terrestrial beings of which any traces have ever appeared."

MAN, the head of the animal creation, is a being who feels, reflects, thinks, contrives, and acts; who has the power of changing his place upon the earth at pleasure; who possesses the faculty of communicating his thoughts by means of speech; and who has dominion over all other creatures on the face of the globe. Animated and enlightened by a ray from the Divinity, he surpasses in dignity every material being. He spends less of his time in solitude, than in society, and in obedience to those laws which he himself has framed.

In the *Systema Naturæ* MAN (*Homo*), is ranked as a distinct genus of the order *Primates* or "Chiefs," belonging to the *Mammalia* class of animals, or those which nourish their young by means of lactiferous teats or paps. Of this genus he is the only species, and denominated *Sapiens*, as being endowed with wisdom far superior to, or rather in exclusion of, all other animals.—He varies, from climate, education, and habits; and the following varieties, exclusive of *wild men*, are enumerated by Linnæus.

Americans. "Of copper coloured complexion, choleric constitution, and remarkably erect."—Their hair is black, lank, and coarse; their nostrils are wide; their features harsh, and the chin is scantily supplied with beard. Are obstinate in their tempers, free and satisfied with their condition; and are regulated in all their proceedings by traditional customs.—Paint their skin with red streaks."

Europeans. "Of fair complexion, sanguine temperament, and brawny form."—The hair is flowing, and of various shades of brown; the eyes are mostly blue.—They are of gentle manners, acute in judgment, of quick invention, and governed by fixed laws.—Dress in close vestments."

Asiatics. "Of sooty complexion, melancholic temperament, and rigid fibre."—The hair is strong, black, and lank; the eyes a dark brown.—They are of grave, haughty, and covetous manners, and are governed by opinions.—Dress in loose garments."

♂ *Africans*. "Of black complexion, phlegmatic temperament, and relaxed fibre."—The hair is black and frizley; the skin soft and silky; the nose flat; the lips are thick; and the female has a natural apron, and long lax breasts.—They are of crafty, indolent, and careless disposition, and governed in their actions by caprice.—Anoint the skin with grease.

• *Monsters*. Of these there are several varieties; the first and second of which, in the following list, are occasioned by peculiarity of climate, while the rest are produced by artificial management. 1. *Alpini*; The inhabitants of the northern mountains: they are small in stature, active and timid in their dispositions. 2. *Patagonici*; The Patagonians of South America; of vast size, and indolent in their manners. 3. *Monorchides*: The Hottentots; having one testicle extirpated. 4. *Imberbes*: Most of the American nations; who eradicate their beards and the hair from every part of the body except the scalp. 5. *Macrocephali*: The Chinese; who have their heads artificially forced into a conical form. 6. *Plagiocephali*: The Canadian Indians; who have the fore part of their heads flattened, when young, by compression.

MANATI, or sea-cow, in Mammalia, a species of the genus *Trichecus*. For description of the genus and species appertaining to it, see *TRICHECUS*.

MANDAMUS, in law, a writ that issues out of the court of king's-bench, sent to the corporation, commanding them to admit or restore a person to his office. This writ also lies where justices of the peace refuse to admit a person to take the oaths in order to qualify himself for enjoying any post or office; or where a bishop or archdeacon refuses to grant a probate of a will, to admit an executor to prove it, or to swear a church-warden, &c.

MANDARIN, a name given to the nobility and magistracy of the eastern countries, especially to those of China. There are in China nine orders of *mandarins*, or nine degrees of nobility; which have as many different animals for their characteristics. The first is distinguished by a crane, the second by a lion, the third by an eagle, the fourth by a peacock, &c. There are in all thirty-two or thirty-three thousand *mandarins* in China. The *mandarinate* is not hereditary, nor are any raised to it but men of letters. Mandarin is also a name which the Chinese give to the learned language of the country. Besides the proper and peculiar language of each nation and province, they have one common to all the learned men in the empire. This they call the *mandarine* tongue, or the language of the court. Their public officers, as notaries, lawyers, judges, and chief magistrates, write and speak the *mandarin*.

MANGANESE, or MAGNESIA NIGRA, a dark-coloured mineral employed in glass works for purifying the glass, by taking away the colour it has already, or superadding by a new colour to it. It is also used in the glazing of earthen ware where it communicates a black colour. From its property of rendering glass colourless, it has sometimes been called the soap of glass. For an account of its ores, reductions, properties and uses, see the system of *CHYMISTRY*, Part. III. Chap. I. Sect. 6.

MANGEL WURZEL, or Root of Scarcity, a plant lately introduced into this kingdom. For the method of and the advantages arising from its cultivation, see the System of *AGRICULTURE*, Sect. XV.

MANIA, *madness*, in medicine, the most violent and acute species of delirium, arising from a perturbation of the imagination and judgment. See the System, Genus 48. For the distinguishing characteristics of the mania, or raving or furious *madness*, according to the opinions of several eminent physicians, together with the different methods of treatment, see the System of *Medicine*, Genus 48.

MANIS, the *Scaly Lizard*, in mammalia, a genus of quadrupeds belonging to the order of bruta. There are two species: the first of which is the pentadactyla, or scaly lizard, with five toes on each foot. The head is smaller than the neck; the eyes are very small; the length of the body, including the tail, is from six to eight feet. The whole body is covered with hard scales excepting the under part of the head and neck, the breast, the belly, and the internal side of each leg. Betwixt the scales of this animal there are some hairs like the bristles of a hog, brownish at the points. The scales are of a reddish colour, very hard, convex above, and concave below. The scales are unconnected; and the animal can raise or lower them at pleasure, like the quills of the porcupine. When irritated, he erects his scales, and rolls himself up like a hedge-hog. In this situation, neither the lion, tiger, nor any other animal can hurt him. It is a mild inoffensive creature, is slow of motion, and has no other method of escaping the pursuit of man but by concealing himself in crannies of rocks, and in holes which they dig in the ground, and where they likewise bring forth their young. It is a native of the East-Indies, and is very rare. It lives in woods and marshy places; feeds on ants, which it takes by laying its long tongue across their paths, which is covered with a viscid saliva, so that the insects which attempt to pass over it cannot extricate themselves. For representation, see Plate II. 2 Genus 9, Species 1.

The second is the *tetradactyla*, or scaly lizard, with four toes

on each foot. This species is very similar to the former only the tail of it is much longer in proportion to the body; and such parts as want scales, instead of being naked, are covered with a soft hair. It is also found in the East-Indies.

MANNA, in the materia medica, the juice of certain trees of the ash kind, either naturally concreted on the plants, or exsiccated and purified by art. There are several sorts of manna in the shops. The larger pieces, called *flake manna*, are usually preferred; though the smaller grains are equally good, provided they are white, or of a pale yellow colour; very light, of a sweet, not unpleasant taste, and free from any visible impurities. Some people injudiciously prefer the fat honey-like manna to the foregoing; this has either been exposed to a moist air, or damaged by sea or other water. This kind of manna is said to be sometimes counterfeited by a composition of sugar and honey mixed with a little scammony; there is also a factitious manna, which is white and dry, said to be composed of sugar, manna, and some purgative ingredient, boiled to a proper consistence. This may be distinguished by its weight, solidity, untransparent whiteness, and by its taste, which is different from that of manna. Manna is a mild, agreeable laxative; and may be given with safety to children and pregnant women: nevertheless, in some particular constitutions, it acts very unkindly, producing flatulencies and distensions of the viscera: these inconveniences may be prevented by the addition of any grateful warm aromatic. It operates so weakly, that it does not produce the full effect of a cathartic, unless taken in large doses; and hence it is rarely given in this intention by itself. It may be commodiously dissolved in the purging mineral waters, or joined to the cathartic salts, senna, rhubarb, or the like. Geoffroy recommends acuating it with a few grains of emetic tartar: by this management, he says, bilious ferum will be plentifully evacuated, without any nausea, gripes, or other inconvenience. It is remarkable, that the efficacy of this drug is greatly promoted (if the account of Vallisneri is to be relied on) by a substance which is itself very slow of operation, viz. casia.

MANNA-TREE, is a species of the ash, and a native of Calabria in Italy.

A great quantity of fine manna is gathered at Carini in Sicily, oozing from a kind of ash-tree, with a bark similar to that of the ebony, and a leaf somewhat like the acacia. M. de Non, who gives an account of this manna, says, that it is produced from young trees about seven or eight years old, when they are only about eight feet high. Incisions are then made horizontally in the bark, and from these the manna flows. The incisions are made from the earth to the top of the tree, and are repeated every two days, from the end of July till the circulation is stopped in the course of the year, or till the manna becomes worse in quality.

It exudes first as a white frothy liquor, extremely light, pleasant to the taste, and of an agreeable flavour, which is coagulated by the heat of the sun, and assumes an appearance somewhat resembling stalactites. This is the best kind, and by the people of that country is called *lachrymatory* or *cane manna*. The inferior kind appears first in the form of a glutinous and higher coloured liquor which is received on the leaves of the Indian fig, which are placed for that purpose at the foot of the tree. This also congeals by the heat of the sun; though it is more heavy, purgative, and of much less value, than the former. It is called *fat manna*: In this part only resides the faint and disagreeable flavour observable in manna; for the cane manna is of an agreeable flavour, and of an excellent stomachic quality.

MANNERS, the plural noun, has various significations; as, The general ways of life, the morals, or habits, of any person or people; also, ceremonious behaviour, or studied civility. See the next article.

Good MANNERS, according to Swift, is the art of making those people easy, with whom we converse. Whoever makes the fewest persons uneasy, is the best bred in the company. As the best law is founded upon reason, so are the best manners. And as some lawyers have introduced unreasonable things into common law, so likewise many teachers have introduced absurd things into common good manners. One principal point of this art is to suit our behaviour to the three several degrees of men; our superiors, our equals, and those below us. For instance, to press either of the two former to eat or drink, is a breach of manners; but a tradesman or a farmer must be thus treated, or else it will be difficult to persuade them that they are welcome. Pride, ill-nature, and want of sense, are the three great sources of ill-manners: without some one of these defects, no man will behave himself ill for want of experience; or, of what, in the language of fools, is called *knowing the world*.

"I defy (proceeds our author) any one to assign an incident wherein reason will not direct us what we are to say or to do in company, if we are not misled by pride or ill nature. Therefore I insist that good sense is the principal foundation of good manners; but because the former is a gift which very few among mankind are possessed of; therefore all the civilized nations of the world have agreed upon fixing some rules for common behaviour, best suited to their general customs, or fancies, as a kind of artificial good-sense to supply the defects of reason. Without which,

the

the gentlemanly part of dunces would be perpetually at cuffs, as they seldom fail, when they happen to be drunk, or engaged in squabbles about women or play. And, God be thanked, there hardly happeneth a duel in a year, which may not be imputed to one of those three motives. Upon which account, I shall be exceedingly sorry to find the legislature make any new laws against the practice of duelling; because the methods are easy, and many, for a wise man to avoid a quarrel with honour, or engage in it with innocence. And I can discover no political evil in suffering bullies, sharpers, and rakes, to rid the world of each other by a method of their own, where the law hath not been able to find an expedient.

As the common forms of good-manners were intended for regulating the conduct of those who have weak understandings; so they have been corrupted by the persons for whose use they were contrived. For these people have fallen into a needless and endless way of multiplying ceremonies, which have been extremely troublesome to those who practise them, and insupportable to every body else; inasmuch that wise men are often more uneasy at the over-civility of these refiners, than they could possibly be in the conversations of peasants or mechanics.

The impertinences of this ceremonial behaviour are nowhere better seen than at those tables where ladies preside, who value themselves upon account of their good breeding; where a man must reckon upon passing an hour without doing any one thing he hath a mind to, unless he will be so hardy as to break through all the settled decorum of the family. She determineth what he loveth best, and how much he shall eat; and if the master of the house happeneth to be of the same disposition, he proceedeth in the same tyrannical manner to prescribe in the drinking part: at the same time you are under the necessity of answering a thousand apologies for your entertainment. And although a good deal of this humour is pretty well worn off among many people of the best fashion, yet too much of it still remaineth, especially in the country; where an honest gentleman assured me, that having been kept four days against his will at a friend's house, with all the circumstances of hiding his boots, locking up the stable, and other contrivances of the like nature, he could not remember, from the moment he came into the house to the moment he left it, any one thing wherein his inclination was not directly contradicted; as if the whole family had entered into a combination to torment him. But, besides all this, it would be endless to recount the many foolish and ridiculous accidents I have observed among those unfortunate proselytes to ceremony. I have seen a duchess fairly knocked down by the precipitancy of an officious coxcomb running to save her the trouble of opening a door. Monsieur Buys, the Dutch envoy, whose politics and manners were much of a size, brought a son with him, about 13 years old, to a great table at court. The boy and his father, whatever they put on their plates, they first offered round in order, to every person in the company; so that we could not get a minute's quiet during the whole dinner. At last their two plates happened to encounter, and with so much violence, that being china, they broke in twenty pieces, and stained half the company with wet sweatmeats and cream.

There is a pedantry in manners as in all arts and sciences, and sometimes in trades. Pedantry is properly the overrating any kind of knowledge we pretend to; and if that kind of knowledge be a trifle in itself, the pedantry is the greater. For which reason I look upon fiddlers, dancing masters, heralds, masters of the ceremony, &c. to be greater pedants than Lipsius, or the elder Scaliger. With these kinds of pedants, the court, while I knew it, was always plentifully stocked: I mean from the gentleman usher (at least) inclusive, downward to the gentleman-porter; who are, generally speaking, the most insignificant race of people that this island can afford, and with the smallest tincture of good manners, which is the only trade they profess. For being wholly illiterate, conversing chiefly with each other, they reduce the whole system of breeding within the forms and circles of their several offices: and as they are below the notice of ministers, they live and die in court under all revolutions, with great obsequiousness to those who are in any degree of credit or favour, and with rudeness and insolence to every body else. From whence I have long concluded, that good manners are not a plant of the court-growth: for if they were, those people who have understandings directly of a level for such acquirements, and who have served such long apprenticeships to nothing else, would certainly have picked them up. For as to the great officers who attend the prince's person or councils, or preside in his family, they are a transient body, who have no better a title to good-manners than their neighbours, nor will probably have recourse to gentlemen ushers for instruction. So that I know little to be learned at court on his head, except in the material circumstance of dress; wherein the authority of the maids of honour must indeed be allowed to be almost equal to that of a favourite actress.

I remember a passage my lord Bolingbroke told me: that going to receive prince Eugene of Savoy, at his landing, in order to conduct him immediately to the queen, the prince said he was much concerned that he could not see her majesty that night: for Monsieur Hoffman (who was then by) had assured his highness,

that he could not be admitted into her presence with a tied-up perriwig; that his equipage was not arrived; and that he had endeavoured in vain to borrow a long one among all his valets and pages. My lord turned the matter to a jest, and brought the prince to her majesty: for which he was highly censured by the whole tribe of gentlemen ushers; among whom Monsieur Hoffman, an old dull resident of the emperor's, had picked up this material point of ceremony; and which, I believe, was the best lesson he had learned in five and twenty years residence.

I make a difference between *good-manners* and *good-breeding*; although in order to vary my expression, I am sometimes forced to confound them. By the first, I only understand the art of remembering, and applying, certain settled forms of general behaviour. But *good-breeding* is of a much larger extent: for besides an uncommon degree of literature sufficient to qualify a gentleman for reading a play, or a political pamphlet, it taketh in a great compass of knowledge; no less than that of dancing, fighting, gaming, making the circle of Italy, riding the great horse, and speaking French; not to mention some other secondary or subaltern accomplishments, which are more easily acquired. So that the difference between good-breeding and good manners lieth in this, that the former cannot be attained to by the best understandings without study and labour; whereas a tolerable degree of reason will instruct us in every part of good manners without other assistance.

MANOR, or MANNOR, an ancient lordship or royalty; consisting of demesnes and services, and of a court baron, as incident thereto. *Manor* is the same with what was formerly called *baronia*, *barony*. A *manor* is a kind of noble fee, granted out partly to tenants, for certain services to be performed, and partly reserved to the use of the lord's family: with jurisdiction over his tenant, for the lands, or estates, held of him. For the original of *manors*, we are told there was anciently a certain compass of ground, granted by the king to some men of worth, for him and his heirs to dwell upon, and to exercise some jurisdiction, more or less, within that circuit, such as he thought good to grant; but performing such services and paying such yearly rent, as by this grant was required. Now the lord afterwards parcelling the same to other meaner men, received rent and services from them, and by that means, as he became tenants to the king, the inferiors became tenants to him. But at this time a *manor* rather signifies a jurisdiction, and royalty incorporeal, than the land and suit: for a man may now have a *manor* in gross, i. e. the right and interest of a court baron, with the perquisites, and another enjoy every foot of land belonging to it.

MANSLAUGHTER, is a species of felonious homicide, and denotes the unlawful killing of a man, without any malice, either express or implied; which may be either voluntarily, upon a sudden heat; or involuntarily, but in the commission of some unlawful act. As when two persons, who before meant no harm to one another, falling out on some sudden occasion, the one kills the other; this is voluntarily *manslaughter*. But in this and every other case of homicide upon provocation, if there be a sufficient time for passion to subside, and reason to interpose, and the person provoked afterwards kills the other, this is deliberate revenge, and amounts to *murder*. When a workman flings down a stone or piece of timber into a street, and kills a man, this may be either misadventure, *manslaughter*, or murder, according to the circumstances attending it: if it were in a country village, and he called out to all people to have a care, it is misadventure only; but if it were in London, or other populous towns, where people are continually passing by, it is *manslaughter*, though he gives loud warning; and murder, if he knows of their passing, and gives no warning at all.

MANUAL Exercise, See the Treatise on MILITARY Affairs.

MANURING of Ground, the application of a matter proper for meliorating the soil, and rendering it more fertile. For an account of the several manures, animal, natural, and artificial, and the soils to which they are respectively adapted, see System of AGRICULTURE, Sect. II.

MARBLE, in natural history, a genus of fossils; being bright and beautiful stones, composed of small separate concretions, moderately hard, not giving fire with steel, fermenting with and soluble in acid menstrua, and calcining in a slight fire. Marble, when chymically examined, appears to consist of calcareous earth united with much fixed air; and is, like limestone or chalk, capable of being converted into a strong quicklime. Dr. Black derives the origin of marble, as well as limestone and marble, from the same source, viz. from the calcareous matter of shells and lithophyta. In one kind of limestone, known by the name of *Portland Stone*, and consisting of round grains united together, it was supposed to be composed of the spawn of fish; but comparisons of other phenomena have explained it. It is plain that it has been produced from a calcareous sand, which is found on the shore of some of the islands in the southern climates. By the constant agitation the softer parts are worn off, and the harder parts remain in the form of particles that are highly polished, and which are afterwards gradually made to concrete together by causes of which we have yet no knowledge. There are indeed some few of the limestones and marbles in which we cannot discover any of the relics

of the shells; but there are many signs of their having been in a dissolved or liquified state; so we cannot expect to see the remains of the form of the shells: but even in many of the marbles that have the greatest appearance of a complete mixture, we still find often the confused remains of the shells of which they have been originally composed. We should still find it difficult to conceive how such masses should have derived their origin from shells; but, considering the many collections that we have an opportunity of seeing in their steps towards this process, and a little concreted together, so that by their going a step further they might form limestone and marbles, we shall soon see the possibility of their being all produced in the same manner. Thus vast quantities of shells have been found in the province of Turin in France; and indeed there is no place where they have not been found. The lithophyta likewise seem to be a very fruitful source of this kind of earth. In the cold climates, where the moderate degree of heat is not so productive of animal life, we have not such an opportunity of observing this: but in the hot climates, the sea, as well as the land, swarms with innumerable animals; and, at the bottom, with those that produce the corals and madripores. We learn from the history of a ship that was sunk in a storm in the Gulf of Mexico, the vast growth there is of these bodies. About 30 years after, they attempted to dive into it to get out a quantity of silver; but they found great difficulty in getting it, from the ship being overgrown with coral. Sir Hans Sloane, in his *Philosophical Transactions*, and in his history of Jamaica, observes, that the ship's timber, the iron, and money, were all concreted by the growth of the calcareous matter. So in a tract of many thousands of years the quantity of it should be very great; and as this is going on through a very great extent of the bottom of the sea, it will produce every extensive as well as massy collections of calcareous matter.

Elastic Marble, an extraordinary species of fossil which has surprised all the naturalists who have seen it. There are several tables of it preserved in the house of Prince Borghese at Rome, and shown to the curious. F. Jacquer, a celebrated mathematician, has given a description in the *Literary Gazette of Paris*, but the naturalists cannot be contented with it. If permission was given to make the requisite experiments, this curious phenomenon might be better illustrated. There are five or six tables of that marble; their length is about two feet and a half, the breadth about ten inches, and the thickness a little less than three. They were dug up, as the Abbe Fortis was told, in the feed of Mondragone; the grain is of Carrarese marble, or perhaps of the finest Greek. They seem to have suffered some attack of fire: though the first degree of pulverization observable in the angles, can, perhaps, scarcely be called that of imperfect calcination. They are very dry, do not yield to external impression, rebound to the hammer, like other congenerous marble, and are perhaps susceptible of a polish. Being set on end, they bend, oscillating backward and forward; when laid horizontally, and raised at one end, they form a curve, beginning towards the middle; if placed on a table, and a piece of wood or any thing else is laid under them, they make a salient curve, and touch the table with both ends. Notwithstanding this flexibility, they are liable to be broken if indiscreetly handled; and therefore one table only, and that not the best, is shown to the curious. Formerly they were all together in the prince's apartment on the ground-floor.

Marine Acid, a name given to one of the component parts of sea salt. See the *System of CHYMISTRY*, Part I. Chap. V. Sect. IV.

Under the article *BLEACHING* we have taken notice of the properties of the dephlogisticated acid of sea-salt in whitening cloth.

Mr. Chaptal observes, that this acid may be applied to the whitening of paper and old prints; and by its means (he says) they obtain a whiteness which they never had before. Common ink disappears by its action, but it has no effect upon printer's ink.—It thickens oils, and calcines metals to such a degree, that the process may be much expedited by its means. It dissolves metals without effervescence, and precipitates mercury from its solutions, converting it into corrosive sublimate.—It acts, likewise, very vigorously upon metallic calces, forming with them salts more readily than other acids.

MARINE Acid-Air. For its nature and properties, see the *System of AEROLOGY*, Sect. XI.

St. MARK's Gospel, a canonical book of the New Testament, being one of the four Gospels. *St. Mark* wrote his Gospel at Rome, where he accompanied St. Peter, in the year of Christ 64. or 65. Many of the most ancient writers assert that *St. Mark* was no more than an amanuensis or interpreter to St. Peter, who dictated this Gospel to him; others affirm that he wrote it after St. Peter's death. The learned have been also divided as to the language this Gospel was wrote in, some affirming it was composed in Greek, which is the more general and probable opinion, others in Latin. Several of the ancient heretics received only the Gospel of *St. Mark*: others, among the Catholics, rejected the twelve last verses of this Gospel. The gospel of *St. Mark* is properly an abridgement of that of *St. Matthew*.

MARLE, a kind of calcareous earth, very much used in agri-

culture as a manure. For a copious account ascertaining its quality and directing its uses, see the *System of AGRICULTURE*, Sect. II.—*Marle* is dug in many places of Great Britain and Ireland. In digging for it in Ireland, they meet with horns and other curious fossils. The marle always lies in the bottoms of low bogs, and is found by boring with augers made for that purpose. It usually lies at five, seven, or nine feet depth. The obtaining it in many places is attended with very considerable expence in draining off the water. The manner of digging it is this: they employ six able labourers and a supernumerary; and these cut up a hole of 12 feet square, which is supposed a pit that this number of men can manage in one day. Two men dig, two throw it up, and two throw it by, and the supernumerary man supplies defects on all occasions. For the first three feet they dig through a fuzzy earth, fit for making turf or fuel. Under this lies a stratum of gravel, of about half a foot; under this often, for three feet more, there is a more kindly moss, which would make better fuel. This lower stratum is always full of fossil wood, which is usually so soft that the spade cuts as easily through it as through the earth it lies in. Under this, for the thickness of about three inches, is found a series of leaves, principally of the oak. These appear very fair to the eye, but fall to pieces on being touched; and this stratum is sometimes interrupted by vast heaps of seed, which seem to be broom or furze seed. In some places there appear berries of different kinds, and in others several species of sea-plants; all lying in the same confused manner as the oak leaves. Under this vegetable stratum there lies one of blue clay, half a foot thick, and usually full of sea-shells. This blue clay is not so tough as common clay; but is thrown carefully up, and used as marle in some places. Under this always appears the true marle, the stratum of which is usually from two to four feet thick, and sometimes much more.—This marle looks like buried lime, and is full of shells, which are usually of a small size, and of the periwinkle kind; but there are several other sorts at times found among them. Among this marle, and often at the very bottom of it, are found great numbers of very large horns of the deer kind, which are vulgarly called *elk's horns*. These, where they join to the head, are thick and round; and at that joining there grows out a branch, which is about a foot long, and seems to have hung just over the creature's eyes: it grows still round for about a foot above this; and then spreads out broad, and terminates in branches long, and round, terminating with a small bend. The labourers are obliged to work in a hurry in all these pits, so that they seldom bring out the horns whole. There are also, at times, found the leg-bones and other parts of the skeletons of the same beasts; but this more rarely, only a few together, and but few in places.

Dr. Black is of opinion, that all kinds of marle derive their origin from the calcareous matter of shells and lithophyta.

MARMOTTA, a species of the genus *Mus* in *MAMMALIA*. For description of the genus and several species, see *Mus*. For representation, see Plate VII. Genus 24. Species 7.

MARQUE, or *Letters of MARQUE*, in military affairs, are letters of reprisal, granting the subjects of one prince or state liberty to make reprisals on those of another.

MARQUIS, a title of honour, next in dignity to that of duke. A marquis is created by patent; his mantle has double ermine, three doublings and a half; his title is *most noble*; and his coronet has pearls and strawberry-leaves intermixed round, of equal height. See the *System of HERALDRY*, Sect. VI. and Plate 6.

MARRIAGE, a contract, both civil and religious; between a man and woman, by which they engage to live together in mutual love and friendship for the ends of procreation. The first inhabitants of Greece lived together without marriage. Cecrops, king of Athens, was the first author of this honourable institution among that people. After the commonwealths of Greece were settled, marriage was very much encouraged by their laws; and the abstaining from it was discountenanced, and in many places punished. The Lacedæmonians were particularly remarkable for their severity towards those who deferred marrying, as well as to those who wholly abstained from it. The Athenians had an express law, that all commanders, orators, and persons entrusted with any public affair, should be married men. Polygamy, or the having more than one wife at a time, was not commonly tolerated in Greece. See *POLYGAMY*.

We find but few laws in the books of Moses concerning the institution of marriage; he restrained the Israelites from marrying with certain degrees of consanguinity, but we find that polygamy, though not expressly allowed, is however tacitly implied in the laws of Moses: there is a particular law that obliged a man, whose brother died without issue, to marry his widow, and raise up children to his brother. The Hebrews purchased their wives, by paying down a competent dowry for them; and a man was at liberty to marry, not only in any of the 12 tribes, but even out of them, provided it was with such nation as used circumcision. The Romish church requires of the clergy perpetual abstinence from marriage; and has advanced this institution to the dignity of a sacrament. The church of England, though she does not consider marriage as a sacrament, yet looks upon it as an institution so sacred, as that it ought always to be celebrated by an ecclesiastical

astical person; but marriages, without this sanction, are not therefore null and void. There is no canon of this church, which forbids marriages to be solemnized at any time. The canonical hours for celebrating of matrimony, are from eight to twelve in the forenoon. The impediments to marriage are specified in canon 102 of the English church, and are these: 1. A preceding marriage, or contract, or any controversy or suit depending on the same. 2. Consanguinity or affinity. 3. Want of consent of parents, or guardians, &c.

Marriage, according to our law, cannot be dissolved but by death, breach of faith, or other notorious misbehaviour. A marriage in reputation, as among the quakers, is allowed to be sufficient to give title to a personal estate; though, in the case of a person married by a dissenting minister, who was not in orders, it has been held, that where a husband demands a right due to him as such by the ecclesiastical law, he ought to prove himself a husband, thereby to be entitled to it; and yet this marriage is not altogether a nullity, because, by the laws of nature, the contract is binding. On a promise of marriage, if it be mutual on both sides, damages may be recovered in case either party refuses to marry: and though no time for the marriage be agreed on, if the plaintiff aver that he offered to marry the defendant, who refused it, an action is maintainable for the damages; but no action shall be brought upon any agreement, except it is in writing, and signed by the party to be charged.

For the better preventing clandestine marriages, and the inconveniences arising therefrom, an act of parliament was passed, wherein the following regulations were made, viz. That from and after March 25, 1754, banns of matrimony shall be published in the parish church, or some public chapel belonging to the parish wherein the parties dwell, upon three Sundays before the marriage, during the time of service, immediately after the second lesson; and where the parties dwell in different parishes the banns shall be published in both; and the marriage shall be solemnized in the church or chapel wherein the banns were published, and no where else: and it is also required, that both or either of the parties to be married do reside four weeks at least in the parish where the banns are published. Nothing in this act deprives the archbishop of Canterbury of his usual right of granting special licences to marry at any convenient time or place. All marriages solemnized contrary to the aforesaid regulations, shall be void; and the person solemnizing the same shall be adjudged guilty of felony, and be transported for 14 years to his majesty's colonies. Marriages solemnized by license, where either of the parties (not being a widow or widower,) shall be under age, without the consent of the father first had (if living,) or of the guardians, or one of them, and, where there shall be no guardians, (if living and unmarried,) or of the guardian appointed by chancery, shall be void to all intents and purposes. Where any such guardian shall be *non compos mentis*, or in parts beyond the sea, or shall refuse their consent to a proper match, the party may apply by petition to the lord chancellor, lord keeper, or lords commissioners of the great seal, who shall proceed on such a petition in a summary way; and where the marriage proposed shall appear to be proper, they shall judicially declare the same to be so by an order of court, which shall be deemed effectual. All marriages shall be solemnized in the presence of two or more credible witnesses besides the minister, and an entry thereof shall be immediately made in a register kept for that purpose. This act shall not extend to the marriages of any of the royal family, nor to Scotland, nor to those persons called quakers, nor to those professing the Jewish religion. In Scotland, the parties living together as man and wife, or declaring themselves so before witnesses, makes a valid though informal marriage.

Policy of encouraging MARRIAGE. Dr. Halley observes, that the growth and increase of mankind is not so much stunted by any thing in the nature of the species, as it is from the cautious difficulty most people make to adventure on the state of marriage, from the prospect of the trouble and charge of providing for a family: nor are the poorer sort of people herein to be blamed, who, besides themselves and families, are obliged to work for the proprietors of the lands that feed them; and of such does the greater part of mankind consist. Were it not for the backwardness to marriage, there might be four times as many births as we find; for, by computation, there are 15,000 persons above 16 and under 45, of which at least 7000 are women capable of bearing children; yet there are only 1238, or a little more than a sixth part of these, that breed yearly: whereas, were they all married, it is highly probable that four of six should bring forth a child every year, the political consequences of which are evident. Therefore, as the strength and glory of a kingdom or state consists in the multitude of subjects, celibacy above all things ought to be discouraged, as by extraordinary taxing, or military service: and, on the contrary, those who have numerous families should be allowed certain privileges and immunities, like the *jus trium liberorum* among the Romans; and especially, by effectually providing for the subsistence of the poor.

MARRIAGE Settlement, is a legal act, previous to marriage, whereby a jointure is secured to the wife after the death of the husband. These settlements seem to have been in use among the ancient Germans, and their kindred nation the Gauls. See an No. 99.

excellent marriage settlement by Blackstone, in the appendix to the second volume of his Commentaries.

MARS, in Pagan worship and mythology, the god of war. He was, according to some, the son of Jupiter and Juno. The amours of Mars and Venus, and the manner in which Vulcan caught and exposed them to the laughter of the other gods, have been described by several of the ancient poets. He is represented as having several wives and mistresses, and a considerable number of children. He was held in the highest veneration by the Romans, both from his being the father of Romulus their founder, and from their inclination to conquest; and had magnificent temples erected to him at Rome. Mars is usually represented in a chariot, drawn by furious horses. He is completely armed; and extends his spear with the one hand, and grasps a sword, imbrued in blood, with the other. He has a fierce and savage aspect. Discord is represented preceding his car; and Clamour, Fear, and Terror, appear in his train. The victims sacrificed to him were the wolf, the horse, the wood-pecker, the vulture, and the cock.

MARS, in astronomy, one of the five planets, and of the three superior ones; its place being between the earth and Jupiter. See the System, Sect. VIII.

MARSHALSEA. See COURT.

MARSHY, or MARSH lands, a name given by our farmers to a sort of pasture land, or grazing ground, which lies near the sea, rivers, or fens. For the method of draining marshy lands, see the System of AGRICULTURE, Sect. XIX.

MARSUPIALIS, a species of the genus Diadelphis, in Mammalia. For description of the Genus and several Species, see DIADELPHIS. For representation, see Plate VI. Genus 17, Species 1.

MARTES, or MARTIN, a species of the genus Mustela, in Mammalia. For description of the Genus and several Species, see MUSTELA. For representation, see Plate V. Genus 15, Species 6.

MARTYR, a person who suffers torments, and even death, in defence of the truth of the gospel and his religion. Anciently those who were banished for the faith, were called *martyrs*, and also those who perished in the holy wars. St. Stephen is called the *proto martyr*, or first martyr. Nineteen thousand seven hundred are computed to have suffered *martyrdom* with St. Irenæus at Lyons, under the empire of Severus: six thousand six hundred and sixty-six soldiers of the Theban legion are said to have been *martyred* in Gaul: Father Papebroch reckons sixteen thousand Abyssinian *martyrs*, and one hundred and fifty thousand others under Dioclesian alone.

There is scarce any faith or religion that does not pretend to its *martyrs*: Mahometans, heathens, idolaters, &c. all have their *martyrs*. In the ancient church, the acts, sayings, sufferings, and deaths, of the *martyrs*, were preserved with great care, in order to be read on certain days, and thus proposed as models to future ages: and yet, notwithstanding all this diligence, we have but very little left of them: the greatest part of them having been destroyed during that dreadful persecution which Dioclesian carried on for ten years, with fresh fury, against the Christians: for a most diligent search was then made after all their books and papers; and all of them that were found were committed to the flames; Eusebius, indeed, composed a *martyrology*, but it never reached down to us; and those since compiled are extremely suspected. From the eighth century, downwards, several Greek and Latin writers endeavoured to make up the loss, by compiling, with vast labour, accounts of the lives and actions of the ancient *martyrs*: but most of them have given us little else than a series of fables, adorned with profusion of rhetorical flowers, and striking images, as the wiser, even among the Romish doctors, frankly acknowledge. Nor are those records, that pass under the name of *Martyrology*, worthy of superior credit, since they bear the most evident marks both of ignorance and falshood.

MARTYROLOGY, in the church of Rome, is a catalogue or list of martyrs, including the history of their lives and sufferings for the sake of religion. The term comes from *μαρτυρ*, "witness," and *λογος*, "dico," or *λεγω*, "colligo."

The *martyrologies* draw their materials from the kalendars of particular churches, in which the several festivals dedicated to them are marked; and which seem to be derived from the practice of the ancient Romans, who inserted the names of heroes and great men in their fasti, or public registers. The *martyrologies* are very numerous, and contain many ridiculous and even contradictory narratives; which is easily accounted for, if we consider how many forged and spurious accounts of the lives of saints and martyrs appeared in the first ages of the church, which the legendary writers afterwards adopted without examining into the truth of them. However, some good critics, of late years, have gone a great way towards clearing the lives of the saints and martyrs from the monstrous heap of fiction they labour under. We have also several protestant *martyrologies*, containing the sufferings of the reformed under the papists; viz. an English *martyrology*, by J. Fox; with others by Clark, Bray, Southwell, &c. Those who are inclined to be farther informed on this subject are referred to Dr. Southwell's edition of Fox's *Martyrology*.

MASCULINE, the stronger of the two sexes. See MALE.

M A S

MASCULINE, is more ordinarily used in grammar to signify the first and worthiest of the genders of nouns. See **GENDER**. The masculine gender is that which belongs to the male kind, or something analogous to it. Most substantives are ranged under the heads of masculine or feminine. This, in some cases, is done with a show of reason, but in others is merely arbitrary, and for that reason is found to vary according to the languages and even according to the words introduced from one language into another. Thus the names of trees are generally feminine in Latin, and masculine in the French. Farther, the genders of the same word are sometimes varied in the same language. Thus *alvus*, according to Priscian, was anciently masculine, but is now become feminine. And *navire*, a ship, in French, was anciently feminine, but is now masculine. See **System of GRAMMER**, Part. I. Chap. I. Sect. I.

MASONS, *Free or Accepted*, a very ancient society, or body of men, so called, either from some extraordinary knowledge of masonry or buildings, which they are supposed to be masters of, or because the first founders of the society were persons of that profession. They are now very considerable both for numbers and character; being found in every country in Europe, and consisting principally of persons of merit and consideration. As to antiquity, they lay claim to a standing of some thousand years; and, it is said, can trace up their original as early as the building of Solomon's temple. It is very doubtful when they were first introduced into this country; some have traced the origin of masonry in general to the year 674: and it is certain that, after that time, many of our public buildings, in the Gothic style, were erected by men in companies, who, as some say, called themselves *free*, because they were at liberty to work in any part of the kingdom. Others have derived the institution of *free masons* from a combination among the *masons* not to work without an advance of wages, when they were summoned from several counties, by writs of Edward III. directed to the sheriffs, to assist in rebuilding and enlarging the castle, together with the church and chapel of St. George, at Windsor: accordingly it is said, that the *masons* agreed on tokens, &c. by which they might know one another, and to assist one another against being impressed, and not to work unless *free*, and on their own terms. What the end of their institution is, seems still, in some measure, a secret; though so much of it as is known appears laudable enough, as it tends to promote friendship, society, mutual assistance, and good fellowship. The brothers of this fraternity are said to be possessed of a great number of secrets, which have been religiously observed from age to age.

MASS, in a religious sense, denotes the office, or public prayers made in the Romish church, at the celebration of the eucharist. Romish divines define the mass, an oblation made to God, wherein, by the change of a sensible object by virtue of a divine institution, the sovereign dominion of God over all things is acknowledged. This they esteem the greatest and most august ceremony in use in the church; as being the sacrifice of the new law, wherein the body and blood of Jesus Christ are offered up to God. There is a great variety of masses in the Romish church; the mass acquiring new titles, and appellations, according to the different rites, intentions, and manners, in which it is performed, as well as other circumstances.

MASSACRE, a term used to signify the sudden and promiscuous butchery of a multitude. The most atrocious example of this kind upon record is that called the *Parisian Massacre*, or *Massacre of St. Bartholomew's Day*. The Parisian massacre was carried on with such detestable perfidy, and executed with such a bloody cruelty, as would surpass all belief, were it not attested by the most undeniable evidence. In the year 1572, in the reign of Charles IX. many of the principal protestants were invited to Paris, under a solemn oath of safety, upon occasion of the marriage of the king of Navarre with the French king's sister, viz. the king of Navarre's mother, Coligni admiral of France, with other nobles. The queen-dowager of Navarre, a zealous protestant, was poisoned by a pair of gloves before the marriage was solemnized; and on the 24th of August 1572, being Bartholomew's day, about day-break, upon the toll of the bell of the church of St. Germain, the butchery began. The admiral was basely murdered in his own house; and then thrown out of the window, to gratify the malice of the duke of Guise: his head was afterwards cut off, and sent to the king and queen-mother, and his body, after a thousand indignities offered to it, hung up by the feet on a gibbet. After this, the murderers ravaged the whole city of Paris, and butchered in three days above ten thousand lords, gentlemen, presidents, and people of all ranks. An horrible scene of things, says Thuanus, when the very streets and passages resounded with the noise of those that met together for murder and plunder; the groans of those who were dying, and the shrieks of such as were just going to be butchered, were every where heard; the bodies of the slain thrown out of the windows; the courts and chambers of the houses filled with them; the dead bodies of others dragged through the streets, their blood running down the channels in such plenty, that torrents seemed to empty themselves in the neighbouring river: and, in a word, an innumerable multitude of men, women with child, maidens, and children, were all involved in one common destruction; and

M A S

the gates and entrances of the king's palace all besmeared with their blood.

From the city of Paris the massacre spread almost throughout the whole kingdom. In the city of Meaux they threw above two hundred into jail; and after they had ravished and killed a great number of women, and plundered the houses of the protestants, they executed their fury on those they had imprisoned, and calling them out, one by one, they were killed, as Thuanus expresses, like sheep in a market; the bodies of some were flung into ditches, and of others into the river Maine. In Orleans they murdered above five hundred men, women, and children, and enriched themselves with their spoil. The same cruelties were practised at Angers, Troyes, Bourges, La Charité, and especially at Lyons, where they inhumanly destroyed above eight hundred protestants; children hanging on their parents' necks; parents embracing their children; putting ropes about the necks of some, dragging them through the streets, and throwing them, mangled, torn, and half dead, into the river.

It would be endless to mention the butcheries committed at Valence, Romaine, Rouen, &c. We shall, therefore, only add, that, according to Thuanus, above thirty thousand protestants were destroyed in this massacre, or, as others, with greater probability, affirm, above one hundred thousand.

Thuanus himself calls this a most detestable villainy; and, in abhorrence of St. Bartholomew's day, used to repeat these words of P. Statius, *Silv. v. iii. ver. 88. &c.*

Excidat illa dies ævo, ne postera credant

Secula. Nos certe taceamus, et obruta multa

Nocte tegi propriæ patiamur crimina gentis.

In the words of Job, chap. iii. ver. 3. &c. "Let that day perish; and let it not be joined unto the days of the year. Let darkness and the shadow of death stain it," &c. And yet, as though this had been the most heroic transactions, and could have procured immortal glory to the authors of it, medals were struck at Paris in honour of it.

But how was the news of this butchery received at Rome, that faithful city, that holy mother of churches! How did the vicar of Christ, the successor of Peter, and the father of the Christian world, relish it? Let Thuanus tell the horrid truth. When the news, says he, came to Rome, it was wonderful to see how they exulted for joy. On the 6th of September, when the letters of the pope's legate were read in the assembly of the cardinals, by which he assured the Pope that all was transacted by the express will and command of the king, it was immediately decreed that the pope should march with his cardinals to the church of St. Mark, and in the most solemn manner give thanks to God for so great a blessing conferred on the see of Rome and the Christian world; and that, on the Monday after, solemn mass should be celebrated in the church of Minerva; at which the pope, Greg. XIII. and cardinals were present; and that a jubilee should be published throughout the whole Christian world, and the cause of it declared to be, to return thanks to God for the extirpation of the enemies of the truth and church in France. In the evening the cannon of St. Angelo were fired, to testify the public joy; the whole city illuminated with bonfires; and no one sign of rejoicing omitted that was usually made for the greatest victories obtained in favour of the Roman church.

Second Parisian Massacre, Sept. 2, 1792.—More recent, though not less mischievous in its effects, was the anarchy by which this ill-fated city was doomed, a second time, to become the centre of every calamity incidental to human nature. Precluded from entering into a copious detail of the particulars, with which this tragic scene abounds, as it would exceed the limits of our work, we shall confine ourselves to the great outline, and just sketch a concise narrative of authenticated facts.

The pusillanimity of the late king, and the imbecility of his ministers, had suffered that spirit of revolution which had manifested itself during the last four years of the reign of that unfortunate monarch to acquire a most alarming ascendancy. In the year 1792, it burst forth with unextinguishable fury; every effort to stifle its flame proved abortive; the monarchy fell with the monarch; religion and the laws were overthrown; the reins of government were seized by an usurping faction, and the property and even lives of the citizens subjected to the caprice and cruelty of an armed, ungovernable rabble. From the 10th of August, the day on which the king was deposed, to the 2d of Sept. the day on which this horrid massacre was perpetrated, every species of vice and infamy, that can degrade humanity, was universally prevalent. Servants informed against their masters, and dragged them to prison, and debtors were suffered to arrest their creditors. The priests were considered as inimical to the general cause, as necessarily attached to that system of government which protected them in the exercise of their functions; they were therefore very narrowly watched by the adverse party, by whom a mandate was issued, requiring all the clergy to take the oath prescribed by the faction, who had usurped the government, and subjecting those who should refuse compliance, within a limited time, to the penalty of expulsion from the country, as enemies to the commonwealth. As the clergy were now become generally obnoxious, this mandate was enforced with the utmost rigour, and numbers

A *medicine*, properly so called, is a substance which, when applied to the living human body, makes such an alteration in it as either to prevent the approach of disease, or to remedy a morbid state when already present. Such substances as may be used for these purposes without any great preparation are called *simple medicines*, or *simples*; and with these the writers on *matéria medica* are chiefly conversant. In treatises written professedly on this subject, it is common to give a particular description of each article, the characteristic marks by which it may be distinguished from all other substances, and the methods by which an adulteration or an imperfection may be discovered in it, together with the dose in which it can safely be given: but as all these particulars are taken notice of in different parts of the work they are omitted here.

M A T

MATHEMATICS, the science of quantity; or science that considers magnitudes either as computable, or measurable. The word, in its original *μαθημα*, signifies *discipline*, or *science*, in the general, and seems to have been applied to the doctrine of quantity, either by way of eminence, or because, as this had the start of all other sciences, the rest took their common name from it. For the origin of the *mathematics*, Josephus dates it before the flood, and makes the sons of Seth observers of the course and order of the heavenly bodies; he adds, that to perpetuate their discoveries, and secure them from the injuries either of a deluge, or conflagration, they had them engraven on two pillars, the one of stone, the other of brick; the former of which, he says, was standing in Syria in his days. The first who cultivated *mathematics* after the flood, were the Assyrians and Chaldeans; from whom the same Josephus adds, they were carried by Abraham to the Egyptians; who proved such notable proficient, that Aristotle makes no scruple to fix the first rise of *mathematics* among them. From Egypt, five hundred eighth-four years before Christ, they passed into Greece through the hands of Thales, who, having learned geometry of the Egyptian priests, taught it in his own country. After Thales, comes Pythagoras; who, among other mathematical arts, paid a peculiar regard to arithmetic; fetching the greatest part of his philosophy from numbers: he was the first, as Laetius tells us, who abstracted geometry from matter; and to him we owe the doctrine of incommensurable magnitude, and the five regular bodies, besides the first principles of music and astronomy. Pythagoras was succeeded by Anagoras, Oenopides, Briso, Antipho, and Hippocrates of Chios; who all applied themselves particularly to the quadrature of the circle, the duplicature of the cube, &c. but the last with most success: this last is also mentioned by Proclus, as the first who compiled elements of *mathematics*.

Democritus excelled in *mathematics* as well as physics; though none of his works, in either kind, are extant: the destruction of which some authors ascribe to Aristotle. The next in order is Plato, who not only improved geometry, but introduced it into physics, and so laid the foundation of a solid philosophy. Out of his school proceeded a crowd of *mathematicians*. Eudoxus was the first founder of a system of astronomy. Menechmus invented the conic sections, and Theudius and Hermotimus improved the elements. As for Aristotle, his works are so stored with *mathematics*, that Blancanus compiled a whole book of them: out of his school came Eudemus and Theophrastus; the first of whom wrote of numbers, geometry, and invisible lines; the latter a mathematical history. To Aristotle, Isidorus, and Hypsicles, we owe the books of solids; which, with the other books of elements, were improved, collected, and methodized by Euclid, who died two hundred and eighty four years before Christ. A hundred years after Euclid, came Eratosthenes and Archimedes. Contemporary with the latter was Conon, a 'geometrician' and astronomer. Soon after came Apollonius Pergæus, whose conics are still extant. To him are likewise ascribed the fourteenth and fifteenth books of Euclid, which are said to have been contracted from Hypsicles. Hipparchus and Menelaus wrote on the sines in a circle, the latter also on spherical triangles; Theodosius's three books of spherics are still extant. All these, Menelaus excepted, lived before Christ.

A. D. 70, Ptolemy of Alexandria was born; the prince of astronomers, and no mean geometrician: he was succeeded by the philosopher Plutarch, of whom we have still extant some mathematical problems. After him came Eutocius; who commented on Archimedes, and occasionally mentions the inventions of Philo, Diocles, Nicodemus, Sporus, and Heron, on the duplicature of the cube. To Ctesibius of Alexandria we owe our pumps; and Geminus, who came soon after, is preferred by Proclus to Euclid himself. Diophantus of Alexandria was a great master of numbers, and the first inventor of algebra: and among others of the ancients, Nicomachus is celebrated for his arithmetical, geometrical, and musical works; Serenus, for books on the section of the cylinder; Proclus, for his comments on Euclid; and Theon has the credit, among some, of being author of the books of Elements ascribed to Euclid. The last to be named among the ancients is Pappus of Alexandria, who flourished A. D. 400, and is celebrated for his books of mathematical collections still extant.

Mathematics are commonly distinguished into pure and speculative, which consider quantity abstractedly; and mixed, which treat of magnitude as subsisting in material bodies, and consequently are interwoven every where with physical considerations. Mixed *mathematics* are very comprehensive; since to them may be referred *Hydrostatics*, which consider the laws of fluids, or of bodies gravitating in fluids. *Pneumatics*, the air, with regard to the laws and mensuration thereof. *Hydraulics*, the motion of fluids. *Optics*, direct light or vision. *Catoptrics*, reflected vision. *Dioptrics*, refracted vision. *Perspectives*, the images of objects, in order to delineate or represent them. *Astronomy*, the universe, and the phenomena of the heavens. *Geography*, the earth, both as in itself, and as in its affections. *Hydrography*, the sea, principally as navigable. *Gnomonics*, or *Dialling*, shadows, in order for determining the hour of the day. *Military Architecture*, the strength of places, with regard to their defence against an enemy.

M E A

Civil Architecture, (now become a branch of *mathematics*) or buildings. *Music*, sounds, and their effects on the ear. For the elements of each of these, see the respective Systems.

Pure *mathematics* have one peculiar advantage, that they occasion no disputes, among wrangling disputants, as in other branches of knowledge: and the reason is, because the definitions of the terms are premised, and every body that reads a proposition has the same idea of every part of it. Hence it is easy to put an end to all mathematical controversies, by showing, either that our adversary has not stuck to his definitions, or has not laid down true premises, or else that he has drawn false conclusions from true principles; and in case we are able to do neither of these, we must acknowledge the truth of what he has proved. It is true, that in mixed *mathematics*, where we reason mathematically upon physical subjects, we cannot give such just definitions as the geometricians: we must therefore rest content with descriptions; and they will be of the same use as definitions, provided we are consistent with ourselves, and always mean the same thing by those terms we have once explained. Dr. Barrow gives a most elegant description of the excellence and usefulness of mathematical knowledge, in his inaugural oration, upon being appointed professor of *mathematics* at Cambridge.

The *mathematics*, he observes, effectually exercise, not vainly delude, nor vexatiously torment, studious minds with obscure subtilties; but plainly demonstrate every thing within their reach, draw certain conclusions, instruct by profitable rules, and unfold pleasant questions. These disciplines likewise inure and corroborate the mind to a constant diligence in study; they wholly deliver us from a credulous simplicity, most strongly fortify us against the vanity of scepticism, effectually restrain us from a rash presumption, most easily incline us to a due assent, and perfectly subject us to the government of right reason. While the mind is abstracted and elevated from sensible matter, distinctly views pure forms, conceives the beauty of ideas, and investigates the harmony of proportions; the manners themselves are sensibly corrected and improved, the affections composed and rectified, the fancy calmed and settled, and the understanding raised and excited to more divine contemplations.

MATRIX, or **UTERUS**, in anatomy, the womb, or that part of the female of any kind, wherein the fœtus is conceived, and nourished till the time of its delivery. See the system, Part V. Sect. XII.

MATTHEW, or *Gospel of St. MATTHEW*, wrote his gospel in Judæa, at the request of those he had converted; and it is thought he began in the year 41, eight years after Christ's resurrection. It was written, according to the testimony of all the ancients, in the Hebrew or Syriac language; but the Greek version, which now passes for the original, is as old as the apostolical times.

MAYOR, or **MAIOR**, the chief magistrate or governor in the cities, and most corporation towns of England; chosen annually by his peers out of the number of the aldermen. See **ALDERMEN**.

The *mayor* of any place is the king's lieutenant, and, with the aldermen and common-council, can make laws, called *by-laws*, for the government of the place. He has also the authority of a kind of judge, to determine matters, and to mitigate the rigour of the law. King Richard I. A. D. 1189, first changed the bailiffs of London into *mayors*; by whose example others were afterwards appointed. *Mayors* of corporations are justices of peace, *pro tempore*, and they are mentioned in several statutes; but no person shall bear any office of magistracy concerning the government of any town, corporation, &c. that hath not received the sacrament, according to the church of England, within one year before his election, and who shall not take the oaths of supremacy, &c. Stat. 13 Car. II. cap. 1.

MEADOW, in husbandry, in its general signification, means pasture, or grass land, annually mown for hay; but is more particularly applied to lands that are so low as to be too moist for cattle to graze upon them, in winter, without spoiling the sward. For the method of overflowing and draining meadow-grounds, see **AGRICULTURE**, Sect. XIX.

MEAT, See **FOOD**, **DIET**, **DRINK**, &c.

Method of preserving fish-meat without spices, and with very little salt. Jones, in his *Miscellanea Curiosa*, gives us the following description of the Moorish *Elchelles*, which is made of beef, mutton, or camel's flesh, but chiefly beef, and which they cut all in long slices, and let it lie for 24 hours in a pickle. They then remove it out of those jars or tubs into others with water; and when it has laid a night, they take it out, and put it on ropes in the sun and air to dry. When it is thoroughly dried and hard, they cut it into pieces of two or three inches long, and throw it into a pan or caldron, which is ready with boiling oil and suet sufficient to hold it, where it boils till it be very clear and red when cut. After this they take it out, and set it to drain; and when all is thus done, it stands to cool, and jars are prepared to put it up in, pouring upon it the liquor in which it was fried; and as soon as it is thoroughly cold, they stop it up close. It will keep two years; will be hard, and the hardest they look upon to be the best done. This they dist up cold, sometimes fried with eggs and garlic, sometimes stewed, and lemon squeezed on it. It is very good any way, either hot or cold.

l
s
-
a
e
y
-
e
s
a
of
s
s
o
-
ne
of
ns
-
or
d.
s,
ry
w-
ef,
all
en
nd
in
rd,
it
net
red
nd
to
ed;
will
to
with
it.

Mechanic Powers, with their Application in Cranes, Mills & other Compound Engines. See System of Mechanics.
Section 3.

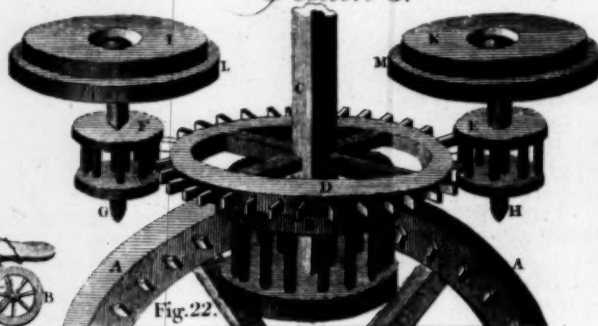
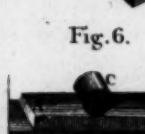
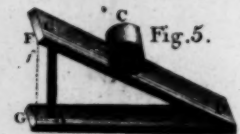
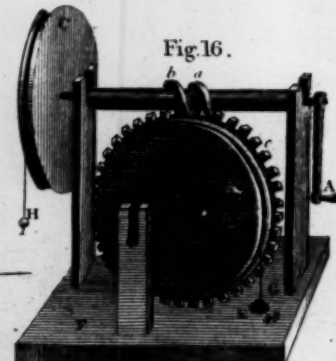
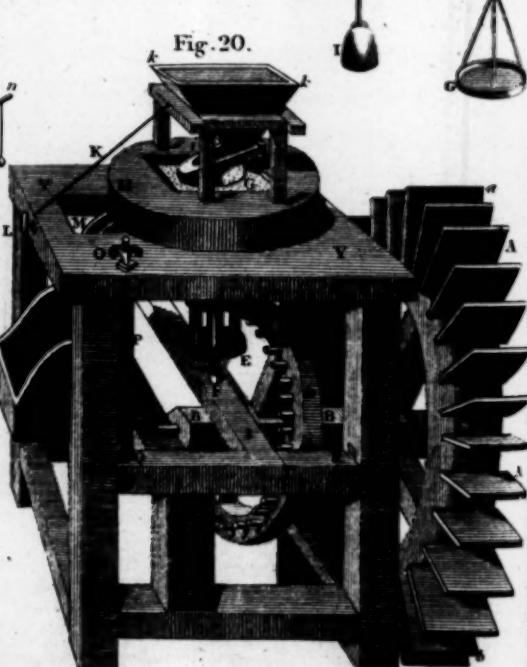
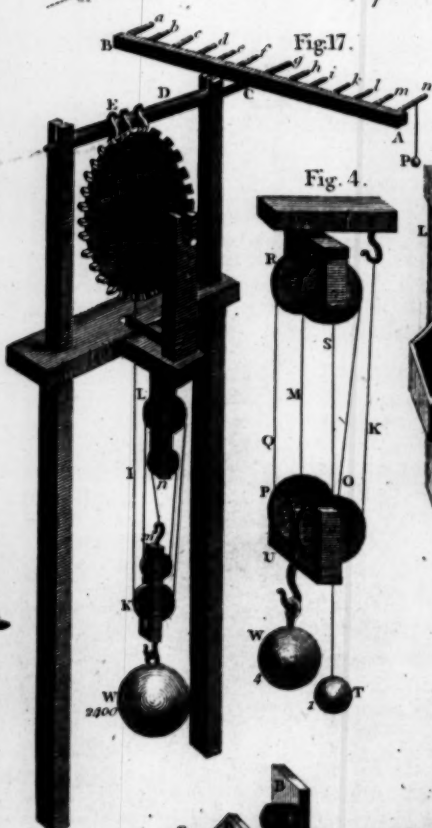
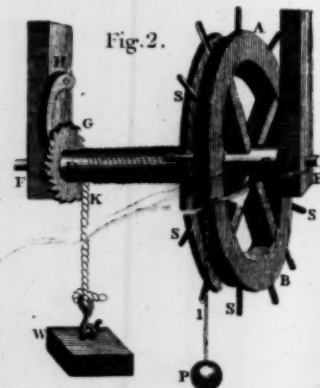
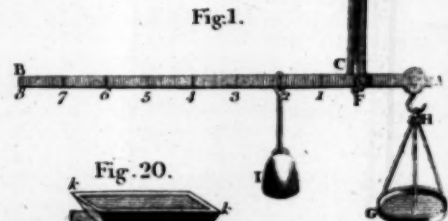
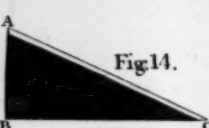
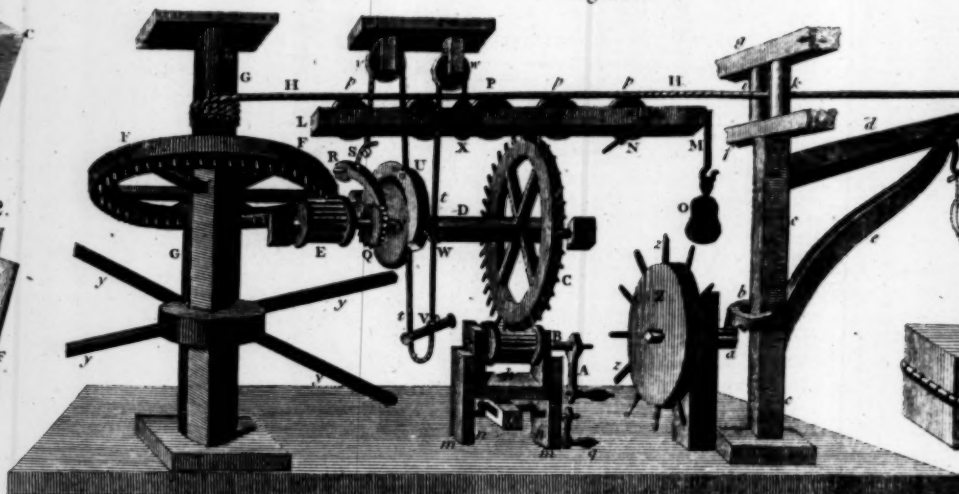
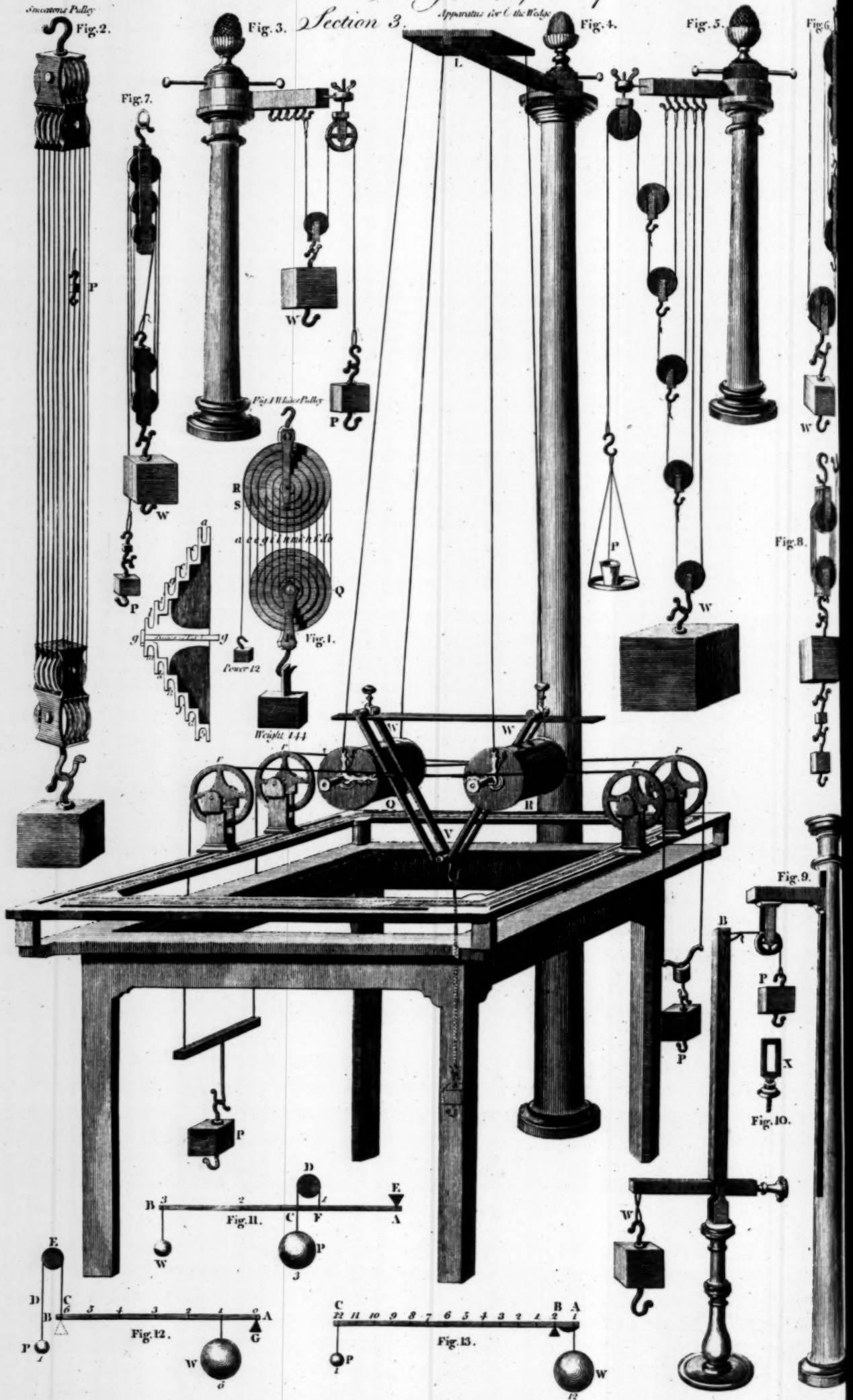


Fig. 23.





*Mechanical Powers according to the latest Improvements, (including
White's Patent Concentric Pulley, &c.) System of Mechanics.*



SYSTEM OF MECHANICS.

INTRODUCTION.

MECHANICS, *Mechanica*, *Μηχανική*, a mixed mathematical science, which considers motion, and moving powers, their nature and laws, with the effects thereof, in machines, &c. It is distinguished by Sir Isaac Newton into practical and rational *mechanics*: the former treats of the *mechanical* powers and of their various combinations: rational *mechanics* comprehends the whole theory of motion, and shews, when the powers or forces are given, how to determine the motions that are produced by them; and *vice versa*. That part of *mechanics*, which considers the motion of bodies arising from gravity, is by some called *statics*; in distinction from that part which considers the *mechanical* powers, and their application, and which is properly called *mechanics*. See *MECHANICAL POWERS*.

The term *mechanics* has of old been, and still is, used in a double sense in very different sciences, both with respect to their objects and principles. For the name *mechanics* is applied equally to that science which treats of the equilibrium and comparison of powers; and to that science in which the nature, generation, and alteration of motion are explained. To avoid ambiguity, therefore, it would be proper to give the name *statics* to the science of the equilibrium and comparison of powers, and to restrain the term *mechanics* to the science of motion.

These two sciences not only differ as to their objects and principles, but also with respect to the times in which they have been cultivated. Some of the principles of *statics* were established by Archimedes; but Galileo laid the first foundation of *mechanics* when he investigated the descent of heavy bodies: and since his time, by the assistance of the new methods of computation, a great progress has been made, particularly by Sir Isaac Newton, in his *Principia*. This admirable work is now rendered more accessible to beginners by the learned comment of the fathers le Suer and Jacquier, printed, with the text, at Geneva, 1739, 4to. 1742, 4 vols. 4to.

The doctrine of machines or engines is a principal branch of *mechanics*; but has not as yet been treated as it deserves. We shall here insert a few observations on this useful subject, from a late eminent author. In treating of machines, we should consider the weight that is to be raised, the power by which it is to be raised, and the instrument or engine by which this effect is to be produced. There are two principal problems that ought to be resolved in treating of each of them. The first is, to determine the proportion, which the power and weight ought to have to each other, that they may just sustain one another, or be in equilibrio. The second is, to determine what ought to be the proportion of the power and weight to each other, in a given machine, that it may produce the greatest effect possible, in a given time.

All the writers on *mechanics* treat of the first of these problems, but few have considered the second, though equally useful with the other. As to the first problem, this general rule holds in all powers: suppose the engine to move, and reduce the velocities of the power and weight to the respective directions in which they act; find the proportions of those velocities; then if the power be to the weight as the velocity of the weight is to the velocity of the power; or, which amounts to the same thing, if the power multiplied by its velocity, gives the same product as the weight multiplied by its velocity; this is the case wherein the power and weight sustain each other, and are in equilibrio; so that, in this case, the one would not prevail over the other, if the engine was at rest; and if it is in motion, it would continue to proceed uniformly, if it were not for the friction of its parts, and other resistances.

The second general problem in *mechanics* is, to determine the proportion which the power and weight ought to bear to each other; that when the power prevails, and the machine is in motion, the greatest effect possible may be produced by it in a given time. It is manifest, that this is an enquiry of the greatest importance, though few have treated of it. When the power is only a little greater than that which is sufficient to sustain the weight, the motion is too slow; and though a greater weight is raised in this case, it is not sufficient to compensate the loss of time. When the weight is much less than that which the power is able to sustain, it is raised in less time; and this may happen not to be sufficient to compensate the loss arising from the smallness of the load. It ought, therefore, to be determined when the product of the weight, multiplied by its velocity, is the greatest possible; for this product measures the effect of the engine in a given time, which is always the greater in proportion as the weight which is raised is greater, and as the velocity with which it is raised is greater. We shall therefore subjoin some instances of this kind, that may be demonstrated from the common elementary geometry; wishing that farther improvements may be made in this most useful part of *mechanics*.

When the power prevails, and the engine begins to move, the motion of the weight is at first gradually accelerated. The action of the power being supposed invariable, its influence in accelerating the motion of the weight decreases, while the velocity of the weight increases. Thus the action of a stream of water, or air upon a wheel, is to be estimated only from the excess of the velocity of the fluid above the velocity already acquired by the part of the engine which it strikes, or from their relative velocity. On

the other hand, the weight of the load that is to be raised, and the friction, tend to retard the motion of the engine; and when these forces, viz. those that tend to accelerate it, and those that tend to retard it, become equal, the engine then proceeds with the uniform motion it has acquired.

In mechanics we have to consider matter, forces exerted thereon, the motions and velocities produced, &c. We shall, therefore, in the first place, take notice of the properties of matter.

SECT. I. MATTER AND ITS PROPERTIES.

By the word *matter* is here meant every thing that has length, breadth, and thickness, and resists the touch.

The inherent properties of matter are solidity, inactivity, mobility, and divisibility.

The *Solidity* of matter arises from its having length, breadth, thickness; and hence it is, that all bodies are comprehended under some shape or other, and that every particular body hinders all others from occupying the same part of space which it possesseth. Thus, if a piece of wood or metal be squeezed ever so hard between two plates, they cannot be brought into contact. And even water or air has this property; for if a small quantity of it be fixed between any other bodies, they cannot be brought to touch one another. Dr. Priestley and some others have indeed denied this property to matter; and supposed, that if a sufficient degree of force was applied to two bodies, they might actually exist in the same place at the same moment: but such abstruse speculations cannot be of any service in mechanics, the very foundation of which is built on the opposite principle, and necessarily implies the impenetrability or solidity of matter.

Inactivity or Passiveness of Matter. Since matter always endeavours to continue in the state that it is in, whether of rest or motion, therefore, if one body contains twice or thrice as much matter as another body does, it will have twice or thrice as much inactivity; that is, it will require twice or thrice as much force to give it an equal degree of motion, or to stop it after it hath been put into such a motion. A great deal of this inactivity, however, we are assured, arises from gravity; for in those cases wherein gravity is not opposed, a small body will set a very large one in motion.

Mobility of matter. We find that all matter is capable of being moved, if a sufficient degree of force be applied to overcome its inactivity or resistance, or the force of gravity which acts upon all terrestrial bodies.

Divisibility of Matter. Since matter can never be annihilated, by cutting or breaking, we can never imagine it to be cut into such small particles, but that if one of them is laid on a table, the uppermost side of it will be further from the table than the undermost side. Moreover, it would be absurd to say that the greatest mountain on earth has more halves, quarters, or tenth parts, than the smallest particle of matter has; wherefore the divisibility of matter has no end.

We have many surprising instances of the smallness to which matter can be divided by art; of which the two following are very remarkable.

1. If a pound of silver be fused with a single grain of gold, the gold will be equally diffused through the whole silver; so that taking one grain from any part of the mass (in which there can be no more than the 5760th part of a grain of gold) and dissolving it in *aqua fortis*, the gold will fall to the bottom. 2. The gold-beaters can extend a grain of gold into a leaf containing 50 square inches; and this leaf may be divided in 500000 parts. For an inch in length can be divided into 100 parts, every one of which will be visible to the bare eye; consequently a square inch can be divided into 10000 parts, and 50 square inches into 500000. And if one of these parts be viewed with a microscope that magnifies the diameter of an object only ten times, it will magnify the area 100 times; and then the 100th part of a 500000th part of a grain (that is, the 50 millionth part) will be visible. Such leaves are commonly used in gilding; and they are so very thin that if 124500 of them were laid upon one another, and pressed together, they would not exceed one inch in thickness.

Yet all this is nothing in comparison of lengths that nature goes in the division of matter. For Mr. Leewenhoek tells us, that there are more animals in the milt of a single cod fish, than there are men upon the whole earth: and that, by comparing these animals in a microscope with grains of common sand, it appeared that one single grain is bigger than four millions of them. Now each animal must have a heart, arteries, veins, muscles and nerves, otherwise they could neither live nor move. How inconceivably small then must the particles of their blood be, to circulate through the smallest ramifications and joinings of their arteries and veins! It has been found, by calculation, that a particle of their blood must be as much smaller than a globe of the tenth part of an inch in diameter, as that globe is smaller than the whole earth; and yet, if these particles be compared with the particles of light, they will be found to exceed them as much in bulk as mountains do single grains of sand. For, the force of any body striking against an obstacle is directly in proportion to its quantity of matter multiplied into its velocity: and since the velocity of the particles of light is demonstrated to be at least a million times greater than the

MECHANICS.

Velocity of a cannon-ball, it is plain, that if a million of these particles were as big as a single grain of sand, we durst no more open our eyes to the light, than we durst expose them to sand shot point-blank from a cannon.

Another property of (or it may be an attendant on) matter, is *attraction*. This seems rather to be infused, or present with, than inherent in matter. Of this there are four kinds, viz. *cohesion*, *gravitation*, *magnetism*, and *electricity*.

The *Attraction of Cohesion* is that by which the small parts of matter are made to stick and cohere together. Of this we have several instances, some of which follow: 1. If two drops of quicksilver are placed near each other, they will run together and become one large drop. 2. If two polished plates of marble or brass be put together, with a little oil between them to fill up the pores in their surfaces, and prevent the lodgment of any air, they will cohere so strongly, even if suspended in an exhausted receiver, that the weight of the lower plate will not be able to separate it from the upper one. In putting these plates together, the one should be rubbed upon the other, as a joiner does two pieces of wood when he glues them. 3. If two pieces of cork, equal in weight, are put near each other in a basin of water, they will move equally fast toward each other with an accelerated motion, until they meet: and then, if either of them is moved, it will draw the other after it. If two corks of unequal weights are placed near each other, they will approach with accelerated velocities inversely proportionate to their weights: that is, the lighter cork will move as much faster than the heavier, as the heavier exceeds the lighter in weight. This shews, that the attraction of each cork is in direct proportion to its weight or quantity of matter. This kind of attraction reaches but to a very small distance; for if two drops of quicksilver are rolled in dust, they will not run together, because the particles of dust keep them out of the sphere of each others attraction. When the sphere of attraction ends, a *repulsive force* begins: thus, water repels most bodies till they are wet; and hence it is that a small needle, if dry, swims without being impeded in its course, by the obstruction of any repulsive force. If a ball of light wood is dipt in oil, and then put into water, the water will recede so as to form a channel of some depth all around the ball.

Attraction of Gravitation is that power by which distant bodies tend towards one another. Of this we have daily instances in the falling of bodies to the earth. By this power in the earth it is, that bodies, on whatever side, fall in lines perpendicular to its surface; and, consequently, on opposite sides, they fall in opposite directions, towards the centre: and by this power it is that bodies on the earth's surface are kept to it on all sides, so that they cannot fall from it. And as it acts upon all bodies in proportion to their respective quantities of matter, without any regard to their bulks or figures, it accordingly constitutes their weight.

As the attraction of any large body, this earth, for instance, consists of the united attractions of all its parts; it thence follows, that if a body descends from the surface towards the centre of the earth, it would continually become lighter and lighter, the parts above attracting it, as well as those below; in which case it is demonstrated, by mathematicians, that the gravity would decrease in the same proportion with the distance from the centre.

The force or power of gravity, is as the quantity of matter; for, as every particle of matter has its proper gravity, the effect of the whole must be in proportion to the number of the attracting particles; that is, as the quantity of matter in the whole body. Gravity, like all other emanations which proceed or issue from a centre, decreases as the square of the distance increases, that is, a body at twice the distance of another, attracts with only a fourth part of the force; at thrice the distance, with a ninth part; at four times the distance, with a sixteenth part; and so on.

Besides the universal properties above-mentioned, there are bodies which have properties peculiar to themselves; such as the loadstone, in which the most remarkable are these: 1. It attracts iron and steel only. 2. It consequently turns one of its sides to the north and another to the south, when suspended by a thread that does not twist. 3. It communicates all its properties to a piece of steel, when rubbed upon it, without losing any itself. See **MAGNETISM**.

Several bodies, particularly amber, glass, jet, sealing wax, agate, and almost all precious stones, have a peculiar property of attracting and repelling light bodies when heated by rubbing. This is called *electrical attraction*. See **ELECTRICITY**.

SECT. II.

GENERAL LAWS OF MOTION.

DEFINITION I. *Body*, in mechanics, is the mass or quantity of matter in motion, or to be put in motion, or acted on. A body that yields to a stroke, and recovers its figure again, is called an elastic body; and one that will not do so is named a non-elastic body.

II. *Density*, is the proportion of the quantity of matter in any body to the quantity of matter in another body of the same size or bigness.

III. *Force*, is a power exerted on a body to move it. If it acts

instantaneously, it is called *percussion* or *impulse*. If constantly, it is an accelerated force.

IV. *Velocity* is a property of motion, by which it passes over a certain space in a certain time, and is greater or less, according as it passes over a greater or less space in a given time.

V. *Motion* is the continual or successive change of place. If a body moves equally, it is called *equable* or *uniform motion*. If it increases or decreases, it is called *accelerated* or *retarded motion*. When it is compared with some body at rest, it is called *absolute motion*. But when compared with other bodies in motion, it is called *relative motion*.

VI. *Direction of Motion*, is the course or way to which the body extends, or the line it moves in.

VII. *Quantity of Motion*, is the motion which a body has, considered both in regard to its velocity and quantity of matter. This is also called the momentum of a body.

VIII. *Vis inertiae* is the innate force of matter, by which it resists any change, striving to preserve its present state of rest or motion.

IX. *Gravity* is the force wherewith a body endeavours to fall downwards. It is called *absolute gravity* in empty space, and *relative gravity* when immersed in a fluid.

X. *Specific Gravity* is a greater or lesser weight of bodies of the same magnitude; or it is the proportion between their weights. This proceeds from the natural density of bodies. See a Table of the specific Gravities of Bodies, with the methods of determining the same, in our System of **HYDROSTATICS**.

XI. *Centre of Gravity* is that point within a body, from which if it be suspended, it will remain at rest in any given position.

XII. *Centre of Motion* is a fixed point about which a body moves, and the axis of motion is a fixed line which it moves about.

XIII. *Power* and *Weight*, when opposed to one another, signify the body that moves another, and the moved body respectively, viz. the body which communicates motion is the Power, and that which receives it is the weight.

XIV. *Equilibrium* is the balance of two or more forces, so as to remain at rest.

XV. *Stress* is the effect which any force has to break a beam or other body; and *strength* is the resistance which a body is capable of making against any straining force.

XVI. *Friction* is the resistance which a machine suffers by the parts rubbing against one another.

POSTULATA.

1st. It must be granted that a small part of the surface of the earth may be looked upon as a plane. For such a small part of it as we have here occasion to consider does not sensibly differ therefrom.

2d. That heavy bodies descend in lines parallel to one another. For though in strictness they tend to a point, viz. the earth's centre, yet it is at such a distance, that, at the earth's surface, those lines do not sensibly differ from parallel lines.

3d. The same body is of the same weight in all places on or near the earth's surface. For the difference is not sensible.

4th. For the ease of calculation, it is supposed that all bodies are perfectly smooth; all planes perfectly even; all bodies or machines to move without friction; all lines straight and inflexible, without weight or thickness; cords extremely pliable, and so on. Allowances for friction must be made more from experiments than any actual theory.

FUNDAMENTAL AXIOMS, OR LAWS OF MOTION.

1st. Every body endeavours to remain in its present state, whether it be at rest, or moving uniformly in a right line. Hence, if a body moved forward in vacuo, or empty space, so that it meets with no resistance, it would move on uniformly for ever without change of velocity.

2d. The alteration of motion, by any external force, is always proportional to that force, and is made in the direction of the right line, in which the force acts.

3d. To every action, there is always opposed an equal reaction, or the mutual actions of two bodies upon each other are always equal and directed to contrary parts. For whatever draws or presses another, is as much drawn or pressed by that other. If you press a stone with your finger, the finger is also pressed by the stone. If a body impinge upon another, and by its force change the motion of the other, that body also, because of the equality of mutual pressure, will undergo an equal change in its own motion, towards the contrary part. The changes made by those actions are equal, not in the velocities, but in the motions of bodies; and therefore since the motions are equally changed, the changes of the velocities made towards contrary parts, are reciprocally proportional to the bodies.

But though this Law of Motion of Sir Isaac Newton is sufficiently evident to an intelligent mind, it has been cavilled at by many; and many, through an unaccountable ignorance in the comprehension of this one Maxim, have attempted to subvert even his whole System of Philosophy, and have gained proselytes among the lower class of readers. But since, as it has been repeatedly shewn by the learned, that the objectors have never advanced any thing but empty notion, resulting from a dull comprehension, the truth of this axiom will remain, and continue to the honour of its renowned author, as long as things and time endure.

To

MECHANICS.

To these three grand axioms may be added the following:

- 4th. The motion of any body is made up of the sum of the motions of all the parts.
- 5th. The weights of all bodies in the same place are proportional to the quantities of matter they contain.
- 6th. The vis inertiae of any body is proportional to the quantity of matter.
- 7th. Every body will descend to the lowest place it can get to.
- 8th. Two equal forces, acting against one another in contrary directions, destroy one another's effects. And unequal forces act only with the difference of them.
- 9th. When a body is kept in equilibrio, the contrary forces in any line of direction are equal.
- 10th. If a certain force generate any motion, an equal force, acting in a contrary direction, will destroy as much motion in the same time.
- 11th. If a body is drawn by a rope, all the parts of the rope are equally stretched: and the force in any part acts in direction of that part; and it is the same thing whether the rope is drawn out at length, or passes over several pulleys. See the Articles MOTION, PENDULUMS, and Section IV. of this System.

SECT. III. MECHANICAL POWERS.

The Foundation of all Mechanics. If we consider bodies in motion, and compare them together, we may do this either with respect to the quantities of matter they contain, or the velocities with which they are moved. The heavier any body is, the greater is the power required either to move it or to stop its motion; and again, the swifter it moves the greater is its force. So that the whole momentum or quantity of force of a moving body is the result of its quantity of matter multiplied by the velocity with which it is moved. And when the products arising from the multiplication of the particular quantities of matter in any two bodies by their respective velocities are equal, the momenta or entire forces are so too. Thus, suppose a body, which we shall call *A*, to weigh 40 pounds, and to move at the rate of 2 miles in a minute; and another body, which we shall call *B*, to weigh only four pounds, and to move twenty miles in a minute; the entire forces with which these two bodies would strike against any obstacle should be equal to each other, and therefore it would require equal powers to stop them. For 40 multiplied by 2 gives 80, the force of the body *A*; and 20 multiplied by 4 gives 80, the force of the body *B*.

Upon this easy principle depends the whole of mechanics; and it holds universally true, that when two bodies are suspended by any machine, so as to act contrary to each other, if the machine be put into motion, and the perpendicular ascent of one body multiplied into its weight be equal to the perpendicular descent of the other body multiplied into its weight, these bodies, how unequal soever in their weights, will balance one another in all situations: for, as the whole ascent of one is performed in the same time with the whole descent of the other, their respective velocities must be directly as the spaces they move through: and the excess of weight in one body is compensated by the excess of velocity in the other.

Upon this principle it is easy to compute the power of any mechanical engine whether simple or compound; for it is but only inquiring how much swifter the power moves than the weight does (i. e. how much farther in the same time), and just so much is the power increased by the help of the engine.

The Mechanical Powers. The simple machines, usually called mechanical powers, are six in number, viz. the lever, the wheel and axle, the pulley, the inclined plane, the wedge, and the screw. They are called mechanical powers; because they help us to raise weights, move heavy bodies, and overcome resistances, which we could not effect without them.

1. A lever is a bar of iron or wood, one part of which being supported by a prop, all the other parts turn upon that prop as their centre of motion: and the velocity of every part or point is directly as its distance from the prop. Therefore, when the weight to be raised at one end is to the power applied at the other to raise it, as the distance of the power from the prop is to the distance of the weight from the prop, the power and weight will exactly balance or counterpoise each other: and as a common lever has but very little friction on its prop, a very little additional power will be sufficient to raise the weight.

There are four kinds of levers. 1. The common sort, where the prop is placed between the weight and the power; but much nearer to the weight than the power. 2. When the prop is at one end of the lever, the power at the other, and the weight between them. 3. When the prop is at one end, the weight at the other, and the power applied between them. 4. The bended lever, which differs only in form from the first sort, but not in property. Those of the first or second kind are often used in mechanical engines; but there are few instances in which the third sort is used.

A common balance is a lever of the first kind; but as both its ends are at equal distances from its centre of motion, they move with

equal velocities; and therefore, as it gives no mechanical advantage, it cannot properly be reckoned among the mechanical powers.

A lever of the first kind is represented by the bar *ABC*, fig. 13, Plate II. supported by the prop under *B*. Its principal use is to loosen large stones in the ground, or raise great weights to small heights, in order to have ropes put under them for raising them higher by other machines. The parts *AB*, and *BC*, on different ends of the prop, are called the arms of the lever; the end *A* of the shorter arm *AB* being applied to the weight intended to be raised, or to the resistance to be overcome; and the power applied to the end *C* of the longer arm *BC*.

In making experiments with this machine, the shorter arm *AB* must be as much thicker than the longer arm *C*, as will be sufficient to balance it on the prop. This supposed, let *P* represent a power whose intensity is equal to 1 ounce, and *W* a weight whose intensity is equal to 12 ounces. Then, if the power be 12 times as far from the prop as the weight is, they will exactly counterpoise; and a small addition to the power *P* will cause it to descend, and raise the weight *W*; and the velocity with which the power descends will be to the velocity with which the weight rises, as 12 to 1: that is, directly as their distances from the prop; and consequently, as the spaces through which they move. Hence, it is plain, that a man who, by his natural strength, without the help of any machine, could support 100 weight, will, by the help of this lever be enabled to support 1200. If the weight be less, or the power greater, the prop may be placed so much farther from the weight; and then it can be raised to a proportionably greater height. For universally, if the intensity of the weight multiplied into its distance from the prop be equal to the intensity of the power multiplied into its distance from the prop, the power and weight will exactly balance each other, and a little addition to the power will raise the weight. Thus, in the present instance, the weight *W* is 12 ounces, and its distance from the prop is 1 inch; and 12 multiplied by 1 is 12; the power *P* is equal to 1 ounce, and its distance from the prop is 12 inches, which multiplied by 1 is 12 again; and therefore there is an equilibrium between them. So, if a power equal to 2 ounces be applied at the distance of 6 inches from the prop, it will just balance the weight *W*; for 6 multiplied by 2 is 12, as before. And a power equal to 3 ounces placed at 4 inches distance from the prop would be the same; for 3 times 4 is twelve; and so on, in proportion.

The *Statera*, or Roman *steelyard*, is a level of this kind, contrived for finding the weights of different bodies by one single weight placed at different distances from the prop or centre of motion *D*, Fig. I. Plate III. For, if a scale hangs at *A*, the extremity of the shorter arm *AB*, and is of such a weight as will exactly counterpoise the longer arm *BC*; if this arm be divided into as many equal parts as it will contain, each equal to *AB*, the single weight *I* (which we may suppose to be 1 pound) will serve for weighing any thing as heavy as itself, or as many times heavier as there are divisions in the arm *BC*, or any quantity between its own weight and that quantity. As for example, if *I* be 1 pound, and placed at the first division 1 in the arm *BC*, it will balance 1 pound in the scale at *A*: if it be removed to the second division at 2, it will balance 2 pounds in the scale: if to the third, 3 pounds; and so on to the end of the arm *BC*. If each of these integral divisions be subdivided into as many equal parts as a pound contains ounces, and the weight *I* placed at any of these subdivisions, so as to counterpoise what is in the scale, the pounds and odd ounces therein are by that means ascertained.

To this kind of lever may be reduced several sorts of instruments, such as scissars, pinchers, snuffers: which are made of levers acting contrary to one another: their prop or centre of motion being the pin which keeps them together.

In common practice, the longer arm of this lever greatly exceeds the weight of the shorter; which gains great advantage, because it adds so much to the power.

A lever of the second kind has the weight between the prop and the power. In this, as well as the former, the advantage gained is as the distance of the power from the prop to the distance of the weight from the prop: for the respective velocities of the power and weight are in that proportion; and they will balance each other when the intensity of the power, multiplied by its distance from the prop, is equal to the intensity of the weight multiplied by its distance from the prop. Thus, if *AB*, Fig. 12, Plate II. be a lever on which the weight *W* of 6 ounces hangs at the distance of 1 inch from the prop *G*, and a power *P* equal to the weight of 1 ounce hangs at the end *B*, 6 inches from the prop, by the cord *CD* going over the fixed pulley *E*, the power will just support the weight: and a small addition to the power will raise the weight 1 inch for every 6 inches that the power descends.

This lever shews the reason why two men, carrying a burden upon a stick between them, bear unequal shares of the burden in the inverse proportion of their distances from it. For it is well known, that the nearer any of them is to the burden, the greater share he bears of it: and if he goes directly under it, he bears the whole. So if one man be at *G*, and the other at *P*, having the pole or stick *AB* resting on their shoulders; if the burden or weight *W* be placed five times as near the man at *G*, as it is to the man at *P*, the former will bear five times as much weight as the latter.

This

M E C H A N I C S.

This is likewise applicable to the case of two horses of unequal strength, to be so yoked, as that each horse may draw a part proportionable to his strength; which is done by dividing the beam so, that the point of traction may be as much nearer to the stronger horse than to the weaker, as the strength of the former exceeds that of the latter.

To this kind of lever may be reduced oars, rudders of ships, doors turning upon hinges, cutting-knives which are fixed at the point of the blade, and the like.

If in this lever we suppose the power and weight to change places, so that the power may be between the weight and the prop, it will become a lever of the third kind: in which, that there may be a balance between the power and the weight, the intensity of the power must exceed the intensity of the weight just as much as the distance of the weight from the prop exceeds the distance of the power from it. Thus, let *E*, *fig. 11*, Plate II. be the prop of the lever *AB*, and *W* a weight of 1 pound, placed three times as far from the prop, as the power *P* acts at *F*, by the cord *C* going over the fixed pulley *D*; in this case, the power must be equal to three pounds, in order to support the weight.

To this sort of lever are generally referred the bones of a man's arm: for when we lift a weight by the hand, the muscle that exerts its force to raise that weight, is fixed to the bone about one tenth part as far below the elbow as the hand is. And the elbow being the centre, round which the lower part of the arm turns, the muscle must therefore exert a force ten times as great as the weight that is raised.

As this kind of lever is a disadvantage to the moving power, it is never used but in cases of necessity; such as that of a ladder, which, being fixed at one end, is by the strength of a man's arms reared against a wall. And in clock-work, where all the wheels may be reckoned levers of this kind, because the power that moves every wheel, except the first, acts upon it near the centre of motion by means of a small pinion, and the resistance it has to overcome acts against the teeth round its circumference.

The fourth kind of lever differs nothing from the first, but in being bended for the sake of convenience. *B*, *fig. 9*, Plate II. is a lever of this sort, bended at the part above *W*, which is its prop, or centre of motion. *P* is a power acting upon the longer arm *B* by means of a cord going over the pulley; and *W* is a weight of resistance acting upon the end of the shorter arm. If the power *P* be to the weight *W* as the bar above *W* is to *B*, they are in *equilibrium*. Thus, suppose *W* to be 5 pounds acting at the distance of one foot from the centre of motion above the pedestal, and *P* to be 1 pound acting at *B* five feet from the centre above the pedestal, the power and weight will just balance each other. A hammer drawing a nail is a lever of this sort.

2. The second mechanical power is the *wheel and axle*, in which the power is applied to the circumference of the wheel, and the weight is raised by a rope which coils about the axle as the wheel is turned round. Here it is plain, that the velocity of the power must be to the velocity of the weight, as the circumference of the wheel is to the circumference of the axle: and consequently, the power and weight will balance each other, when the intensity of the power is to the intensity of the weight as the circumference of the axle is to the circumference of the wheel. Let *AB*, *Fig. 2*, Plate III. represent a wheel, *CD* its axle, and suppose the circumference of the wheel to be 8 times as great as the circumference of the axle; then a power *P* equal to 1 pound hanging by the cord *I*, which goes round the wheel, will balance a weight *W* of 8 pounds hanging by the rope *K*, which goes round the axle. And as the friction on the pivots or gudgeons of the axle is but small, a small addition to the power will cause it to descend, and raise the weight: but the weight will rise with only an eighth part of the velocity wherewith the power descends, and consequently through no more than an eighth part of an equal space, in the same time. If the wheel be pulled round by the handles *S*, *S*, the power will be increased in proportion to their length. And by this means, any weight may be raised as high as the operator pleases.

To this sort of engine belongs all cranes for raising great weights; and in this case, the wheel may have cogs all round it instead of handles, and a small lantern or trundle may be made to work in the cogs, and be turned by a winch; which will make the power of the engine to exceed the power of the man who works it, as much as the number of revolutions of the winch exceeds those of the axle *D*, when multiplied by the excess of the length of the winch above the length of the semidiameter of the axle, added to the semidiameter or half thickness of the rope *K*, by which the weight is drawn up. Thus, suppose the diameter of the rope and axle taken together to be 12 inches, and consequently half their diameters to be 6 inches; so that the weight *W* will hang at 6 inches perpendicular distance from below the centre of the axle; and let us suppose the wheel *AB*, which is fixed on the axle, to have 80 cogs, and to be turned by means of a winch 6 inches long, fixed on the axis of a trundle of 8 staves or rounds, working in the cogs of the wheel. It is plain, that the winch and trundle would make 10 revolutions for one of the wheel *AB*, and its axis *D*, on which the rope *K* winds in raising the weight *W*; and the winch being no longer than the sum of the semidiameters of the great axle and rope, the trundle could have no more power on the wheel

than a man could have by pulling it round by the edge, because the winch would have no greater velocity than the edge of the wheel has, which we here suppose to be ten times as great as the velocity of the rising weight: so that in this case the power gained would be as 10 to 1. But if the length of the winch be 12 inches, the power gained would be as 20 to 1: if 18 inches (which is long enough for any man to work by), the power gained would be as 30 to 1; that is, a man could raise 30 times as much by such an engine, as he could by his natural strength without it, because the velocity of the handle of the winch would be 30 times as great as the velocity of the rising weight; the absolute force of any engine being in proportion of the velocity of the power to the velocity of the weight raised by it. But then, just as much power or advantage is gained by the engine, so much time is lost in working it. In this sort of machines it is requisite to have a ratchet-wheel *G* on one end of the axle, with a catch *H* to fall into its teeth; which will at any time support the weight, and keep it from descending, if the workman should, through inadvertency or carelessness, quit his hold whilst the weight is raising. And by this means, the danger is prevented which might otherwise happen by the running down of the weight when left at liberty.

3. The pulley. The third mechanical power or engine consists either of one *moveable pulley* or a *system of pulleys*; some in a block or case, which is fixed, and others in a block which is moveable and rises with the weight. For though a single pulley that only turns on its axis, and rises not without the weight, may serve to change the direction of the power, yet it can give no mechanical advantage thereto; but is only as a beam of a balance, whose arms are of equal length and weight. Thus, if the equal weights *W* and *P* hang by the cords upon the pulleys whose block is fixed to a beam, they will counterpoise each other, just in the same manner as if the cord were cut in the middle, and its two ends hung upon the hooks fixed in the pulley at equal distances from its centre.

But if a weight *W* hangs at the lower end of the moveable block of the pulley above the weight *W*, *Fig. 3*, Plate II. and the cord goes under the pulley to the wheel above, it is plain that the half of the cord bears one half the weight, and the other half the other; for they bear the whole between them. Therefore, whatever holds the upper end of either rope, sustains one half of the weight: and if the cord which adheres to the weight *P* be drawn up so as to raise the pulley to the wheel, the cord will then be extended to its whole length, all but that part which goes under the pulley; and, consequently, the power that draws the cord will have moved twice as far as the pulley with its weight *W*; on which account, a power whose intensity is equal to one half of the weight will be able to support it, because if the power moves (by means of a small addition) its velocity will be double the velocity of the weight; as may be seen by putting the cord over the wheel (which only changes the direction of the power, without giving any advantage to it), and hanging on the weight *P*, which is equal only to one half of the weight *W*; in which case there will be an equilibrium, and a little addition to *P* will cause it to descend, and raise *W* through a space equal to one half of that through which *P* descends. Hence the advantage gained will be always equal to twice the number of pulleys in the moveable or undermost block. So that, when the upper or fixed block, *Fig. 4*, Plate III. contains two pulleys, which only turn on their axes, and the lower or moveable block *U* contains two pulleys, which not only turn upon their axes, but also rise with the block and weight; the advantage gained by this is as 4 to the working power. Thus, if one end of the rope *KMOQ* be fixed to a hook at *I*, and the rope passed over the pulleys *N* and *R*, and under the pulleys *L* and *P*, and has a weight *T*, of one pound, hung to its other end at *T*, this weight will balance and support a weight *W* of four pounds hanging by a hook at the moveable block *U*, allowing the said block as a part of the weight. And if as much more power be added, as is sufficient to overcome the friction of the pulleys, the power will descend with four times as much velocity as the weight rises, and consequently through four times as much space.

Fig. 7, Plate II. The two pulleys in the fixed block above, and the moveable block below, are in the same case with those last mentioned; and those in the lower block give the same advantage to the power.

As a system of pulleys has no great weight, and lies in a small compass, it is easily carried about; and can be applied, in a great many cases, for raising weights, where other engines cannot. But they have a great deal of friction on three accounts: 1. Because the diameters of their axes bear a very considerable proportion to their own diameters: 2. Because in working they are apt to rub against one another, or against the sides of the block: 3. Because of the stiffness of the rope that goes over and under them.

The common method of arranging pulleys in their blocks, may be reduced to two. The first consists in placing them one by the side of another, upon the same pin; the other, in placing them directly under one another, upon separate pins. Each of these methods is liable to inconvenience. Mr. Smeaton, in order to avoid the impediments to which these combinations are subject, proposes to combine these two methods in one. Accordingly, the pulleys, as in *Fig. 2*, Plate II. are placed in each block in two tiers; several being upon the same pin as in the first method, and

every

MECHANICS.

every one having another under it as in the second; and so that, when the tackle is in use, the two tiers that are the remotest from one another, are so much larger in diameter than those that are nearest, as to allow the lines of the former to go over the lines of the latter without rubbing. From this construction arises a new method of reeving the line upon the shieves: for here, whatever be the number of shieves, the fall of the tackle will be always upon the middle shieve, or on that next to the middle, according as the number of pulleys in each pin is odd or even. To do this, the line is fixed to some convenient part of the upper block, and brought round the middle shieve of the larger tier of the under block; from thence round one of the same sort next the centre one of the other block; and so on, till the line comes to the outside shieve, where the last line of the larger tier falls upon the first shieve of the smaller; and being reeved round those, till it comes at the opposite side, the line from the last shieve of the smaller tier again rises to the first of the larger, whence it is conducted round, till it ends on the middle shieve of the upper block on the larger tier.

Multiplying Pulleys, or pulleys that act one upon another, are exceedingly advantageous in mechanics. In Plate II. Fig. 5, we have a representation of pulleys of this kind: that pulley over which the rope passes to the power or weight P, is a fixed pulley, the other five are moveable, but each having one end of that rope which passes under them, fixed to the beam. In this construction, if the weight, W, be fixed to the lowest pulley, it will only require half the power at P, to raise or sustain it, that it would do if fixed to the pulley next above it; and when fixed at that next pulley, it will only require half the power or weight at P, to sustain it, that it would do if fixed at the next higher pulley, and so on. Thus, if a weight of 32lb. be fixed to the hook of the first or uppermost moving pulley, then a power or weight equal to 16lb. at P, will sustain it, or keep the whole in equilibrio. If the weight be fixed to the next lower pulley, a power at P, at 8lb. will counterbalance it; if fixed to the next below that, a power at P, equal to 4lb. will be sufficient; if the weight be fixed to the 4th moving pulley, then the requisite weight at P will be only 2lb.; and if the weight W, of 32lb. be fixed at the lowest pulley, then 1lb. at P, will sustain it, and the least imaginable increase of power or weight at P, will actually raise the weight W. Hence by increasing the number of such pulleys, the greatest weights at W, may be raised by the smallest power at P, each additional pulley increasing the power in a duplicate ratio.

The next subject that claims our attention, is the Patent Concentric Pulley, invented by Mr. James White, and applied with great success to the raising heavy weights by the application of a small power, as well as to those purposes that may be termed *negative*; where a considerable weight with a slow motion is employed to produce a quicker and less intense one; as in the case of roasting jacks or other machines, of which weight is the motive principle. We are favoured with the following description of it from the inventor.

"Fig. 1. is a front view of the concentric pulley, accompanied with a section for its better explanation. The letters O, P, indicate two frames, containing each a single pulley, revolving on a pin pointed out by the dotted lines Q and R in the figure. Each of these pulleys has six grooves in it of diameters proportionate to the quantity of line they involve from their relative situations in the System. For, supposing each of the grooves a distinct pulley, and their diameters all equal: it is evident that, if the weight 144 were to be raised, by pulling at S, till the pulleys touched each other; the first pulley, or R, must receive that length of line as many times told as there are parts of the line hanging between it and the lower pulley. Now, in this case, there are twelve parts of the same line, formed by its revolving about six upper and six lower pulleys or grooves. Therefore, as much line must pass over the first pulley R, as is equal to twelve times the distance of the two pulleys; but, from a mere view of the figure, the second pulley (which is the first in the lower frame and marked Q,) cannot receive, or conduct, so much line as the former, by what is equal to the distance between them. In like manner the third pulley (which is the second in the upper frame) involves less than the last mentioned; and so on, in a retrograde progression, to the last pulley; which only receives one-twelfth part of the whole. For this takes its share of line n , from a fixed point in the upper frame that gives it nothing: whereas all the others, in the same frame, receive their line, as it were, partly by going to fetch it, and partly by the line coming to meet the pulley: both which motions will be easily noticed, though in different degrees, at all the other pulleys, if attended to by a diligent observer.

"Now, on the supposition that these pulleys are equal in size, and free to move as determined by the line passing about them, it appears evident from the nature of the System (and is daily proved in the use of the common pulley) that the number of their revolutions, and consequently their velocities, must be in proportion to the number of suspending parts that are between the fixed point abovementioned, and each pulley respectively. Thus R would go 12 times round, while the pulley under which the part n of the line passed, if equal to it, would revolve once only: and the intermediate time and velocities would be members of the same series of arithmetical progressions; of which, if the first number were 1,

N^o 100.

the last term would be always equal to the whole number of terms.

"Since then the evolutions of equal and distinct pulleys are measured by their velocities, and that it is possible to find any proportion of velocity on a single body, running on a centre; viz. by searching proportionate distances from such centre, it follows, that if the diameters of certain grooves in the same substance, be exactly adapted to the above series, (supposing the line inelastic and of no magnitude) the necessity of using several pulleys in each frame will vanish, and with it some of those difficulties to which, it must be owned, this useful machine is still liable.

"These were the ideas that suggested this improvement, and produced the pulley represented in Fig. 1. Plate II. where, again, O, P, are the frames; Q, R, are pulleys, and a, b, c , up to n , the coils of line by which the weight is supported; a is the line of fraction, commonly called the fall, which passes over and under the proper grooves, in the order the letters indicate, till it is fastened to the upper frame just above n . The grooves however in practice are not nor can be arithmetical progressions; for the diameter of the line or rope employed, must in all cases be deducted from each term; without which the smaller grooves, to which the said diameter bears a greater proportion than to the larger ones, will tend to rise and fall faster than the larger, and thus introduce confusion and worse defects than those the invention is intended to obviate.

"The section annexed to the former figure shows the method of turning the groove and hollowing the back of the pulley, in order to obtain lightness and save materials. It is needless here to insist on the advantages attending these pulleys, or to attempt a further description of the principle which I suppose is now well understood. Suffice it to say, that lateral friction, and a shaking motion, which so much affect the common pulley, are quite done away in this case by the length of bearing. And lest this circumstance should offer an idea of weakness, I would observe that to have pins for the pulleys to run on, is not the only, nor perhaps the best method; but that I sometimes use centres fixed to the pulleys, and revolving on a very short bearing in the side of the frame, by which strength is increased, and friction very much diminished; for, to the last moment, the motion of the pulley is perfectly circular; and this very circumstance is the cause of its not wearing out the centre as soon as it would, assisted by the ever increasing irregularities of a gullied bearing.

"I shall only add that these pulleys, when well executed, apply to roasting jacks and other machines of that nature, with peculiar advantage, both as to the time of going, and their own durability, and that it is possible to produce a system of such pulleys, of six or eight parts only, and adapted to the pockets, that shall raise upwards of an hundred weight by means of a skain of sewing silk, or a clew of common thread."

[We cannot but consider this Pulley as a great improvement in Mechanics, and of the highest utility; at the same time we cordially embrace this opportunity of informing the public, that the very ingenious Inventor and Patentee, applies in the most unexpensive and simple methods, the principles of Mechanics to many useful purposes in the arts and commerce; by which considerable savings and convenience will accrue to the purchasers; having long devoted to a knowledge of these subjects, the utmost efforts of a mind evidently formed for the successful pursuit of such studies.]

4. **The Inclined Plane.** The fourth mechanical power is the inclined plane; and the advantage gained by it is as great as its length exceeds its perpendicular height. Let AB, Fig. 5, Plate III. be a plane parallel to the horizon, and CD a plane inclined to it; and suppose the whole length CD to be three times as great as the perpendicular height GF: in this case, the cylinder E will be supported upon the plane CD, and kept from rolling down upon it, by a power equal to a third part of the weight of the cylinder. Therefore, a weight may be rolled up this inclined plane with a third part of the power which would be sufficient to draw it up by the side of an upright wall. If the plane was four times as long as high, a fourth part of the power would be sufficient; and so on in proportion. Or, if a pillar was to be raised from a floor to the height GF, by means of the engine ABDC, (which would then act as a half wedge, where the resistance gives way only on one side) the engine and pillar would be in *equilibrium* when the power applied at GF was to the weight of the pillar as GF to GD; and if the power be increased, so as to overcome the friction of the engine against the floor and pillar, the engine will be driven, and the pillar raised: and when the engine has moved its whole length upon the floor, the pillar will be raised the whole height of the engine from G to F.

The force wherewith a rolling body descends upon an inclined plane, is to the force of its absolute gravity, by which it would descend perpendicularly in a free space, as the height of its plane is to its length. For, suppose the plane AB, Fig. 6, Plate III. to be parallel to the horizon, the cylinder C will keep at rest upon any part of the plane where it is laid. If the plane be so elevated, that its perpendicular height D is equal to half its length AB, in Fig. 7, Plate III. the cylinder will roll down upon the plane with a force equal to half its weight; for it would require a power (acting in the direction of AB) equal to half its weight, to keep it from rolling. If the plane AB, Fig. 8, Plate III. be elevated, so as to be perpendicular to the horizon, the cylinder C will descend

*

6 R

scend

MECHANICS.

ascend with its whole force of gravity, because the plane contributes nothing to its support or hinderance; and therefore it would require a power equal to its whole weight to keep it from descending.

Let the cylinder C, Fig. 9, Plate III. be made to turn upon slender pivots in the frame D, in which there is a hook, *e*, with a line G tied to it; let this line go over the fixed pulley H, and have its other end tied to the hook in the weight I. If the weight of the body I, be to the weight of the cylinder C, added to that of its frame D, as the perpendicular height of the plane LM is to its length AB, the weight will just support the cylinder upon the plane, and a small touch of a finger will either cause it to ascend or descend with equal ease: then, if a little addition be made to the weight I, it will descend, and draw the cylinder up the plane. In the time that the cylinder moves from A to B, it will rise through the whole height of the plane ML; and the weight will descend from H to K, through a space equal to the whole length of the plane AB.

If the plane be made to move upon rollers or friction-wheels, and the cylinder be supported upon it; the same power will draw the plane under the cylinder, which before drew the cylinder up the plane, provided the pivots of the axes of the friction-wheels be small, and the wheels themselves be pretty large. For let the machine ABC, Fig. 10, Plate III. (equal in length and height to ABM, Fig. 9.) be provided with four wheels, whereof two appear at D and E, and the third under C, whilst the fourth is hid from sight by the horizontal board *a*. Let the cylinder F be laid upon the lower end of the inclined plane CB, and the line G be extended from the frame of the cylinder, about 6 feet parallel to the plane CB; and, in that direction, fixed to a hook in the wall; which will support the cylinder, and keep it from rolling off the plane. Let one end of the line H be tied to a hook at C in the machine, and the other end to a weight K, the same as drew the cylinder up the plane before. If this line be put over the fixed pulley I, the weight K will draw the machine along the horizontal plane L, and under the cylinder F: and when the machine has been drawn the whole length CB, the cylinder will be raised to *d*, equal to the perpendicular height AB, above the horizontal part at A. To the inclined plane may be reduced all hatchets, chisels, and other edge-tools which are chamfered only on one side.

5. *The Wedge.* The fifth mechanical power or engine is the wedge; which may be considered as two equally inclined planes DEF and CEF, Fig. 11, Plate III. joined together at their basis EF; then, DC is the whole thickness of the wedge at its back ABCD, where the power is applied; EF is the depth or height of the wedge; DF the length of one of its sides, equal to CF the length of the other side; and OF is its sharp edge, which is entered into the wood intended to be split by the force of a hammer or mallet striking perpendicularly on its back.

Thus, ABb, Fig. 12, Plate III. is a wedge driven into the cleft CDE of the wood FG. When the wood does not cleave at any distance between the wedge, there will be an equilibrium between the power impelling the wedge downward, and the resistance of the wood acting against the two sides of the wedge; if the power be to the resistance, as half the thickness of the wedge at its back is to the length of either of its sides; that is, as *Aa* to *Ab*, or *Ba* to *Bb*. And if the power be increased, so as to overcome the friction of the wedge, and the resistance arising from the cohesion or stickage of the wood, the wedge will be drove in, and the wood split asunder.

But when the wood cleaves at any distance before the wedge (as it generally does), the power impelling the wedge will not be to the resistance of the wood, as half the thickness of the wedge is to the length of one of its sides, but as half its thickness is to the length of either side of the cleft, estimated from the top or acting part of the wedge. For if we suppose the wedge to be lengthened down from *b* to the bottom of the cleft, at *E*, the same proportion will hold; namely, that the power will be to the resistance, as half the thickness of the wedge is to the length of either of its sides; or, which amounts to the same thing, as the whole thickness of the wedge is to the length of both its sides.

Some writers have advanced, that the power of the wedge is to the resistance to be overcome, as the thickness of the back of the wedge is to the length only of one of its sides; which seems very strange: for, if we suppose AB, Fig. 14, Plate III. to be a strong inflexible bar of wood or iron fixed into the ground at CB, and D and E to be two blocks of marble lying on the ground on opposite sides of the bar; it is evident that the block D may be separated from the bar to the distance *d*, equal to *ab*, by driving the inclined plane or half wedge *abc* down between them; and the block E may be separated to an equal distance on the other side, in like manner, by the half wedge *cde*. But the power impelling each half wedge will be to the resistance of the block against its side, as the thickness of that half wedge is to the length of its acting side. Therefore the power to drive both the half wedges is to both the resistances, as both the half backs is to the length of both the acting sides, or as half the thickness of the whole back is to the length of either side. And if the bar be taken away, the blocks put close together, and the two half wedges joined to make one, it will require as much force to drive it down between the blocks,

as is equal to the sum of the separate powers acting upon the half wedges when the bar was between them.

To confirm this by an experiment, let two cylinders, as Q and R, Fig. 4, Plate II. be drawn towards one another by lines running over fixed pulleys, and a weight of 40 ounces hanging at the lines belonging to each cylinder: and let a wedge of 40 ounces weight, having its back just as thick as either of its sides is long, be put between the cylinders, which will then act against each with a resistance equal to 40 ounces, whilst its own weight endeavours to bring it down and separate them: and here, the power of the wedge's gravity impelling it downwards, will be to the resistance of both the cylinders against the wedge, as the thickness of the wedge is to the length of both its sides; for there will then be an equilibrium between the weight of the wedge and the resistance of the cylinders against it, and it will remain at any height between them; requiring just as much power to push it upward as to pull it downward. If another wedge of equal weight and depth with this, and only half as thick, be put between the cylinders, it will require twice as much weight to be hung at the ends of the lines which draw them together, to keep the wedge from going down between them. That is, a wedge of 40 ounces, whose back is only equal to half the length of one of its sides, will require 80 ounces to each cylinder, to keep it in equilibrium between them: and twice 80 is 160, equal to 4 times 40. So that the power will be always to the resistance, as the thickness of the back of the wedge is to the length, not of its own side, but of both its sides.

The best way for making a wedge with its apparatus for trying experiments, is as follows:

Let WWV be two flat surfaces, each about 15 inches long and three or four in breadth, joined together by a hinge at V; and let a bar go across WW, on which the said surfaces WWV may be open to any angle not more than 60 degrees, and then fixed at the given angle by means of two screws above WW. It will then represent the wedge with its end *x*, which enters the wood, and it will also represent the two sides of the wedge against which the wood acts in cleaving. By means of the bar which goes across above WW, the wedge may be opened so as to adjust the thickness of its back in any proportion to the length of either of its sides; but not to exceed that length: and any weight may be hung to the wedge upon the hook *x*, which weight, together with the weight of the wedge itself, may be considered as the impelling power, which is all the same in experiment whether it be laid upon the back of the wedge to push it down, or hung to its edge to pull it down. Let O, R, be two wooden cylinders, each about two inches thick, where they touch the outsides of the wedge WWV; and let their ends be made like two round flat plates, to keep the wedge from slipping off endwise between them. Let a small cord with a loop on one end of it go over a pivot in the end of the cylinders O and R, and the cords on the right hand of the figure, which adhere to the weight P, belonging to the cylinder O, go over the fixed pulleys *rr*, on the right hand side, and be fastened at their other ends to the bar above the weight on the right hand on which any weight may be hung at pleasure. In the like manner let the cords on the left hand of the figure belonging to the cylinder R, go over the fixed pulleys *rr*, on the same side, to the bar above the weight P, on which a weight may be hung equal to that on the other side. These weights, by drawing the cylinders towards one another, may be considered as the resistances of the wood acting equally against opposite sides of the wedge; the cylinders themselves being suspended near and parallel to each other, by their pivots in the loops on the lines which lead up to I, at the top of the figure, which lines may be fixed to hooks in the ceiling of the room. The longer these lines are, the better; and they should never be less than four feet each. The farther also the pulleys *r, r*, both on the right and left, are from the cylinders O and R, the truer will the experiments be; and they may turn upon pins fixed into the wall.

In this machine, the weights P, P, on both sides, and the weights in centre which hang to *x*, may be varied at pleasure, so as to be adjusted in proportion of the length of the wedge's sides to the thickness of its back: and when they are so adjusted, the wedge will be in *equilibrium* with the resistance of the cylinders.

The wedge is a very great mechanical power, since not only wood, but even rocks can be split by it; which would be impossible to effect by the lever, wheel and axle, or pulley; for the force of the blow, or stroke, shakes the cohering parts, and thereby makes them separate the more easily.

6. *The Screw.* The sixth and last mechanical power is the screw; which cannot properly be called a *simple machine*, because it is never used without the application of a lever or winch to assist in turning it: and then it becomes a compound engine of a very great force, either in pressing the parts of bodies close together, or in raising great weights. It may be conceived to be made by cutting a piece of paper ABC (Fig. 14, Plate III.) into the form of an inclined plane or half wedge, and then coiling it round a cylinder AB (Fig. 15, Plate III.) And here it is evident that the winch E must turn the cylinder once round before the weight of resistance D can be moved from one spiral winding to another, as from *d* to *e*; therefore as much as the circumference of a circle described by

MECHANICS.

the handle of the winch is greater than the interval or distance between the spirals, so much is the force of the screw. Thus supposing the distance between the spirals to be half an inch, and the length of the winch to be 12 inches; the circle described by the handle of the winch where the power acts will be 76 inches nearly, or about 152 half inches, and consequently 152 times as great as the distance between the spirals: and therefore a power at the handle, whose intensity is equal to no more than a single pound, will balance 152 pounds acting against the screw; and as much additional force, as is sufficient to overcome the friction, will raise the 152 pounds; and the velocity of the power will be to the velocity of the weight as 152 to 1. Hence it appears, that the longer the winch be made, and the nearer the spirals are to one another, so much the greater is the force of the screw.

A machine for shewing the force or power of the screw may be contrived in the following manner. Let the wheel C, Fig. 16. Plate III. have a screw *ab* on its axis, working in the teeth of the wheel D, which suppose to be 48 in number. It is plain, that for every time the wheel C and screw *ab* are turned round by the winch A, the wheel D will be moved one tooth by the screw; and therefore, in 48 revolutions of the winch, the wheel D will be turned once round. Then, if the circumference of a circle described by the handle of the winch be equal to the circumference of a groove *e* round the wheel D, the velocity of the handle will be 48 times as great as the velocity of any given point in the groove. Consequently, if a line G (above number 48) goes round the groove *e*, and has a weight of 48 pounds hung to it below the pedestal EF, a power equal to one pound at the handle will balance and support the weight. To prove this by experiment, let the circumferences of the grooves of the wheels C and D, be equal to one another; and then if a weight H of one pound be suspended by a line going round the groove of the wheel C, it will balance a weight of 48 pounds hanging by the line G; and a small addition to the weight H will cause it to descend, and so raise up the other weight.

If the line G, instead of going round the groove *e* of the wheel D, goes round its axis I; the power of the machine will be as much increased, as the circumference of the groove *e* exceeds the circumference of the axle: which, supposing it to be six times, then one pound at H will balance 6 times 48, or 288 pounds hung to the line on the axle: and hence the power or advantage of this machine will be as 288 to one. That is to say, a man who by his natural strength could lift an hundred weight, will be able to raise 288 hundred, or 14 $\frac{1}{2}$ ton weight by this engine.

But the following engine is still more powerful, on account of its having the addition of four pullies: and in it we may look upon all the mechanical powers as combined together, even if we take in the balance. For as the axis D of the bar AB, Fig. 17. Plate III. is in its middle at C, it is plain, that, if equal weights are suspended upon any two pins equidistant from the axis C, they will counterpoise each other. It becomes a lever by hanging a small weight P upon the pin *n*, and a weight as much heavier upon either of the pins *b*, *c*, *d*, *e*, or *f*, as in proportion to the pins being so much nearer the axis. The wheel and axle FG is evident, so is the screw E; which takes in the inclined plane, and with it the half wedge. Part of a cord goes round the axle, the rest under the lower pullies K, *m*, over the upper pullies L, *n*, and then it is tied to a hook at *m*, in the lower or moveable block, on which hangs the weight W.

In this machine, if the wheel F has 30 teeth, it will be turned once round in 30 revolutions of the bar AB, which is fixed on the axis D of the screw E: if the length of the bar is equal to twice the diameter of the wheel, the pins *a* and *n* at the ends of the bar will move 60 times as fast as the teeth of the wheel do; and consequently, one ounce at P, will balance 60 ounces hung upon a tooth at *q* in the horizontal diameter of the wheel. Then, if the diameter of the wheel F is 10 times as great as the diameter of the axle G, the wheel will have 10 times the velocity of the axle; and therefore one ounce P at the end of the lever AC will balance 10 times 60, or 600 ounces hung to the rope H which goes round the axle. Lastly, if four pullies be added, they will make the velocity of the lower block K, and weight W, four times less than the velocity of the axle: and this being the last power in the machine, which is four times as great as that gained by the axle, it makes the whole power of the machine 4 times 600, or 2400. So that a man who could lift 100 weight in his arms by his natural strength, would be able to raise 2400 weight by this engine.

By one or more of these simple powers, all great weights are raised to considerable heights; but in them all, the more they diminish the weight, the more slow they are in their operations, and consequently the more do they retard the workman's dispatch; and universally the more simple they are, the more expeditious. Besides this, their friction or rubbing against each other, greatly diminishes their power. The friction in the balance is least, it is more in the lever, increased in the axle and wheel, yet more in the pulley, but most of all in the screw. In general, in combined engines, upon account of this friction, they will require a third part more of power to move them, than the theory allows. For this reason, therefore, it will for ever be impossible to fulfil the boast of Wilkins, who vaunted that he could pull up an oak by the roots with a single horse hair; for the force requisite to work the ma-

chine in pulling it up, would nearly amount to a third part of the force which the machine exacts. The large capstan and pulley, used in launching a man of war, would in theory do it most effectually. A simple lever, drawn a proper length by the imagination, would do it as well; it would even fulfil the great boast of Archimedes, it would remove the earth itself. The learned often amuse themselves with fancies like these; and it was for this that Cicero called *Archimedes* a trifler.

COMPOUND ENGINES.

A Carriage to go without any other Force than what it receives from the Passengers.—By means of wheels some people have contrived carriages to go without horses, or any other moving power than what was given by the passengers, by the wind, &c. One of these is represented by Fig. 18, Plate III. It is moved by the footman behind it; and the fore-wheels, which act as a rudder, are guided by the person who sits in the carriage.

Between the hind wheels, is placed a box, in which is concealed the machinery that moves the carriage. AA, (Fig. 19, Plate III.) is a small axis fixed into the box. B is a pulley, over which runs a rope, whose two ends are fastened to the ends of the two levers, or treddles CD, whose other ends are fixed in such manner in the piece E, which is joined to the box, that they can easily move up and down. F, F, are two flat pieces of iron that are joined to the treddles, and take the teeth of the two wheels H, H, which are fixed on the same axis with the hind wheels of the carriage I, I.

It is evident, that when the footman behind presses down one of the treddles, suppose C, with his foot, he must bring down one of the pieces of iron F, and consequently turn the wheel H that is next to it, and at the same time, by means of the rope that goes over the pulley, he must raise the other treddle D, together with its piece F, which being thrust down, will turn the other wheel H; and so alternately; and as the great wheels are fixed on the same axis, they must necessarily move at the same time.

It is easy to conceive, that if the end of the treddles next E, instead of being placed behind the carriage, were turned the opposite way, so as to come under the feet of the person who sits in it, he might move it with equal or even with greater facility, than the footman, as it would then be charged with the weight of one person only.

A machine of this kind will afford a salutary recreation in a garden or park, or on any plain ground; but in a rough or deep road must be attended with more pain than pleasure.

OF MILLS AND CRANES.

A common Mill.—In a common breast-mill, Fig. 20, Plate III. where the fall of water may be about ten feet, AA is the great wheel, which is generally about 17 or 18 feet in diameter, reckoned from the outermost edge of any float board at *a*, to that of its opposite float at *b*. To this wheel the water is conveyed through a channel; and by falling upon the wheel turns it round.

On the axis BB of this wheel, and within the mill-house, is a wheel D, about 8 or 9 feet diameter, having 61 cogs, which turn a trundle E, containing ten upright staves or rounds; and when these are the number of cogs and rounds, the trundle will make 6 $\frac{1}{10}$ revolutions for one revolution of the wheel.

The trundle is fixed upon a strong iron axis, called the spindle, the lower end of which turns in a brass foot fixed at F, in the horizontal beam ST, called the *bridge-tree*; and the upper part of the spindle turns in a wooden bush fixed into the nether-millstone which lies upon beams in the floor YY. The top part of the spindle above the bush is square, and goes into a square hole in a strong iron cross *abcd*, (See Fig. 21, Plate III.) called the *rynd*; under which, and close to the bush, is a round piece of thick leather upon the spindle, which it turns round at the same time that it does the rynd.

The rynd is let into grooves in the under surface of the running millstone G (Fig. 20.); and so turns it round in the same time that the trundle E is turned round by the cog-wheel D. This millstone has a large hole quite through its middle, called the *eye of the stone*, through which the middle part of the rynd and upper end of the spindle may be seen; whilst the four ends of the rynd lie hid below the stone in their grooves.

The end T of the bridge-tree TS (which supports the upper millstone G upon the spindle (is fixed into a hole in the wall; and the end S is let into a beam QR, called the *brayer*, whose end R remains fixed in a mortise; and its other end Q hangs by a strong iron rod P, which goes through the floor YY, and has a screw-nut on its top at O; by the turning of which nut, the end Q of the brayer is raised or depressed at pleasure, and consequently the bridge-tree TS and upper millstone. By this means, the upper millstone may be set as close to the under one, or raised as high from it, as the miller pleases. The nearer the millstones are to one another, the finer they grind the corn; and the more remote from one another, the coarser.

The upper millstone G is inclosed in a round box H, which does not touch it any where; and is about an inch distant from its edge all round. On the top of this box stands a frame for holding the hopper, *i k*, to which is hung the shoe, I, by two lines fastened to the hind part of it, fixed upon hooks in the hopper, and by one end of the crook-string K, fastened to the fore part of it at *i*, the other end being twisted round the pin L. As the pin is turned

MECHANICS.

one way, the string draws up the shoe closer to the hopper, and so lessens the aperture between them; and as the pin is turned the other way, it lets down the shoe, and enlarges the aperture.

There is a square hole in the top of the spindle, in which is put the feeder *z*, Fig. 21. This feeder (as the spindle turns round) jogs the shoe *I*, three times in each revolution, and so causes the corn to run constantly down from the hopper *K*, through the shoe, into the eye of the millstone, where it falls upon the top of the rynd, and is, by the motion of the rynd and the leather under it, thrown below the upper stone, and ground between it and the lower one. The violent motion of the stone creates a centrifugal force in the corn going round with it, by which means it gets farther and farther from the centre, as in a spiral, in every revolution until it be thrown quite out; and, being then ground, it falls through a spout *M*, called the *mill eye*, into the trough *N*.

In order to cut and grind the corn, both the upper and under millstones have channels or furrows cut into them, proceeding obliquely from the centre towards the circumference. And these furrows are each cut perpendicularly on one side, and obliquely on the other, into the stone, which gives each furrow a sharp edge; and in the two stones they come as it were against one another, like the edges of a pair of scissars; and so cut the corn, to make it grind the easier when it falls upon the places between the furrows. These are cut the same way in both stones when they lie upon their backs, which makes them run cross-ways to each other when the upper stone is inverted by turning its furrowed surface towards that of the lower. For, if the furrows of both stones lay the same way, a great deal of the corn would be driven onward in the lower furrows: and so come out from between the stones without ever being cut.

A less quantity of water will turn an overshot-mill, where the wheel has buckets instead of float-boards, than a breast-mill, where the fall of the water seldom exceeds half the height *Ab* of the wheel. So that, where there is but a small quantity of water, and a fall great enough for the wheel to lie under it, the bucket, or overshot wheel is always used. But where there is a large body of water, with a little fall, the breast or float board wheel must take place.

Those who recollect what has been said concerning the acceleration of bodies falling freely by the power of gravity acting constantly and uniformly upon them, may perhaps ask, Why should the motion of the wheel be equable, and not accelerated, since the water acts constantly and uniformly upon it? The plain answer is, that the velocity of the wheel can never be so great as the velocity of the water that turns it; for if it should become so great, the power of the water would be quite lost upon the wheel, and then there would be no proper force to overcome the friction of the gears and attrition of the stones. Therefore, the velocity with which the wheel begins to move, will increase no longer than till its momentum or force is balanced by the resistance of the machine; and then the wheel will go on with an equable motion.

A hand-mill. If the cog-wheel *D*, fig. 20, Plate III. be made about 18 inches diameter, with 30 cogs, the trundle as small in proportion, with 10 flaves, and the millstones be each about two feet in diameter, and the whole work be put into a strong frame of wood, as represented in the figure, the engine will be a hand-mill for grinding corn or malt in private families. And then, it may be turned by a winch instead of the wheel *AA*; the millstone making three revolutions for every one of the winch. If a heavy fly be put upon the axle *B*, near the winch, it will help to regulate the motion.

If the cogs of the wheel and rounds of the trundle could be put in as exactly as the teeth are cut in the wheels and pinions of a clock, then the trundle might divide the wheel exactly; that is to say, the trundle might have a given number of revolutions for one of the wheel, without a fraction. But as any exact number is not necessary in mill-work, and the cogs and rounds cannot be set in so truly as to make all the intervals between them equal; a skilful mill-wright will always give the wheel what he calls a *hunting-cog*; that is, one more than what will answer to an exact division of the wheel by the trundle. And then, as every cog comes to the trundle, it will take the next staff or round behind the one which it took in the former revolution: and by that means will wear all the parts of the cogs and rounds which work upon one another equally, and to equal distances from one another, in a little time; and so make a true uniform motion throughout the whole work. Thus, in the above water-mill, the trundle has 10 flaves, and the wheel 61 cogs.

Sometimes, where there is a sufficient quantity of water, the cog-wheel *AA*, Fig. 22, Plate III. turns a large trundle *BB*, on whose axis *C* is fixed the horizontal wheel *D*, with cogs all round its edge, turning two trundles *E* and *F* at the same time; whose axes or spindles *G* and *H* turn two millstones *I* and *K*, upon the fixed slopes *L* and *M*. And when there is not work for them both, either may be made to lie quiet, by taking out one of the flaves of its trundle, and turning the vacant place towards the cog-wheel *D*. And there may be a wheel fixed on the upper end of the great upright axle *C*, for turning a couple of boulting mills; and other work for drawing up the sacks, fanning and cleaning the corn, sharpening of tools, &c.

A Horse-mill. If, instead of the cog-wheel *AA* and trundle *BB*,

horizontal levers be fixed into the axle *C* below the wheel *D*, then horses may be put to these levers for turning the mill: which is often done where water cannot be had for that purpose.

A Wind-mill. The working parts of a wind-mill differ very little from those of a water-mill: only the former is turned by the action of the wind upon four sails, every one of which ought (as is generally believed) to make an angle of $54\frac{1}{2}$ degrees with a plane perpendicular to the axis on which the arms are fixed for carrying them; it being demonstrable, that when the sails are set to such an angle, and the axis turned end-ways toward the wind, the wind has the greatest power upon the sails. But this angle answers only to the case of a vane or sail just beginning to move: for, when the vane has a certain degree of motion, it yields to the wind; and then that angle must be increased to give the wind its full effect.

A crane is an engine by which great weights are raised to certain heights, or let down to certain depths. It consists of wheels, axles, pulleys, ropes, and a gib or gibbet. When the rope *H*, Fig. 23, Plate III. is hooked to the weight *K*, a man turns the winch *A*, on the axis whereof is the trundle *B*, which turns the wheel *C*, on whose axis *D* is the trundle *E*, which turns the wheel *F* with its upright axis *G*, on which the great rope *HH* winds as the wheel turns; and going over a pulley *I*, at the end of the arm *d* of the gib *ccde*, it draws up the heavy burden *K*; which being raised to a proper height, as from a ship to the quay, is then brought over the quay by pulling the wheel *Z* round by the handle *z*, which turns the gib by means of the half wheel *b* fixed on the gib post *cc*, and the strong pinion *a* fixed on the axis of the wheel *Z*. This wheel gives the man that turns it an absolute command over the gib, so as to prevent it from taking any unlucky swing, such as often happens when it is only guided by a rope tied to its arm *d*; and people are frequently hurt, sometimes killed, by such accident.

The great rope goes between two upright rollers *i* and *k*, which turn upon gudgeons in the fixed beams *f* and *g*; and as the gib is turned towards either side, the rope bends upon the roller next that side. Were it not for these rollers, the gib would be quite unmanageable; for the moment it were turned ever so little towards any side, the weight *k* would begin to descend, because the rope would be shortened between the pulley *I*, and axis *G*; and so the gib would be pulled violently to that side, and either be broken to pieces, or break every thing that came in its way. These rollers must be placed so, that the sides of them, round which the rope bends, may keep up the middle of the bended part directly even with the centre of the hole in which the upper gudgeon of the gib turns in the beam *f*. The truer these rollers are placed, the easier the gib is managed, and the less apt to swing either way by the force of the weight *K*.

A ratchet wheel *Q* is fixed upon the axis *D*, near the trundle *E*; and into this wheel falls the catch or click *R*. This hinders the machine from running back by the weight of the burden *K*, if a man who raises it should happen to be careless, and so leave off working at the winch *A*, sooner than he ought to do.

When the burden *K* is raised to its proper height from the ship, and brought over the quay by turning the gib about, it is let down gently upon the quay, or into a cart standing thereon, in the following manner: A man takes hold of the rope *tt* (which goes over the pulley *v*, and is tied to a hook at *S* in the catch *R*) and so disengages the catch from the ratchet-wheel *Q*; and then, the man at the winch *A*, turns it backward, and lets down the weight *K*. But if the weight pulls too hard against this man, another lays hold of the handle *V*, and by pulling it downward draws the gripe *U* close to the wheel *Y*, which, by rubbing hard against the gripe, hinders the too quick descent of the weight; and not only so, but even stops it at any time if required. By this means heavy goods may be either raised or let down at pleasure, without any danger of hurting the men who work the engine.

When part of the goods are craned up, and the rope is to be let down for more, the catch *R* is first disengaged from the ratchet-wheel *Q*, by pulling the cord *t*; then the handle *q* is turned half round backward, which, by the crank *nn* in the piece *h*, pulls down the frame *b* between the guides *m* and *m* (in which it slides in a groove) and so disengages the trundle *B* from the wheel *C*; and then the heavy hook *β*, at the end of the rope *H*, descends by its own weight, and turns back the great wheel *F* with its trundle *E* and the wheel *C*; and this last wheel acts like a fly against the wheel *F* and hook *β*, and so hinders it from going down too quick; whilst the weight *X* keeps up the gripe *U* from rubbing against the wheel *Y*, by means of a cord going from the weight, over the pulley *w*, to the hook *W* in the gripe; so that the gripe never touches the wheel, unless it be pulled down by the handle *V*.

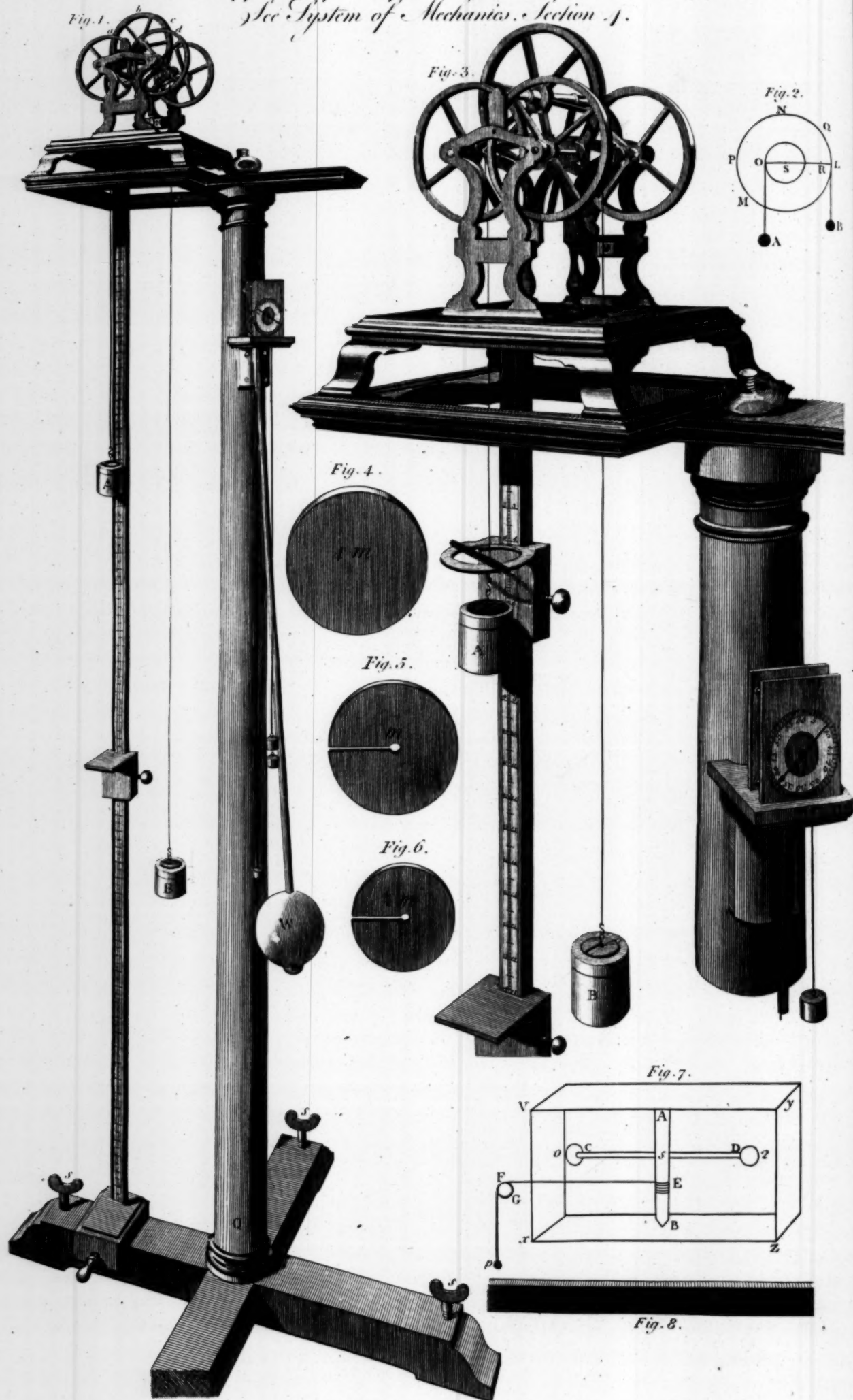
When the crane is to be set at work again for drawing up another burden, the handle *q* is turned half round forwards; which, by the crank *nn*, raises up the frame *b*, and causes the trundle *B* to lay hold of the wheel *C*; and then, by turning the winch *A*, the burden of goods *K* is drawn up as before.

The crank *nn* turns pretty stiff in the mortise near *a*, and stops against the farther end of it when it has got just a little beyond the perpendicular; so that it can never come back of itself: and therefore the trundle *B* can never come away from the wheel *C*, until the handle *q* be turned half round.

E;
 ne
 a
 off
 P,
 rn
 l-
 es
 fo
 an
 K.
 old
 U
 e,
 ut
 ds
 er
 let
 et-
 half
 ills
 les
 C:
 by
 dle
 the
 rk;
 the
 the
 ver
 no-
 ch,
 to
 the
 ops
 the
 re-
 nil
 The

Atwood's Apparatus for Experiments on Accelerated Motion.
See System of Mechanics, Section 4.

Plate 1.



MECHANICS.

The great rope runs upon rollers in the lever LM, which keep it from bending between the axle at G and the pulley I. This lever turns upon the axis N by means of the weight O, which is just sufficient to keep its end L up to the rope; so that, as the great axle turns, and the rope coils round it, the lever rises with the rope, and prevents the coils going over one another.

The power of this crane may be estimated thus: Suppose the trundle B to have 13 staves or rounds, and the wheel C to have 78 spur-cogs; the trundle E to have 14 staves, and the wheel F 56 cogs. Then by multiplying the staves of the trundles, 13 and 14, into one another, their product will be 182; and by multiplying the cogs of the wheels, 78 and 56, into one another, their product will be 4368; and dividing 4368 by 182, the quotient will be 24; which shews, that the winch A makes 24 turns for one turn of the wheel F and its axle G on which the great rope or chain HIH winds. So that, if the length or radius of the winch A were only equal to half the diameter of the great axle G, added to half the thickness of the rope H, the power of the crane would be as 24 to one; but the radius of the winch being double the above length, it doubles the said power, and makes it as 48 to one; in which case, a man may raise 48 times as much weight by this engine as he could do by his natural strength without it, making proper allowance for the friction of the working parts. Two men may work at once, by having another winch on the opposite end of the axis of the trundle under B; and so make the power still double.

If this power be thought greater than what may be generally wanted, the wheels may be made with fewer cogs in proportion to the staves in the trundles; and so the power may be of whatever degree is judged to be requisite. But if the weight be so great as will require yet more power to raise it (suppose a double quantity) then the rope H may be put under the moveable pulley, as D, and the end of it tied to a hook in the gib at E; which will give a double power to the machine, and so raise a double weight hooked to the block of the moveable pulley.

When only small burdens are so raised, this may be quickly done by men pushing the axle G round by the handspokes x, y, y; having first disengaged the trundle B from the wheel C: and then, this wheel will only act as a fly upon the wheel F; and the catch R will prevent its running back, if the men should inadvertently leave off pushing before the burden be unhooked from G.

Lastly, when very heavy burdens are to be raised, which might endanger the breaking of the cogs in the wheel F; their force against these cogs may be much abated by men pushing round the handspokes x, y, y, whilst the man at A turns the winch.

We have only shewn the working parts of this crane, without the whole of the beams which support them; knowing that these are easily supposed, and that if they had been drawn, they would have hid a great deal of the working parts from sight, and also confused the figure.

SECT. IV. ATWOOD'S EXPERIMENTS ON MOTION ACCELERATED.

Among the experiments of different artists for ascertaining the quantities of accelerated motion; there are none that we have met with so well adapted to the purpose, as the apparatus of Mr. Atwood, F. R. S. which, as he observes, at once discovers to the understanding, the quantity of matter moved, the constant force which moves it, the space described from rest, the time of description, and the velocity acquired:

1. *Of the Mass moved.* In order to observe the effects of the moving force, which is the object of any experiment, the interference of all other forces should be prevented: the quantity of matter moved therefore, considering it before any impelling force has been applied, should be without weight: for although it be impossible to abstract the natural gravity or weight from any substance whatever, yet, the weight may be so counteracted as to be of no sensible effect in experiments. Thus in the instrument constructed to illustrate this subject experimentally, A, B, Plate I. Fig. 1. represent two equal weights affixed to the extremities of a very fine and flexible silk line: this line is stretched over a wheel or fixed pulley *a b c d*, moveable round an horizontal axis: the two weights A, B being precisely equal and acting against each other, remain in equilibrio; and when the least weight is superadded to either (setting aside the effects of friction) it will preponderate. When A, B, are set in motion, by the action of any weight *m*, the sum $A+B+m$ would constitute the whole mass moved, but for the inertia of the materials which must necessarily be used in the communication of motion: these materials consist of 1. The wheel *a b c d* over which the line sustaining A and B passes. 2. The four friction wheels on which the axle of the wheel *a b c d* rests: the use of these wheels is to prevent the loss of motion, which would be occasioned by the friction of the axle if it revolved on an immoveable surface. 3. The line by which the bodies A and B are connected so as when set in motion to move with equal velocities. The weight and inertia of the line are too small to have sensible effect on the experiments, but the inertia of the other materials just mentioned constitute a considerable proportion of the mass moved, and must be taken into account. Since when A and B are put in motion, they must necessarily move with a velocity equal to that of the circumference of the wheel *a b c d* to which the line is applied;

No. 100

it follows, that if the whole mass of the wheels were accumulated in this circumference, its inertia would be easily estimated by the quantity of matter moved; but since the parts of the wheels move with different velocities, their effects in resisting the communication of motion to A and B by their inertia will be different: those parts which are furthest from the axis resisting more than those which revolve nearer, in a duplicate proportion of those distances. If the figures of the wheels were regular, from knowing their weights and figures, the distances of their centres of gyration from their axes of motion would become known, and consequently an equivalent weight, which being accumulated uniformly in the circumference *a b c d*, would exert an inertia equal to that of the wheels in their constructed form. But as the figures are wholly irregular, recourse must be had to experiment, to assign what equivalent quantity of matter, which being accumulated uniformly in the circumference of the wheel *a b c d*, would resist the communication of motion to A in the same manner as the wheels.

In order to ascertain the inertia of the wheel *a b c d*, with that of the friction wheels, the weights A, B, being removed, the following experiment was made.

A weight of thirty grains was affixed to a silk line, (the weight of which was not so much as $\frac{1}{2}$ of a grain, and consequently too inconsiderable to have sensible effect in the experiment) this line being wound round the wheel *a b c d*, the weight 30 grains by descending from rest communicated motion to the wheel, and by many trials was observed to describe a space of about 38 $\frac{1}{2}$ inches in 3 seconds. From these data the equivalent mass or inertia of the wheels will be known from this rule:

Let a weight P, be applied to communicate motion to a system of bodies (Fig. 24, Plate III.) by means of a very slender and flexible line going round the wheel SDM, through the centre of which the axis passes (G being the common centre of gravity, *g* the centre of gravity of the matter contained in this line, and *o* the centre of oscillation.) Let this weight descend from rest through any convenient space *s* inches, and let the observed time of its descent be *t* seconds, then if *l* be the space through which bodies descend freely by gravity in one second, the equivalent weight

$$\text{Sought} = \frac{W \times S \times g \times S \times P \times t^2 \times l}{SD^2} = P.$$

Here we have $p = 30$ grains, $t = 3$ seconds, $l = 193$ inches,
 $P \times t^2 \times l = 30 \times 9 \times 193$
 $= 38.5$ inches; and $\frac{38.5}{385} = P = 30 = 1323$
 grains, or 2 $\frac{1}{2}$ ounces.

This is the inertia equivalent to that of the wheel *a b c d*, (Fig. I. Plate I.) and the friction wheels together: for the rule extends to the estimation of the inertia of the mass contained in all the wheels.

The resistance to motion therefore arising from the wheel's inertia, will be the same as if they were absolutely removed, and a mass of 2 $\frac{1}{2}$ ounces were uniformly accumulated in the circumference of the wheel *a b c d*. This being premised let the boxes A and B be replaced, being suspended by the silk line over the wheel or pulley *a b c d*, and balancing each other: suppose that any weight *m* be added to A so that it shall descend; the exact quantity of matter moved, during the descent of the weight A, will be ascertained, for the whole mass will be $A+B+m+2\frac{1}{2}$ oz.

In order to avoid troublesome computations in adjusting the quantities of matter moved and the moving forces, some determinate weight of convenient magnitude may be assumed as a standard, to which all the others are referred. This standard weight in the subsequent experiments is $\frac{1}{2}$ of an ounce, and is represented by the letter *m*. The inertia of the wheels being therefore $2\frac{1}{2}$ ounces, will be denoted by $11m$. A and B are two boxes constructed so as to contain different quantities of matter, according as the experiment may require them to be varied: the weight of each box, including the hook to which it is suspended, $= \frac{1}{2}$ oz. or according to the preceding estimation, the weight of each box will be denoted by $6m$; these boxes contain such weights as are represented by Fig. 4, Plate I. each of which weighs an ounce, so as to be equivalent to $4m$; other weights of $\frac{1}{2}$ an oz. $= 2m$, $\frac{1}{4}$ $= m$, and aliquot parts of *m*, such as $\frac{1}{8}m$, $\frac{1}{16}m$, may be also included in the boxes, according to the conditions of the different experiments hereafter described.

If $4\frac{1}{2}$ oz. or $19m$, be included in either box, this with the weight of the box itself will be $25m$; so that when the weights A and B, each being $25m$, are balanced in the manner above represented, their whole mass will be $50m$, which being added to the inertia of the wheels $11m$, the sum will be $61m$. Moreover, three circular weights, such as that which is represented at Fig. 5. are constructed; each of which $= \frac{1}{2}$ oz. or m ; if one of these be added to A and one to B, the whole mass will now become $63m$ perfectly in equilibrio, and moveable by the least weight added to either (setting aside the effects of friction) in the same manner precisely as if the same weight or force were applied to communicate motion to the mass $63m$, existing in free space and without gravity.

2. *The moving Force.* Since the natural weight or gravity of any given substance is constant, and the exact quantity of it easily estimated, it will be convenient here to apply a weight to the mass A, as a moving force: thus, when the system consist of a mass $= 63m$, according to the preceding description, the whole being perfectly

*

6 S

fectly

MECHANICS.

fectly balanced, let a weight $\frac{1}{2}$ oz. or m such as is represented in Fig. 5, be applied on the mass A; this will communicate motion to the whole system: by adding a quantity of matter m to the former mass $63m$, the whole quantity of matter moved will now become $64m$, and the moving force being $=m$, this will give the

force which accelerates the descent of $A = \frac{m}{64m}$, or $\frac{1}{64}$ part of the accelerating force by which the bodies descend freely towards the earth's surface.

By the preceding construction, the moving force may be altered without altering the mass moved; for suppose the three weights m , two of which are placed on A, and one on B to be removed, then will A balance B. If the weights $3m$ be all placed on A, the moving force will now become $3m$, and the mass moved $64m$ as before,

and the force which accelerates the descent of $A = \frac{3m}{64m} = \frac{3}{64}$ part of the force by which gravity accelerates bodies in their free descent to the surface.

Suppose it were required to make the moving force $2m$, the mass moved continuing the same. In order to effect this, let the three weights, each of which $=m$, be removed: A and B will balance each other; and the whole mass will be $61m$: let $\frac{1}{2}m$, Fig. 6, be added to A, and $\frac{1}{2}m$ to be, the equilibrium will still be preserved, and the mass moved will be $62m$; now let $2m$ be added to A, the moving force will be $2m$, and the mass moved $64m$, as before; wherefore the force of acceleration $=\frac{2}{64}$ part of the acceleration of gravity. These alterations in the moving force may be made with great ease and convenience in the more obvious and elementary experiments, there being no necessity for altering the contents of the boxes A and B; but the proportion and absolute quantities of the moving force and mass moved may be of any assigned magnitude, according to the conditions of the proposition to be illustrated.

3. *Of the Space described.* The body A, Fig. 1, descends in a vertical line; and a scale about 64 inches in length graduated into inches and tenths of an inch is adjusted vertical, and so placed that the descending weight A may fall in the middle of a square stage, fixed to receive it at the end of the descent: the beginning of the descent is estimated from 0 on the scale, when the bottom of the box A is on a level with 0. The descent of A is terminated when the bottom of the box strikes the stage, which may be fixed at different distances from the point 0, so that by altering the position of the stage, the space described from quiescence may be of any given magnitude less than 64 inches.

4. *The Time of Motion* is observed by the beats of a pendulum, which vibrate seconds: and the experiments intended to illustrate the elementary propositions, may be easily so constructed that the time of motion shall be a whole number of seconds; the estimation of the time therefore admits of considerable exactness, provided the observer takes care to let the bottom of the box A begin its descent precisely at any beat of the pendulum; then the coincidence of the stroke of the box against the stage, and the beat of the pendulum at the end of the time of motion, will shew how near the experiment and the theory agree together. There might be various mechanical devices thought of for letting the weight A begin its descent at the instant of a beat of a pendulum; let the bottom of the box A, when at 0 on the scale, rest on a flat rod, held in the hand horizontally, its extremity being coincident with 0; by attending to the beats in the pendulum, and with a little practice the rod which supports the box A may be removed at the distance the pendulum beats, so that the descent of A shall commence at the same instant.

5. *Of the Velocity acquired.* It remains only to describe in what manner the velocity acquired by the descending weight, A, at any given point of the space through which it has descended, is made evident to the senses. The velocity of A's descent being continually accelerated will be the same in no two points of the space described: this is occasioned by the constant action of the moving force; and since the velocity of A at any instant, is measured by the space which would be described by it, moving uniformly for a given time with the velocity it had acquired at that instant, this measure cannot be experimentally obtained, except by removing the force by which the descending bodies' acceleration was caused.

In order to shew in what manner this is effected particularly, let us again suppose the boxes A and B $=25m$ each, so as together to be $=50m$; this with the wheel's inertia $11m$ will make $61m$; now let m , Fig. 5, be added to A, and an equal weight m to B, these bodies will balance each other, and the whole mass will be $63m$. If a weight m be added to A, motion will be communicated, the moving force being m , and the mass moved $64m$. In estimating the moving force, the circular weight $=m$ was made use of as a moving force; but for the present purpose of shewing the velocity acquired, it will be convenient to use a flat rod, the weight of which is also $=m$, Fig. 8, Plate I. Let the bottom of the box A be placed on a level with 0 on the scale, the whole mass being as described above $=63m$, perfectly balanced in equilibrio. Now let the rod, the weight of which $=m$, be placed on the upper surface of A; this body will descend along the scale precisely in the same manner as when the moving force was applied in the

form of a circular weight. Suppose the mass A, Fig. 3, Plate I. to have descended by constant acceleration of force of m , for any given time or through a given space: let a circular frame be so affixed to the scale, contiguous to which the weight descends, that A may pass centrally through it, and that this circular frame may intercept the rod m by which the body A has been accelerated from quiescence. After the moving force m has been intercepted at the end of the given space or time, there will be no force operating on any part of the system, which can accelerate or retard its motion; this being the case, the weight A, the instant after m has been removed, must proceed uniformly with the velocity which it had acquired that instant: in the subsequent part of its descent, the velocity being uniform, will be measured by space described in any convenient number of seconds.

Other uses of the Instrument. It is needless to describe particularly, but it may not be improper just to mention the further uses of this instrument; such as the experimental estimation of the velocities communicated by the impact of bodies elastic and nonelastic; the quantity of resistance, opposed by fluids, as well as for various other purposes; these uses we shall not insist on, but the properties of retarded motion being a part of the present subject, it may be necessary to shew in what manner the motion of bodies resisted by constant forces are reduced to experiment by means of the instrument above described, with as great ease and precision as the properties of bodies uniformly accelerated. A single instance will be sufficient: thus, suppose the mass contained in the weights A and B Fig. 3, Plate I. and the wheels to $61m$, when perfectly in equilibrio, let a circular weight m be applied to B, and let two long weights or rods, each $=m$, be applied to A, then will A descend by the action of the moving force m , the mass moving being $64m$: suppose that when it has described any given space by constant acceleration, the two rods m are intercepted by the circular frame above described, while A is descending through it; the velocity acquired by that descent is known, and when the two rods are intercepted, the weight A will begin to move on with the velocity acquired, being now retarded by the constant force m ; and since the mass moved is $62m$, it follows that the force of retardation will be $\frac{1}{62}$ part of that force whereby gravity retards bodies thrown perpendicularly upwards. The weight A will therefore proceed along the graduated scale in its descent with an uniformly retarded motion, and the spaces described, times of motion and velocities destroyed by the resisting force, will be subject to the same measures as in the examples of accelerated motion above described.

In the foregoing descriptions, two suppositions have been assumed, neither of which are mathematically true: but it may be easily shewn that they are so in a physical sense: the errors occasioned by them in practice being insensible.

1. The force which communicates motion to the system has been assumed constant, which will be true only to a supposition that the line, at the extremities of which the weights A and B Fig. 1, are affixed, is without weight. In order to make it evident, that the line's weight and inertia are of no sensible effect, let a case be referred to, wherein the body A descends through 48 inches from rest by the action of the moving force m , when the mass moved is $64m$; the time wherein A describes 48 inches is increased by the effects of the line's weight by no more than $\frac{1}{1000}$ part of a second: the time of descent being 3.9896 seconds, when the string's weight is not considered; and the time when the string's weight is taken into account $=4.0208$ seconds; the difference between which is wholly insensible by observation.

2. The bodies have also been supposed to move in vacuo, whereas the air's resistance will have some effect in retarding their motion; but as the greatest velocity communicated in these experiments cannot much exceed that of about 26 inches in a second, (suppose the limit 26.2845) and the cylindrical boxes being about $1\frac{1}{4}$ inches in diameter, the air's assistance can never increase the time of descent in so great a proportion as that of 240:241; its effects therefore will be insensible in experiment.

The effects of friction are almost wholly removed by the friction wheels; for when the surfaces are well polished and free from dust, &c. if the weights A and B be balanced in perfect equilibrio, and the whole mass consists of $63m$, according to the example already described, a weight of $1\frac{1}{2}$ grains, or at most 2 grains, being added either to A or B, will communicate motion to the whole, which shews that the effects of friction will not be so great as a weight of $1\frac{1}{2}$ or 2 grains. In some cases, however, especially in experiments relating to retarded motion, the effects of friction become sensible; but may be very readily and exactly removed by adding a small weight 1.5 or two grains to the descending body, taking care that the weight added is such as is in the least degree smaller than that which is just sufficient to set the whole in motion, when A and B are equal and balance each other, before the moving force is applied.

We have rather been copious in the description of this apparatus, as it is a new improvement, and very curiously illustrates those principles of motion, which had hitherto been only established by theory: at least, we do not recollect any invention before this that could afford such a striking proof of the Principles of Gravitation and Motion Accelerated.

SYSTEM OF MEDICINE.

HISTORY.

THE art of medicine is in itself so noble, and so generally useful to mankind, that many have thought it came originally from God by express revelation; and, accordingly we find the heathens with one voice ascribing the origin of the medicinal art to their gods. But it is evidently of human invention: and mankind were naturally led to it from casual observations on the diseases to which they found themselves subject. At what time medicine was first reduced to rules and began to be practised as an art is not known. The most ancient physicians we read of were those who embalmed the patriarch Jacob by order of his son Joseph. The sacred writer styles these physicians *servants* to Joseph: from whence we may be assured that they were not *priests*, as the first physicians are generally supposed to have been: for in that age we know the Egyptian priests were in such high favour, that they retained their liberty, when, through a public calamity, all the rest of the people were made slaves to the prince.

What seems most probable on this subject is, that religion and medicine came to be mixed together only in consequence of that degeneracy into ignorance and superstition, which some time or other hath taken place among all nations. The Egyptians, we know, came at last to be sunk in the most ridiculous and absurd superstition; and then indeed it is no wonder to find their priests commencing physicians, and mingling charms, incantations, &c. with their remedies. That this was the case, though long after the days of Joseph, we are very certain; and indeed it seems as natural for ignorance and barbarism to combine religion with physic, as it is for a civilized and enlightened people to keep them separate. Hence we see, that among all modern barbarians their priests or conjurers are their only physicians.

The Greeks too had several perions to whom they attributed the invention of physic, particularly Prometheus, Apollo, or Pæan, and Æsculapius, which last was the most celebrated of any. But here we must observe, that as the Greeks were a very warlike people, their physic seems to have been little else than what is now called surgery, or the cure of wounds, fractures, &c. Hence, Æsculapius, and his pupils Chiron, Machaon, and Podalirius, are celebrated by Homer only for their skill in curing these, without the least mention of their attempting the cures of internal diseases. We are not, however, to suppose, that they confined themselves entirely to surgery. They no doubt would occasionally prescribe for internal disorders; but as they were most frequently conversant with wounds, we may naturally suppose the greatest part of their skill to have consisted in knowing how to cure these.

The practice of these ancient Greek physicians, notwithstanding the praises bestowed on them by their poets, seems to have been very limited, and in some cases even pernicious. All the external remedies applied to Homer's wounded heroes were fomentations, while inwardly their physicians gave them wine, sometimes mingled with cheese scraped down. This last we know must have been pernicious in many cases by increasing the inflammation: and it is very probable, that such an improper exhibition was merely a consequence of their ignorance; as we see old women in this country will give ardent spirits to those who are seized with inflammatory fevers, in order to prevent their patients from fainting. A great deal of their physic also consisted in charms, incantations, amulets, &c. of which, as they are common to all superstitious and ignorant nations, it is superfluous to take any further notice. Among the Greeks, however, Æsculapius, as he was reckoned the most eminent practitioner of his time, so his name continued to be revered after his death; he was ranked amongst the gods; and the principal knowledge of the medicinal art remained with his family to the time of Hippocrates, who reckoned himself the seventeenth in a lineal descent from Æsculapius; and who was truly the first who treated of medicine in a regular and rational manner.

At last the Grecian philosophers attempted to introduce particular theories into the medicinal art. Pythagoras, who lived about the 60th Olympiad, and founded the Italic school, is the first we read of who began to take these things into consideration.

This may be a sufficient specimen of the antient philosophic medicine, of which we shall now take no farther notice, but proceed to give a brief account of the state in which the art was left by Hippocrates, whose name has been celebrated through so many ages. According to Soranus, Hippocrates was born in the island of Cos, in the first year of the 88th Olympiad; but others make him older, so that the exact time in which he lived cannot be ascertained.

The works attributed to him are very voluminous, but evidently done by different persons, as many of them are contradictory to each other, so that it is difficult to determine those which are really his writings, and those which are not. Some indeed are so sceptical on this head, as to deny that we have proper evidence that any of those works really belong to Hippocrates: in most of the writings of Hippocrates, we find a general principle acknowledged, which is called *nature*. To this principle he ascribes a mighty power. "Nature (says he) is of herself sufficient to every animal. She performs every thing that is necessary to them, without needing the least instruction from any one how to do it." Upon this footing, as if nature had been a principle endowed with knowledge, he gives her the title of *just*, and ascribes

virtues or powers to her, which are her servants, and by means of which she performs all her operations in the bodies of animals; they distribute the blood, spirits, and heat, through all parts of the body, which by this means receive life and sensation. And in other places he tells us, that it is this faculty which gives nourishment, preservation, and growth to all things.

The health or sickness of the body he reckoned to consist in the state of the four humours. These are the blood, phlegm, the yellow bile, and the melancholy or black bile. The blood, he says, is naturally hot and moist, of colour red, and sweet to the taste: the phlegm is cold and moist, white, viscid, and saltish; the bile yellow, dry, viscid, bitter, and drawn from the fat part of the blood or aliments; the melancholy, black bile, he said, was cold, and dry, very viscid, windy and fermentative. On these four humours, according to him, depend health and sickness.

Of all the causes of diseases, mentioned by Hippocrates, the most general are diet and air. On the subject of diet he has composed several books, and in the choice of this he was exactly careful; and the more so, as his practice turned almost wholly upon it. He also considered the air very much; he examined what winds blew ordinarily or extraordinarily; he considered the irregularity of the seasons, the rising and setting of stars, or the time of certain constellations; also the time of the solstices and of the equinoxes; those days in his opinion, producing great alterations in certain distempers. But what hath chiefly contributed to procure the vast respect generally paid to Hippocrates, is his industry in observing the most minute circumstances of diseases, and his exactness in nicely describing every thing that happened before, and every accident that appeared at the same time with them; as also what appeared to give ease, and what to increase the malady, which is what we call *writing the history of a disease*.

Hippocrates also enquired into the state of the pulse, or the beating of the arteries. According to Galen he was the first physician that made use of the word *pulse* in the sense in which it is now commonly taken; that is to say, for the natural and ordinary beating of the arteries. For the most ancient physicians, and even Hippocrates himself, for a long time, by this word, understood the violent pulsation that is felt in an inflamed part, without putting the fingers to it. It is observed, however, by Galen, and other physicians, that Hippocrates touches on the subject of the pulse more slightly than any other on which he treats. But that our celebrated physician understood something even on this subject, is easily gathered from several passages in his writings; as when he observes, that in acute fevers the pulse is very quick and very great; and when he makes mention, in the same place, of trembling pulses, and those that beat slowly; when he observes that in some diseases incident to women, when the pulse striking the finger faintly, and in a languishing manner, it is a sign of approaching death.

From this account of Hippocrates, it will appear, that he was not so much taken up with reasoning on the phenomena of diseases, as of reporting them. He was content to observe these phenomena exactly, to distinguish diseases by them, and judged of the event by comparing them exactly together. For his skill in prognostics he was indeed very remarkable, as we have already mentioned, inasmuch that he and his pupils were looked upon by the vulgar as prophets. What adds very much to his reputation is, that he lived in an age when physic was altogether buried in superstition, and yet he did not suffer himself to be carried away by it; on the contrary, on many occasions, he expresses his abhorrence of it. One of his principal maxims was this, That, to preserve health, we ought not to overcharge ourselves with too much eating, nor neglect the use of exercise and labour.

Here we cannot help taking notice of the prodigious disparity between the delicacy of the people in our days, and in those of Hippocrates: for he takes great pains to tell the difference between the flesh of a dog, a fox, a horse, and an ass; which he would not have done, if at that time they had not been used for victuals, at least by the common people. With regard to drink, he takes pains to distinguish the good waters from the bad. He advises to mix wine with an equal quantity of water: and this he says, is the just proportion; by using which the wine will expel what is hurtful to the body, and the water will serve to temper the acrimony of the humours. Venery, in his opinion, is wholesome, provided people consult their strength, and do not pursue it to excess; which he finds fault with on all occasions, and would have it avoided also in relation to sleep and watching. In his writings are likewise to be found several remarks concerning good and bad air; and he makes it appear that the good or bad disposition of this element does not depend solely on the difference of the climate, but on the situation of every place in particular. He speaks also of the good and bad effects of the passions, and would have us use a great deal of moderation in regard to them. Hippocrates gives also the following instruction: "We ought, (says he) to mind with a great deal of attention what gives ease, and what creates pain; what is easily supported, and what cannot be endured." We ought not to do any thing rashly; but ought to pause, or wait without doing any thing: by this way, if you do the patient no good, you will at least do him no hurt. These are the principal and

MEDICINE.

and most general maxims of the practice of Hippocrates, and which proceed upon the supposition laid down at the beginning, viz. that nature cures diseases. We next proceed to consider particularly the remedies employed by him, which will serve to give us further instructions concerning his practice.

Diet was the first, the principal, and oftentimes the only remedy made use of by this great physician to answer the greatest part of the intentions abovementioned. That he spoke the truth in this respect is plain from what we have already observed concerning the treatment of the wounded heroes by the pupils of Æsculapius.

There were many diseases for which he judged the bath was a proper remedy; and he takes notice of all the circumstances that are necessary in order to cause the patient to receive benefit from it.

In chronic distempers Hippocrates approved very much of exercise, though he did not allow it in acute ones: but even in these he did not think that a patient ought always to lie a-bed; but tells us, that "we must sometimes push the timorous out of bed, and rouse up the lazy."

When our physician found that diet and exercise were not sufficient to ease nature of a burden of corrupted humours, he was obliged to make use of other means, of which *purgation* was the principal one.

Blood-letting was another method of evacuation pretty much used by Hippocrates. Another aim he had in this, besides the mere evacuation, was to divert or recall the course of the blood when he imagined it was going where it ought not. A third end of bleeding was to procure a free motion of the blood and spirits. In a pleurisy he directs to take blood from the arm of the side affected; and for the same reason in pains of the head, he directs the veins of the nose and forehead to be opened. These directions, however, we now know to be almost entirely superfluous, and to have proceeded from Hippocrates's ignorance of the blood's circulation.

When bleeding and purging, which were the principal and most general means used by Hippocrates for taking off a plethora, proved insufficient for that purpose, he had recourse to diuretics and sudorifics.

Of the external remedies prescribed by Hippocrates, fomentations were the chief. These were of two kinds. The one was a sort of bath, in which the patient sat in a vessel full of a decoction of simples appropriated to his malady; so that the part affected was soaked in the decoction. This was chiefly used in distempers of the womb, of the arms, the bladder, the reins, and generally all the parts below the diaphragm. The second way of fomenting was, to take warm water and put it into a skin or bladder, or even into a copper or earthen vessel, and to apply it to the part affected. From prescribing the bath it is evident that Hippocrates minutely observed the effects of the several remedies he prescribed; and particularly in this instance of infusing the virtues of his medicines through the absorbent system. Though he had not a knowledge of this set of vessels, which are but of late discovery, it more evidently points out the merit of this great man, as he discovered the effect without knowing the cause.

Gargles, a kind of fomentation for the mouth, were also known to Hippocrates. In the quinsy he used a gargle made of marjoram, fennel, celery, mint, and nitre, boiled with water and a little vinegar. When this was strained, they added honey to it, and washed their mouths frequently with it. Oils and ointments were likewise much used by Hippocrates, with a view to mollify and abate pain, to ripen boils, resolve tumours, refresh after weariness, make the body supple, &c. It is worth our observation, that the compound medicines of Hippocrates were but very few, and composed only of four or five ingredients at most; and that he not only understood pharmacy, or the art of compounding medicines, but prepared such as he used himself, or caused his servants to prepare them in his house by his directions.

The first physician of eminence who differed considerably in his practice from Hippocrates, was Praxagoras. From some authors we learn that he accounted for diseases from the qualities of the humours, of which he reckoned ten sorts, whereas Hippocrates supposed only four.

About the 131st year after Christ, in the reign of the emperor Adrian, lived the celebrated Galen, a native of Pergamus, whose name makes such a conspicuous figure in the history of physic. At this time the dogmatic, empiric, methodic, and other sects, had each their abettors. The methodics were held in great esteem, and looked upon to be superior to the dogmatics, who were strangely divided among themselves, some of them following Hippocrates, others Erasistratus, and others Asclepiades. Galen undertook the reformation of medicine, and seems to have been of that sect which was called *eclectic*, from their choosing out of different authors what they esteemed good in them, without being particularly attached to any one more than the rest. This declaration he indeed sets out with; but, notwithstanding this, he follows Hippocrates much more than any of the rest. Though before his time several physicians had commented on the works of Hippocrates, yet Galen pretends that none of them had understood his meaning besides himself. His first attempt therefore was to explain the works of Hippocrates; with which view he wrote a great deal, and after this set about composing a system of his

own. In one of his books entitled, "Of the establishment of medicine," he defines the art to be one which teaches to preserve health and cure diseases. In another book, however, he proposes the following definition: "Medicine (says he) is a science which teaches what is found, and what is not to; and what is of an indifferent nature, or holds a medium between what is found and what is the reverse."

His method of cure differed little from that of Hippocrates: but from the specimen of Galen's method of teaching the medicinal art, it is evident that his system was little else than a heap of speculations, distinctions, and reasonings; whereas that of Hippocrates was founded immediately upon facts, which he had either observed himself, or had from the observations of others. In consequence of the establishment of such a system, the medicinal art, as well as others during the dark ages of popery, came to be reduced to a heap of quibbling distinctions and metaphysical nonsense. After the days of Galen, however, the knowledge of medicine did not immediately decline. Dr. Friend is of opinion that it continued to advance till the year 600. He censures Mr. Le Clerc for placing the physicians Oribasius, Aëtius, Alexander, and Paulus Ægineta, all without any distinction, in the fourth century: and still more for placing Diocles Carysius 500 years after Christ, when he should, according to him, have been placed 300 years before him.

Oribasius flourished about the year 360, and was physician to the emperor Julian. He speaks very fully of the effects of bleeding by way of scarification, a thing little taken notice of by former writers.

Aëtius lived very near the end of the fifth, or in the beginning of the sixth century. Many passages in his writings serve to shew us how much the actual and potential cautery were used by the physicians of that age. He also takes notice of the worms bred in different parts of the body called *dracunculi*, which were unknown to Galen. He seems also to be the first Greek writer among the Christians who gives us any specimen of medicinal spells and charms; such as that of a finger of St. Blasius for removing a bone which sticks in the throat, and another in relation to a fistula. He gives a remedy for the gout, which he calls the *grand drier*: the patient is to use it for a whole year, and observe the following diet each month: "In September, he must eat and drink milk: in October, he must eat garlic: in November abstain from bathing: in December, he must eat no cabbage: in January, he is to take a glass of pure wine in the morning: in February, to eat no beet: in March, to mix sweet things both in eatables and drinkables: in April, not to eat horse-radish: nor in May, the fish called Polypus: in June, to drink cold water in a morning: in July, to avoid venery: and lastly, in August, to eat no mallows." This may sufficiently show the quackery of those times, and how superstition was beginning to mix itself with the art.

Alexander, who flourished in the reign of Justinian, is a more original author than either of the two former. He confines himself directly to the describing the signs of diseases, and the methods of cure, without meddling with anatomy, the materia medica, or surgery, as all the rest did.

Paulus was born in the island Ægina, and lived in the 7th century. He transcribes a great deal from Alexander and other physicians. His descriptions are short and full. He treats particularly of women's disorders; and seems to be the first instance upon record of a professed *man-midwife*, for so he was called by the Arabians; and accordingly he begins his book with the disorders incident to pregnant women. He treats also very fully of surgery; and gives some directions, according to Dr. Friend, not to be found in the most ancient writers.

With this physician closes the period of the Greek classical physicians. As for the western parts of the world, every art and science had been long lost in them, by the inundation of Goths and other barbarous nations who over-ran the Roman empire. The Arabians, who about this time over-ran the eastern parts of the world, were at first as great enemies to learning of all kinds as the Goths; but at length they applied themselves to the study of several sciences, particularly medicine. They were for the most part, indeed, only copiers of the Greeks; we are, however, indebted to them for some improvements. They were the first who introduced chymical remedies, though of these they used but few, nor did they make any considerable progress in the chymical art. Anatomy was not in the least improved by them, nor did surgery receive any advancement till the time of Albucasis, who lived, probably, in the 12th century. They added a great deal to botany and the materia medica, by the introduction of new drugs, of the aromatic kind especially, from the east, many of which are of considerable use. They also found out the way of making sugar; and by help of that, syrups; which two new materials are of great use in mixing up compound medicines.

With regard to their practice, in some few particulars they deviated from the Greeks. They deviated from Hippocrates, in particular, in one very trivial circumstance, which produced a terrible controversy. The question was, Whether blood in a pleurisy ought to be drawn from the arm of the affected side, or the opposite? Hippocrates had directed it to be drawn from the arm of the affected side; but the Arabians, following some other ancient

MEDICINE.

ancient physicians, ordered it to be drawn from the opposite one. Such was the ignorance of those ages, that the university of Salamanca in Spain, made a decree, that no one should dare to let blood but in the contrary arm; and endeavoured to procure an edict from the emperor Charles V. to second it; alledging that the other method was of no less pernicious consequence to medicine, than Luther's heresy had been to religion.

By reason of the general decay of learning in the western parts of the world, the Greek writers became totally forgot, because nobody could read the language; and the Arabians, though mostly copiers from them, enjoyed all the reputation that was due to the others. The Arabian physic was introduced into Europe very early, with the most extravagant applause: and not only this, but other branches of their learning came into repute in the west; insomuch that in the 11th century, the studies of natural philosophy and the liberal arts, were called *the studies of the Saracens*. This was owing partly to the crusades undertaken against them by the European princes; and partly to the settlement of the Moors in Spain, and the intercourse they and other Arabians had with the Italians.

From this time to the end of the 15th and beginning of the 16th century, the history of physic furnishes us with no interesting particulars. This period, however, is famous for the introduction of chymistry into medicine, and the discovery of three new distempers, the sweating sickness, the venereal disease, and the scurvy. The sweating sickness began in 1483, in the army of Henry VII. upon his landing in Milfordhaven, and spread itself at London from the 21st of September to the end of October. It returned here five times and always in summer; first in 1485, then in 1506, afterwards in 1517, when it was so violent that it killed many in the space of three hours, so that numbers of the nobility died, and of the commonalty in several towns often the one half perished. It appeared the fourth time in 1528, and then proved mortal in six hours; many of the courtiers died of it, and Henry VIII. himself was in danger. In 1529, and only then, it infested the Netherlands and Germany, in which last country it did much mischief. The last return of it was in 1551.

In the beginning of the 16th century, the famous chymist Paracelsus introduced a new system into medicine, founded on the principles of his art. The Galenical system had prevailed till his time; but their practice had greatly degenerated, and was become quite trifling and frivolous. The physicians rejected the use of opium, mercury and other efficacious remedies. Paracelsus, who made use of these, had therefore greatly the advantage over them; and now all things relating to medicine were explained on imaginary chymical principles. It will easily be conceived that a practice founded in this manner, could be no other than the most dangerous quackery. At this time, however, it was necessary; for now a new disease over-ran the world, and threatened greater destruction than almost all the old ones put together, both by the violence of its symptoms, and its baffling the most powerful remedies at that time known. This was the venereal disease, which is said to have been imported from the West-Indies by the companions of Christopher Columbus. Its first remarkable appearance was at the siege of Naples in 1494, from whence it was soon after propagated through Europe, Asia, and Africa. The symptoms with which it made the attack at that time were exceedingly violent, much more so than they are at present; and consequently were utterly unconquerable by the Galenists. The quacks and chymists, who boldly ventured on mercury, though they no doubt destroyed numbers by their excessive use of it, yet shewed that a remedy for this terrible distemper was at last found out, and that a proper method of treating it might soon be fallen upon. Shortly after, the West-Indian specific, guaiacum, was discovered: the materia medica was enriched with that and many other valuable medicines, both from the East and West-Indies; which contributed considerably to the improvement of the practice of physic. The scurvy likewise began to spread during the course of this century. The mariners of Saxony called it *scharbock*, which in their language, signifies inflammation; and this it seems was one way in which it first appeared, and terminated often in a gangrene. It broke out among the Portuguese sailors in some of their voyages to the East-Indies.

The revival of learning, which now took place throughout Europe, the appearance of these new distempers, and the natural fondness of mankind for novelty, contributed greatly to promote the advancement of medicine as well as other sciences.

It was not, however, till the year 1628 that a foundation was laid for a solid and rational system. This was done by Dr. Harvey, who discovered the circulation of the blood; which may justly be reckoned the most capital discovery that ever was made with regard to the practice of medicine.

Before this time every physician had some kind of theory of his own, yet, as all these were built upon principles in themselves erroneous, and inconsistent with what has been since discovered concerning the structure of the human body, they are now quite unworthy of notice. But, on the discovery of the circulation of the blood, matters took a different turn, and physicians began to aim at establishing a theory of medicine upon more solid and consistent principles. It was generally agreed, that the circulation was

the capital and vital function of the body, and that upon it the life and health did immediately depend. The blood was considered as it were the *primum mobile* of the whole body; and to something in the blood all the disorders to which the human race are liable, were thought to be owing. About this time also, the laws of mechanics began to be better and more generally understood; and various theories were formed with a design to account for all the phenomena of the human body upon mathematical or mechanical principles. Calculations were made concerning the diameters of the vessels, their gradual diminution, the friction of the blood against their sides, the force of the heart, &c. Thus were mathematics introduced into physic, and every thing relative to the human body was thought to be performed by the mere force of such mechanical powers as we are acquainted with, and whose effects we observe in pumps, steam-engines, and other hydraulic machines.

The consequences of this doctrine, however, soon destroyed the principles on which it was founded; and such prodigious powers were attributed to the action of some parts of the body, as were much more than sufficient to destroy the texture of the parts themselves. Upon the whole, the immediate consequences of Dr. Harvey's most important discovery, were, that all the vain and fanciful theories of the ancients were thrown aside, and others more rational established in their place. Such were the progress and the general principles and modes of practice which prevailed in former times. With respect to those of more modern date, they are so various and numerous that as we cannot enter into a detail of them, consistently with the limits of our work, we refer our readers to the theories of professors, and proceed to point out the most approved methods of practice, according to modern use.

PRACTICE OF MEDICINE:

Or the DESCRIPTION and CURE of the principal Diseases incident to Human Nature, arranged in Systematic Order.

Sauvages was the first who attempted to arrange diseases according to the plan suggested by Sydenham; and his work still continues the only one that merits the title of *Methodical Nosology*. For though Linnæus, Vogel, Cullen and Sagar, have successively endeavoured to improve his method of classification, they have contented themselves with an enumeration and arrangement of the different genera, without entering into their description and cure: so that, though we have since had various *Schemes of Arrangement*, we have had, properly speaking, no complete *System of Nosology*; that is, no complete Course of Medicine according to any of these arrangements. Presuming, therefore, that a Practice formed upon the most approved Classification, in imitation of the work of Sauvages, might be esteemed an acquisition by our readers, we have endeavoured to execute that task in such a manner, as to exhibit the most approved methods of treatment, with the latest discoveries and improvements in the healing art.

CLASS I. PYREXIE; Or FEBRILE DISEASES IN GENERAL. ORDER I. FEBRES.

GENUS I. TERTIANA; the TERTIAN, or THIRD DAY FEVER.

Description. This disease comes on in the morning, or from breakfast to dinner time. It begins with a remarkable shivering, increasing frequently to a kind of convulsive shaking of the limbs. The extremities are always cold, sometimes remarkably so. The cold for the most part is first perceived about the lumbar regions, and from thence ascending along the spine, turns toward the pit of the stomach. Sometimes it begins in the first joint of the fingers and tip of the nose. Sometimes it attacks only a particular part of the body, as one of the arms, the side of the head, &c. This cold is preceded by a heavy and sleepy torpor, languor and lassitude, which we are partly to ascribe to real weakness, and partly to mere laziness. To these symptoms succeed yawning and stretching; after which the cold comes on as above described, not unfrequently with a pain of the back, and a troublesome sensation of tension in the precordia and hypochondria. To this succeed nausea and vomiting; and the more genuine the disease, the more certainly does the vomiting come on, by which a great deal of tough mucous matter, and sometimes bilious stuff or indigested food, is evacuated during the first paroxysms. In some there is only a violent straining to vomit, without bringing up any thing; sometimes, instead of these symptoms, a diarrhoea occurs; and this chiefly in weak, phlegmatic, and aged people, or where an indigested mucous saburra has long remained in the primæ viæ.

When these symptoms have continued for an hour or two, the cold begins to go off, and is succeeded by a lassitude, languor, and flaccidity of the whole body, but chiefly in the limbs, with an uneasy foreboding as if the parts had been bruised; excepting in those cases where the nausea continues for a longer time. After this languor a heat comes on; the increase of which is generally slow, but sometimes otherwise, with pain of the head, thirst, and bitterness in the mouth. The pulse is quick and unequal; sometimes beating 120 strokes in a minute. As soon as this heat hath abated, a little moisture or sweat is observed to break forth; not always indeed in the first, but always in the succeeding paroxysms,

MEDICINE.

and the urine lets fall a quantity of lateritious sediment. The whole paroxysm is scarce ever over in less than six hours, more frequently eight, and in violent cases extends to twelve hours; but that which exceeds 12 hours is to be reckoned a spurious kind, and approaching to the nature of continued fevers. All these symptoms, however, are repeated every third day, in such a manner that the patient is quite free from fever for at least 24 hours. The paroxysms return much about the same time, though sometimes a little sooner or later.

Causes of this Disease, and Persons subject to it. The genuine tertian attacks men rather than women, young people rather than old; the latter being more subject to anomalous tertians. It likewise seizes the lusty and active, rather than the lazy and indolent. Those, however, who are very sensible and apt to nauseate their meat, fall easily into a tertian fever. The cause, according to Dr. Cullen, is the miasma of marshy places, and that only. Other physicians have taken in many more causes, almost every thing indeed which debilitates the body; but the Doctor denies that any of these, though they may dispose the body for receiving the disease, or may augment it, can by any means produce it without the concurrence of the marsh miasma.

Prognosis. The genuine simple tertian, unless improper medicines are administered, is generally very easily cured; nay, the vulgar reckon it of such a salutary nature, that after it they imagine a person becomes more strong and healthy than before. Hippocrates hath justly observed; that these fevers terminate of their own accord after seven or nine paroxysms. Juncker tells us, that it frequently terminates before the seventh paroxysm, but rarely before the fourth. He also denies that anything critical is to be observed in its going off: but in this he differs from Vogel, who tells us, that the urine, for some days after the fever is quite gone off, appears slimy, and lets fall much sediment. The latter also informs us, that besides the common crisis by sweat and urine, the tertian hath one peculiar to itself, namely, dry scabby ulcers breaking out upon the lips. These sometimes appear about the third or fourth paroxysm; and then we may venture to foretell that the disease will go off spontaneously after the seventh. But though the disease is never dangerous, in cold climates at least, when properly treated; yet the improper use of hot and stimulating medicines may change it into a continued fever, more or less dangerous according to the quantity of medicines taken and the constitution of the patient; in which case the prognosis must be regulated by the particular symptoms which occur.

The treatment of all genuine intermittents, whether tertians, quotidianas, or quartans, being precisely the same, the general method of cure applicable to them all may be here given, to which it will be easy to refer when we come to describe the others.

In treating intermittent fevers, physicians have formed indications of cure according to their different theories. The followers of Boerhaave, Stahl, &c. who imagined that the disease proceeded from a lentor or other disorder in the blood and juices, always thought it necessary to correct and evacuate these peccant humours by emetics and purgatives before they attempted to stop the disease by the bark or any other medicine: The bark indeed seems to be held in very little estimation by them; since Vogel affirms, that this medicine, instead of deserving to have the preference of all other febrifuge medicines, ought rather to be ranked among the lowest of the whole; and for this reason he ascribes the cures hereafter mentioned, by the external application of the bark, entirely to nature.

The circumstances which may especially prevent the fulfilling of these two indications, and therefore give occasion to the third, are, a phlogistic diathesis prevailing in the system, and congestions fixed in the abdominal viscera. The first must be removed by blood-letting and the antiphlogistic regimen; the second, by vomiting and purging.

It is not, however, very common for intermittents to be cured by medicines given during the time of the paroxysm. The bark is the medicine to which we are chiefly to trust. Our physicians are now generally agreed, that very little preparation of the body is requisite previous to the administration of the bark, in intermittent fevers. It is sufficient to cleanse the stomach and alimentary canal by an emetic or cathartic. Where the disease is attended with sickness or nausea, six or eight grains of ipecacuanha may be given: but where there are no symptoms of this kind, it is better to give a stomachic purge, as an ounce or two of tinctura sacra, or a few grains of pil. Ruffi. These are to be administered in the intermission, immediately after the paroxysm hath ceased, so that their operation may be over before its return; and after their operation is completed, the bark may be given with perfect safety. If the paroxysm be moderate, we need not have recourse to the bark till another fit hath manifested the true nature of the disease: but if it proves severe, there is often an absolute necessity for administering the bark on the first intermission of the fever, and even with hardly any preparation of the patient.

The bark hath been often observed to fail in removing intermittents, from not continuing the use of it for a sufficient length of time, from administering it in too small a dose, or from giving it in an improper form. It was a prevailing opinion, that an ounce, or an ounce and a half, of the bark, taken during one intermission,

is sufficient to prevent the return of another paroxysm. But this is not always the case; for a severe fit will often attack a patient who hath taken such a quantity. When this happens, the patient ought to persevere during the following intermissions, with an increase of the dose, till five or six ounces at least have been taken. The medicine also ought not to be omitted as soon as one fit is stopped, but should be continued in a smaller dose for at least ten days or a fortnight. Even for several months after the disease is entirely removed, it would be advisable to take a little bark occasionally in damp weather, or during an easterly wind, to prevent a relapse. Where the intervals between the fits are short, as in quotidianas and double tertians, from one to two drachms of it ought to be taken every two or three hours.

GENUS II. QUARTANA; the QUARTAN or FOURTH DAY FEVER.

Description. The genuine quartan, according to Juncker, keeps its form more exactly than other intermittents; scarcely coming on at any other time than four or five in the afternoon. The cold is less violent than in the tertian; but is very perceptible, though it doth not proceed to such a height as to make the limbs shake; and continues for about two hours. It is preceded and accompanied by a languor both of body and mind. There is seldom any vomiting unless when the stomach is manifestly overloaded with aliment; neither is there any diarrhoea, but the belly in general is rather bound, not only on the days on which the paroxysm takes place, but also on the intermediate ones. The heat, which slowly succeeds the cold, is less troublesome to the patient by its violence than by the uneasy dryness of the skin, which is scarce ever moistened with sweat. This heat rarely continues longer than four or six hours, unless perhaps at the first or second paroxysm. It is accompanied also with a giddiness and dull pain of the head. On the termination of the paroxysm, the patient returns to a middling state of health, and continues in the same for the rest of the intermediate days; only there remains somewhat of a loathing, and a deep-seated pain, as if the person was all over bruised or broken, which kind of sensation the physicians are wont to call *osteoporus*. The fit returns every fourth day, and that precisely at the same hours, being rarely postponed.

Causes of, and Persons subject to this Disorder. The same general causes concur in producing this as in other intermittents, namely, marshy miasmata, and whatever can dispose the body to be easily affected by them. Studious people, and those of a melancholic turn, are said to be particularly subject to quartans; but what are the immediate causes which produce a return of the fits every fourth day, instead of every day, or every third day, must no doubt lie for ever concealed, as depending upon the secret and inexplicable mechanism of the human body.

Prognosis. A simple quartan, where there is no reason to dread any induration of the viscera, may very certainly admit of a cure; and the prognosis can never be unfavourable, unless in cases of extreme weakness, or where the distemper hath been unskillfully treated.

Cure. This does not in the least differ from that which hath been laid down for the simple tertian, and which it is therefore needless to repeat here.

To the tertian or quartan fevers also belong the *Erraticæ* of authors. As all those abovementioned differ only in the slight circumstance of the type from the intermitting and remitting tertians already described at length, it is unnecessary here to take up time in describing every minute circumstance related by physicians concerning them, especially as it could contribute nothing towards the laying down a better method of cure than what hath been already suggested.

GENUS III. QUOTIDIANA; the QUOTIDIAN or DAILY FEVER.

Description. This kind of fever generally comes on about six or seven o'clock in the morning, beginning with a considerable degree of cold and shivering, which lasts for about an hour; and is often accompanied with vomiting, or spontaneous diarrhoea, or both. It is succeeded by a pretty strong heat, accompanied with thirst, restlessness, and pain of the head. When the heat abates a little, spontaneous sweat commonly follows, and the whole paroxysm rarely exceeds six hours. It returns, however, every day almost always at the same hour, unless it is evidently disturbed.

Causes of, and Persons subject to, the Disease. The same general causes are to be assigned for the quotidian as for other intermittents. This kind occurs but rarely: and is said to attack people of a phlegmatic temperament rather than any other; also old people rather than young, and women rather than men. The prognosis and method of cure are not different from those of tertians and quartans.

CONTINUED FEVERS.

GENUS IV. SYNOCHA:

Description. The synocha, or diary fever, begins without any sensation of cold or shivering, unless there is some internal inflammation, or the small pox or measles happen to be present. A continual heat without any intermission constitutes the essence of this disease. The heat, however, is more tolerable than in the synocha

MEDICINE.

synocha properly so called. In some the pains of the head are pungent and throbbing, answering to the pulsations of the arteries; but in others they are dull and heavy. The face is red and bloated; and there is a remarkable lassitude of the limbs, with a great, full, and frequent pulse. The urine is red, and deposits a sediment almost of the colour of orange-peel; and in the very first day of the disease, signs of concoction, (according to the Hippocratic phrase), appear in it. The fever commonly goes off with a gentle sweat, but more rarely with an hæmorrhage of the nose. Its shortest period is 24 hours; but if it goes beyond the fourth day, it is then a *synocha* properly so called.

Causes of, and Persons subject to, this Disease. As we have already remarked of intermittents, so must we also now remark of continued fevers, that it is impossible to discover those minute causes, which occasioned the difference of type betwixt one inflammatory fever and another, though most authors pretend to enumerate these with great certainty. Thus Juncker tells us, that the cause of the simple ephemera is plethora, together with any immoderate agitation and commotion of the fluids while in that state. Vogel reckons among the causes of his *febris diaria*, passions of the mind, pain, want of exposure to the sun, &c. a repulsion or absorption of certain humours; wounds, fractures, luxations, &c.: so that in general we may reckon every thing tending to increase the action of the arterial system to be in certain circumstances a cause of inflammatory fever. Hence we find those are more subject to the *synocha* whose constitution is either naturally robust, or who are exposed to those causes which tend to produce an increased action of the arterial system; such as hard labour, high living, &c.

Prognosis. The most simple kind of *synocha*, that is, the ephemera or diary fever, is commonly cured without the assistance of medicine; and therefore the prognosis is for the most part favourable: yet, if it is improperly treated by heating medicines, it may easily be converted into the other kind; or, if there is a putrid disposition of the fluids, into a fever of a very dangerous nature. The same thing is to be understood even of the most violent kind; for simple inflammatory fevers are not dangerous unless complicated with an affection of some particular part, as the pleura, stomach, &c.

Cure. Here Dr. Cullen objects to the hypothesis of those who are for leaving the cure of continued fevers to the operations of nature; because these operations are neither certain in themselves, nor are they so well understood as to enable us to regulate them properly; and it is likewise possible to supersede them by art. The plan therefore on which he proceeds is, to form his indications of cure upon the means of obviating the tendency to death in fevers; and these he reduces to three. 1. To moderate the violence of re-action. 2. To remove or obviate the causes of debility, as before mentioned; and, 3. To obviate or correct the tendency of the fluids to putrefaction, will be noticed under the following Genus.

GENUS V. TYPHUS; the Typhus, or Slow Nervous Fever.

Description. Of all the descriptions we have of the nervous fever, that of Dr. Huxham is the best. According to him, the patient at first grows somewhat listless, and feels slight chills, and shudders, with uncertain flushes of heat, and a kind of weariness all over, like what is felt after great fatigue. This is always attended with a sort of heaviness and dejection of spirit, more or less of a load, pain, or giddiness of the head; a nausea and disrelish of every thing soon follows, without any considerable thirst, but frequently with urging to vomit, though little but insipid phlegm is brought up. Though a kind of lucid interval of several hours sometimes intervenes, yet the symptoms return with aggravation, especially towards night: the head grows more giddy or heavy; the heats greater; the pulse quicker, but weak; with an oppressive kind of breathing. A great torpor, or obtuse pain and coldness, affects the hinder part of the head frequently, and oftentimes a heavy pain is felt on the top all along the *coronary suture*; this, and that of the back-part of the head, generally attend nervous fevers, and are commonly succeeded by some degree of a delirium. The pulse during all this time is quick, weak, and unequal; sometimes fluttering, and sometimes for a few moments slow; nay, even intermitting, and then with a sudden flush in the face, immediately very quick, and perhaps soon after surprisingly calm and equal; and thus alternately. The tongue at the beginning is seldom or never dry or discoloured, but sometimes covered with a thin whitish mucus: at length, indeed, it often appears very dry, red, and chapped, or of the colour of pomegranate rind; but this mostly at the *state* or close of the disease; yet however dry the tongue and lips seem, the patient scarce ever complains of thirst, though sometimes of a heat in the tongue. Frequently profuse sweats pour forth all at once about the ninth, tenth, or twelfth day, commonly coldish and clammy on the extremities; oftentimes very thin stools are discharged, and then nature sinks apace; the extremities grow cold, the nails pale or livid. This delirium sometimes ends in a profound coma, or unconquerable propensity to sleep, and that soon in eternal sleep. The stools, urine, and tears, run off involuntarily, and denounce a speedy dissolution, as the vast tremblings and twitchings of the nerves and tendons are preludes to a general convulsion, which at once snaps off the thread of life. In one or other of these ways are the sick carried off, after having languished for

fourteen, eighteen, or twenty days; nay, sometimes much longer. All persons grow deaf and stupid towards the end of this disease (some extremely deaf), though too quick and apprehensive at the beginning; inasmuch that the least noise or light greatly offended them. Many from their immoderate fears seem to hurry themselves out of life, where little danger is apparent at the beginning: nay, some will not allow themselves to sleep, from a vain fear of dozing quite away; and others, from the vast hurry, anxiety and confusion they are sensible of in it, or at their awaking.

Causes of, and Persons subject to, this Disorder. The nervous fever is a consequent of contagion received by means of some corrupted animal substance. It most commonly attacks persons of weak nerves, a lax habit of body, and a poor thin blood, those who have suffered great evacuations, a long dejection of spirits, immoderate watchings, studies, fatigue, &c. also those who have used much crude unwholesome food, vapid impure drinks, or who have been confined long in damp foul air; who have broken the vigour of their constitutions by salivations, too frequent purging, immoderate venery, &c. Hence we see that the disease consists principally in an extreme debility of the nervous system; for, when people are prepared for this fever by having their nerves already weakened, the contagious particles immediately attack the nervous system, without so much affecting the state of the blood or juices, though the latter are greatly affected in the putrid malignant fevers.

Prognosis. In nervous fevers, the prognosis is very much the same with that of the putrid malignant kind.

Cure. This fever is produced by a contagion affecting the nervous system of a person already debilitated, and thus producing weakness in an extreme degree.

In contagious diseases, of which this is one, we know, both from the effects which appear, and from dissections, that the tone of the heart and arteries is considerably diminished; and that tonic remedies are therefore properly indicated. We are to consider these remedies as of two kinds; 1. The power of cold; 2. That of tonic medicines.

The power of cold as a tonic in fevers may be employed in two ways; either as thrown into the stomach, or as applied to the surface of the body. As the power of cold may be communicated from any one part to every other part of the system, so it will be readily allowed that the stomach is a part as fit as any other for this communication, and that cold drink taken into the stomach may prove an useful tonic in fevers. This the experience of all ages has confirmed; but at the same time it has been frequently observed, that, in certain circumstances, cold drink taken into the stomach has proved very hurtful; and therefore that its use in fevers requires some limitations. What these limitations should be, and what are all the circumstances which may forbid the use of cold drink, it is difficult to determine; but it seems clearly forbidden in all cases where a phlogistic diathesis prevails in the system, and more especially when there are topical affections of an inflammatory nature.

The other method of employing cold as a tonic, is by applying it to the surface of the body, as a refrigerant power fit to moderate the violence of re-action; but probably it may here also be considered properly as a tonic, and useful in cases of debility. Not only cool air, but cold water also, may be applied to the surface of the body as a tonic. The ancients frequently applied it with advantage to particular parts as a tonic; but it is a discovery of modern times, that, in the case of putrid fevers attended with much debility, the body may be washed all over with cold water. This was first practised at Breslaw in Silesia, as appears from a dissertation under the title of *Epidemia Verna, quæ Wratislaviæ, anno 1737 afflxit*, to be found in the *Acta Nat. Curios.* vol. x. And from other writers it appears, that the practice has passed into some of the neighbouring countries; but in this island it doth not appear that we have yet had any experience of it.

The medicines which have been employed in fevers as tonics are various. If the *saccharum saturni* hath been found useful, it is probably as a tonic rather than as a refrigerant, and the *ens venetis*, or other preparations of iron which have been employed, can act as tonics only. The preparations of copper, from their effects in epilepsy, are presumed to possess a tonic power; but whether their use in fevers be founded on their tonic or emetic powers, is uncertain. And upon the whole there may, do doubt, occur some instances of fevers being cured by tonics taken from the fossil kingdom; but the vegetable tonics are the most efficacious, and among these the Peruvian bark certainly holds the first place.

The bark has commonly been considered as a specific, or a remedy of which the operation was not understood. We must observe, however, that, as in many cases the effects of the bark are perceived soon after its being taken into the stomach, and before it can possibly be conveyed to the mass of blood, we may conclude, that its effects do not arise from its operating on the fluids; and must therefore depend upon its operating on the nerves of the stomach, and being thereby communicated to the rest of the nervous system. This operation seems to be a tonic power, the bark being a remedy in many cases of debility, particularly in gangrene: and if its operation may be explained from its possessing a tonic power, we may easily perceive why it is improper when a phlogistic diathesis prevails; and from the same view we can ascertain in what cases of continued fever it may be admitted.

MEDICINE.

Of all the stimulants which may be properly employed, wine seems to be the most eligible. It has the advantage of being grateful to the palate and stomach, and of having its stimulant parts so much diluted, that it can be conveniently given in small doses; and therefore it may be employed with sufficient caution; but it is of little service unless taken pretty largely. It may be suspected that wine has an operation analogous to that of opium; and on good grounds. But we can distinctly remark its stimulant power only; which renders its effects in the phrenetic delirium manifestly hurtful; and in the mild delirium depending on debility, as remarkably useful.

The other method of cure is to correct or obviate the tendency in the fluids to putrefaction. This may be done, 1. By avoiding any new application of putrid or putrescent matter. 2. By evacuating the putrid or putrescent matter already present in the body. 3. By correcting the putrid or putrescent matter remaining in the body by diluents and antiseptics. 4. By supporting the tone of the vessels, and thereby resisting further putrefaction, or obviating its effects. 5. By moderating the violence of re-action, considered as a means of increasing putrefaction.

The further application of putrid or putrescent matter may be avoided, 1. By removing the patient from places filled with corrupted air. 2. By preventing the accumulation of the patient's own effluvia, by a constant ventilation, and by a frequent change of bed clothes and body-linen. 3. By the careful and speedy removal of all excremental matters from the patient's chamber. 4. By avoiding animal food.

The putrid or putrescent matter already present in the body, may be evacuated partly by frequent evacuations of the contents of the intestines; and more effectually still by supporting the excretions of perspiration and urine by the plentiful use of diluents. That which remains in the body may be rendered more mild and innocent by the use of diluents, or may be corrected by the use of antiseptics. These last are of many and various kinds; but which of them are conveniently applicable, or more particularly suited to the case of fevers, is not well ascertained. Those most certainly applicable and useful are acceſcent aliments, acids of all kinds, and neutral salts.

The progress of putrefaction may be considerably retarded, and its effects obviated, by supporting the tone of the vessels; and this may be done by tonic medicines, of which the chief are cold, and the Peruvian bark, as already mentioned. The violence of re-action increasing the tendency to putrefaction, may be moderated by the means already mentioned under *synocha*. These are the proper indications to be observed in the cure of the slow nervous fever.

Towards the decline of the fever also, where the sweats are abundant and weakening, small doses of the tincture of the bark, with saffron and snake-root are given with the greatest advantage, frequently interposing a dose of rhubarb to carry off the putrid colluvies in the first passages; which, withal makes the remissions or intermissions that often happen in the decline of nervous diseases more distinct and manifest, and gives a fairer opportunity of throwing in the bark, for in the proper exhibition of this medicine we are to place our chief hope of curing both the nervous and putrid malignant fevers.

GENUS VI. FEBRIS PESTILENS, MALIGNA; Putrid, Pestilential, or Malignant Fever.

Description. This is a disease of the most dangerous nature, as, besides the extreme debility of the nervous system; there is a rapid tendency of the fluids to putrefaction; which sometimes cuts off the patient in a few days, nay, in the warm climates, in 12 or 14 hours; or if the patient recovers, he is for a long time, even in this country, in an exceedingly weak state, and requires many weeks to recover his former health.

The putrid fevers according to Huxham, make their attack with much more violence than the slow nervous ones; the rigors are sometimes very great, though sometimes scarce felt; the heats much sharper and permanent; yet, at first, sudden, transient, and remittent; the pulse more tense and hard, but commonly quick and small; though sometimes slow, and seemingly regular for a time, and then fluttering and unequal. The head-ach, nausea, and vomiting, are much more considerable even from the beginning. Sometimes a severe fixed pain is felt in one or both temples, or over one or both eye-brows; frequently in the bottom of the orbits of the eyes. The eyes always appear very dull, heavy, yellowish, and very often a little inflamed. The countenance seems bloated, and more dead-coloured than usual. Commonly the temporal arteries throb much, and a tinnitus aurium is very troublesome; a strong vibration also of the carotid arteries frequently takes place in the advance of the fever, though the pulse at the wrist may be small, nay, even slow; this is a certain sign of an impending delirium, and generally proceeds from some considerable obstructions in the brain.

Few or none of these fevers are without a sort of lumbago, or pain in the back and loins; always a universal weariness or soreness is felt, and often much pain in the limbs. Sometimes a great heat, load, and pain, affect the pit of the stomach, with perpetual vomiting of porraceous or black choler; and a most troublesome singultus; the matter discharged is frequently of a very nauseous

smell. The tongue, though only white at the beginning, grows daily more dark and dry; sometimes of a shining livid colour, with a kind of dark bubble at top; sometimes exceeding black; and so continues for many days together; nor is the tinge to be got off many times for several days, even after a favourable crisis: at the height of the disease, it generally becomes vastly dry, stiff, and black, or of a dark pomegranate colour. Hence the speech is very inarticulate, and scarce intelligible. The thirst in the increase of the fever is commonly very great, sometimes unquenchable; and yet no kind of drink pleases, but all seem bitter and mawkish; at other times, however, no thirst is complained of, though the mouth and tongue are exceedingly foul and dry; this is always a dangerous symptom, and ends in a frenzy or coma. The lips and teeth, are furred up with a very black tenacious fordes. At the onset of the fever, the urine is often crude, pale, and rapid, but grows much higher coloured in the advance, and frequently resembles a strong lixivium, or citrine urine, tinged with a small quantity of blood; it is without the least sediment or cloud, and so continues for many days together: by degrees it grows darker, like dead strong high-coloured beer, and smells very rank and offensive. In petechial fevers, the urine hath often been seen almost black and very fetid. The stools, especially near the state, or in the decline of the fever, are for the most part intolerably fetid, green, livid, or black, frequently with severe gripes and blood. When they are more yellow or brown, the less the danger: but the highest when they run off insensibly, whatever their colour may be. It is likewise a very bad symptom when the belly continues tense, swollen, and hard, after profuse stools, for this is generally the consequence of an inflammation or mortification of the intestines. A gentle diarrhoea is often very beneficial, and sometime seems to be the only way which nature takes to carry off the morbid matter.

Sometimes black, livid, dun, or greenish spots appear, which always indicate a high degree of malignity; however, the more florid the spots are, the less danger is to be feared. It is also a good sign when the black or violet petechiae become of a brighter colour. The large, black, or livid spots, are almost always attended with profuse hæmorrhages; and the small, dusky, brown spots, like freckles are not much less dangerous than the livid or black; though they are seldom accompanied with fluxes of blood; excessively profuse, cold, clammy sweats are often concomitant, by which also they sometimes vanish, though without any advantage to the patient. The eruption of the petechiae is uncertain; sometimes they appear on the fourth or fifth day; though sometimes not till the eleventh, or even later. The *vibices*, or large, dark greenish marks, seldom appear till very near the fatal period. Frequently also we meet with efflorescence like the measles in malignant fevers, but of a much more dull and livid hue; in which the skin, especially on the breast, appears as it were marbled or variegated. This in general is an ill symptom, and is often attended with fatal consequences.

Sometimes about the 11th or 14th day, on the coming on of profuse sweats, the petechiae disappear, and vast quantities of white miliary pustules break out. This is seldom found of any considerable advantage; but an itching, smarting, red rash, commonly gives great relief; and so do the large, fretting, watery bladders, which many times rise upon the back, breast, shoulders, &c. A scabby eruption likewise about the lips and nose is certainly one of the salutary symptoms; and the more hot and angry it is, so much the better. But of much more uncertain and dangerous event are the brown coloured apthæ; nor are those that are exceeding white and thick like lard, of a very promising aspect. They are soon succeeded by great difficulty of swallowing, pain and ulceration of the fauces, œsophagus, &c. and with an incessant singultus; the whole *primæ viæ* become at last affected; a bloody dysentery comes on, followed by a sphacelation of the intestines; as is evident from the black, sanious, and bloody stools, extremely fetid and infectious. *Vibices*, or large, black, and bluish marks resembling bruises, are frequently seen towards the close of the fever; and when attended with lividity and coldness of the extremities, are certain tokens of approaching death. In some cases, the blackness hath been known to reach almost to the elbows, and the hands have been dead cold for a day or two before the death of the patient.

Such are the general appearances of the putrid malignant fever in this country, among those who enjoy a free air, and are not crowded together, or exposed to the causes of infection; but in jails, hospitals, or other places where the sick are crowded, and in some measure deprived of the benefit of the free air, the symptoms are if possible, more terrible.

Causes of, and Persons subject to, this Disorder. The cause of this fever, as well as that of the slow nervous fever, is an infection or contagion from some diseased animal body, or from corrupted vegetables; and therefore is very little, if at all, different from those pestilential disorders which have arisen after battles, when great numbers of dead bodies were allowed to lie above ground and effect the air with their effluvia. This is confirmed by an observation of Forestus, who was eye-witness to a distemper of this kind, (which indeed he calls a *plague*), owing to the same cause, attended with buboes and a high degree of contagion. The same author also gives an account of a malignant fever breaking out

MEDICINE.

out at Egmont in North Holland, occasioned by the rotting of a whale which had been left on the shore. We have a like observation of a fever affecting the crew of a French ship, by the putrefaction of some cattle which they had killed on the island of Nevis, in the West Indies. These men were seized with a pain in their head and loins, great weakness, and a disorder of the stomach, accompanied with fever. Some had carbuncles; and on others purple spots appeared after death.

Galen assigns two causes for pestilential fevers: 1. The great heat of the weather, when the humours happen to be in a more putrescent state than usual. 2. A putrid state of the air, arising either from a multitude of dead bodies left unburnt, as after a battle, or from the evaporation of corrupted lakes and marshes.

Prognosis. In these fevers we cannot draw a prognostic from any symptom by itself; and perhaps all of them together are more fallible than in others. Generally the following are good; turbid urine in the decline of the disease: and at that time a gentle sweat or moisture diffused over the body, or even the skin soft, and the tongue moist; or to have some loose stools, succeeded by a diaphoresis: the pulse to rise by wine or cordials, with an abatement of the stupor, tremor, and other affections of the brain. Deafness is rather a good sign. The bad signs are, a *subfultus tendinum*: the eyes much inflamed and staring; the speech quick, and the sound of the voice altered; a high delirium; perpetual watchfulness; constant sickness at the stomach, and vomitings; frequent stools, with a sinking pulse, and the disorder of the head increased; coldness of the extremities, and a tremulous motion of the tongue. It is observed to be among the worst signs when the patient complains of blindness; when he swallows with difficulty, or cannot put out his tongue when desired; when he can lie on his back only, and pulls up his knees; or when, insensible, he endeavours to uncover his breast, or makes frequent attempts to get out of bed, without assigning any reason. If to any of these are added, ichorous, cadaverous, and involuntary stools, it is a sign of a mortification of the bowels, and approaching death. It will not seem strange to find most of these prognostics common to the advanced state of other fevers, when we consider, that from whatever cause fevers begin, by a long continuance the humours are corrupted, and the brain and nerves affected much in the same manner as in those which arise from infection.

Prevention and Cure. As distempers of the putrid kind never arise without an infection received, from some quarter or other, the methods of prevention must evidently be reduced to two general heads. 1. To avoid receiving the affection into the body; and, 2. To put the body in such a situation as may enable it to resist the infection when received.

Cure. It now remains to consider the proper method of curing putrid fevers, on the supposition that the infection hath been allowed to operate till the blood becomes radically tainted, and of consequence the nervous system affected to such a degree, that its power cannot be restored by any of the simple medicines before mentioned. Here all authors agree that a change of air, when it can be effected, is absolutely necessary, and often contributes more towards the removing of the disease than all the medicines that can be exhibited.

Vomits must be used with caution; for, though they may be of use by way of prevention, yet in the advanced state of the disease, when the patient has all along complained of a sickness at stomach, they are evidently unsafe. Here the antiseptic quality of fixed air is of much use, and the neutral draughts given in the act of effervescence are generally attended with happy effects. Nay, clysters of fixed air itself have been found very serviceable. Even in very bad stages of the distemper, where a putrid and colliquative looseness hath taken place, clysters of fixed air have been known to alleviate the symptoms. We must not, however, put too much confidence in medicines of this kind. Mild astringent cordials, especially the wine and Peruvian bark, are the only resources in these disorders. Concerning the former, Sir John Pringle observes, in the low state of these fevers, and in great sinkings, which either come after unseasonable bleedings, or long want of nourishment, it was a most grateful and efficacious cordial, to which nothing was comparable. Perhaps there is no rule more necessary in this state, than not to let the patient, when low, remain long without taking something cordial and nourishing; as many have been observed past recovery, by being suffered to pass a whole night without any support, about the time of the crisis. In the advanced state of this fever the sick are remarkably low; and therefore Hoffman advises, in such cases, that they should be constantly kept in bed, and not permitted even to sit up in it. In the last stage of this fever, as well as in that of the sea-scurvy, it would seem that the force of the heart was too small to convey the blood to the brain, except when the body is in an horizontal posture.

But, however necessary wine and the bark may be in the low stages of this fever, we must remember, that these remedies are to be administered only as antiseptics and supporters of the *vis vita*, without aiming at thoroughly raising the pulse, or relieving the head, or at forcing a sweat by them, before nature points that way. If the delirium increased upon using wine, if the eyes looked wild, or the voice became quick, there was reason to apprehend a *phrenitis*; and accordingly it was observed, that at such times all in-

ternal heating medicines aggravated the symptoms; and in these cases blisters were of the greatest service. Fomentations of vinegar, and warm water for the feet, our author is of opinion, would answer better than either sinapisms or blisters, provided they were long enough and often enough applied. In the inflammatory fevers, he has known these fomentations have little effect for the first hour, and yet succeed afterwards. For internal medicine, the bark was omitted for some time, but the patient was continued with an acidulated drink, *viz.* barley-water and vinegar; and treated also with camphire, *pulvis contrayerva compositus*, and nitre, as was usual in the beginning of the fever. If the delirium was of the low kind, a decoction of the bark and wine were the only remedies; for in no instance was the delirium perfectly removed till the time of the crisis. It must also be observed, that a delirium may arise in putrid fevers from two opposite errors; one from large and repeated bleeding, and the other from wine and the cordial medicines being taken too early. It appears therefore how nice the principles are that regard the cure; as neither a hot nor a cool regimen will answer with every patient, or in every state of the disease.

If a diarrhoea came on the decline of a fever, it was moderated, but not suppressed, by adding an opiate to the usual medicines. For though the looseness may be considered as critical, yet, as the sick were too low to bear evacuations, there was a necessity for restraining it in some measure; and it has often been observed, that when it has been treated in this manner, about the usual time of the crisis, the patient has fallen into a gentle sweat, which has carried off the disease. In proportion to the putrid nature of the stools, opiates and astringents were used with the greater caution.

Sometimes the patient falls into an irregular intermittent; which, if not of an hectic nature, from an internal abscess, may proceed from neglecting to clear the *prima via*. For it is easy to conceive, that after a long fever, of such a putrid nature, often attended with languor of the bowels, the feces may be so much accumulated, and so corrupted, as to occasion new disorders. In such cases, after proper evacuation by purge, the bark was almost an infallible remedy.

GENUS VII. SYNOCHUS or HECTIC FEVER.

This is a contagious distemper, being a complication of a *synocha*, and *typhus*; we shall therefore refer to what hath been already said concerning these diseases.

The hectic is reckoned by Dr. Cullen to be merely symptomatic; as, indeed, seems very probable, seeing it always accompanies absorption of *pus* into the blood, from internal suppurations, or indeed from such as are external, provided they are very large or of a bad kind.

Description. The best description of this disorder we have, is that by Dr. Heberden. According to him, the appearance of the hectic fever is not unlike that of the genuine intermittent; from which, however, the disease is very different in its nature, as well as infinitely more dangerous. In the true intermittent, the three stages of cold, heat, and sweat, are far more distinctly marked, the whole fit is much longer, the period which it observes is more constant and regular, and the intermissions are more perfect, than in the hectic fever. For in the latter, even in the clearest remission, there is usually a feverish quickness perceptible in the pulse, which seldom fails to exceed the utmost limits of a healthy one, by at least ten strokes in a minute.

The chilliness of the hectic fever is sometimes succeeded by heat, and sometimes immediately by a sweat, without any intermediate state of heat. The heat will sometimes come on without any remarkable chilliness preceding; and the chilliness has been observed to go off without being followed either by heat or sweat. The duration of these stages is seldom the same for three fits together; and, as it is not uncommon for one of them to be wanting, the length of the whole fit must vary much more than in the true intermittent; but in general it is much shorter.

The hectic fever will return with great exactness, like an intermittent, for two, or perhaps three fits; but Dr. Heberden informs us, that he does not remember ever to have known it keep the same period for four fits successively. The paroxysm will now and then keep off for ten or twelve days; and at other times, especially when the patient is very ill, it will return so frequently on the same day, that the chilliness of a new fit will follow immediately the sweat of the former. It is not unusual to have many threatenings of a shivering return in the same day; and the same degree of drowsiness is apt to attend the cessation of a fit.

The urine in a true intermittent, is clear in the fits and turbid in the intervals; but in the hectic fever it is liable to all kinds of irregularity. It will be equally clear or turbid in both stages; or turbid in the fits and clear in the intervals; and sometimes it will be, as in a true intermittent, clear during the fever, and thick at the going off.

Hectic patients often complain of pains like those of the rheumatism, which either affect by turns almost every part of the body, or else return constantly to the same part; which is often at a great distance from the seat of the principal disorder, and, as far as is known, without any peculiar connection with it. Those pains

*

6 U

are

MEDICINE.

are so violent in some patients as to require a large quantity of opium. As far as Dr. Heberden has observed, they are common, where the hectic arises from some ulcer open to the external air, as in cancers of the face, breast, &c. Joined with this fever, and arising probably from one common cause, he has been surprised to see swellings of the limbs, neck, or trunk of the body, rise up almost in an instant, as if the part was all at once grown fatter.— These swellings are not painful, hard, or discoloured, and they continue for several hours.

Dr. Heberden has seen this fever attack those who seemed in tolerable health, in a sudden and violent manner, like a common inflammatory one; and, like that, also, in a very short time, bring them into imminent danger of their lives; after which it has begun to abate, and to afford hopes of a perfect recovery. But though the danger might be over for the present, and but little of a fever remain, yet that little has soon shewed that it was kept up by some great mischief within, and, proving unconquerable by any remedies, has gradually undermined the health of the patient, and never ceased, except with his life. This manner of its beginning, however, is extraordinary; it much oftener dissembles its strength at first; and creeps on so slowly, that the subjects of it, though they be not perfectly well, yet for some months hardly think themselves ill; complaining only of being sooner tired with exercise than usual, of want of appetite, and falling away. But, gentle as the symptoms may seem, if the pulse be quicker than ordinary, so as to have the artery to beat 90 times, and perhaps 120 times in a minute, there is the greatest reason to be apprehensive of the event. In no disorder perhaps is the pulse of more use to guide our judgment than in the hectic fever: yet even here we must be upon our guard, and not trust entirely to this criterion; for one in about 20 patients, with all the worst signs of decay, from some incurable cause, which irresistibly goes on to destroy his life, will shew not the smallest degree of quickness, or any other irregularity of the pulse, to the day of his death.

Causes, &c. This fever will supervene whenever there is a great collection of matter formed in any part of the body; but it more particularly attends upon the inflammation of the schirrhous gland, and even upon one that is slight and only just beginning; the fever growing worse in proportion as the gland becomes more inflamed, ulcerated, or gangrenous. And such is the lingering nature of those glandular disorders, that the first of those stages will continue for many months, and the second for many years.

Lying-in women, on account of the violence sustained in delivery, generally die of this fever. Women of the age of near 50 and upwards, are particularly liable to it. For, upon the cessation of their natural discharge, the glands of the breasts, ovaries, or womb, too commonly begin to grow schirrhous, and proceed to be cancerous. Not only these, but the glandular parts of all the abdominal viscera, are disposed to be affected at this particular time, and to become the seats of incurable disorders.

The injuries done to the stomach and liver by hard-drinking, are attended with similar symptoms, and terminate in the same manner.

Dr. Heberden observes, that the slightest wound, by a fine pointed instrument is known, upon some occasions, to bring on the greatest disturbances, and the most alarming symptoms, nay, even death itself. For not only the wounded part will swell and be painful, but, by turns, almost every part of the body; and very distant parts have been known to come even to suppuration. These symptoms are constantly accompanied with this irregular intermittent, which lasts as long as any of them remain.

Prognosis. This anomalous fever is never less dangerous than when it belongs to a kindly suppuration, into which all the diseased parts are melted down, and for which there is a proper outlet.

The symptoms and danger from some small punctures, with their concomitant fever, most frequently gives way, in a few days, though in some persons they have continued for two or three months, and in others have proved fatal.

The inflammation of internal schirrhous glands, or of those in the breasts, sometimes goes off, and the fever, which depended upon it, ceases; but it much oftener happens, that it proceeds to cancerous and gangrenous ulcers, and terminates in death.

Cure. The same medicines are not likely always to suit a fever, which, arising from very different causes, is attended with such a variety of symptoms. A mixture of afoetida and opium, has, in some persons, seemed singularly serviceable in this fever, when brought on by a small wound; but in most other cases the principal, if not the sole attention of the Physician must be employed in relieving the symptoms, by tempering the heat, by preventing both costiveness and purging, by procuring sleep, and by checking the sweats. If at the same time, continues Dr. Heberden, he put the body into as good general health as may be, by air, exercise, and a proper course of mild diet, he can perhaps do nothing better than to leave all the rest to nature. In some few fortunate patients nature appears to have such resources as may afford reason for entertaining hopes of cure, even in very bad cases. For some have recovered from this fever attended with every symptom of abdominal viscus incurably diseased, after all probable methods of relief from art had been tried in vain, and after the flesh and strength were so exhausted as to leave scarce any hopes from nature. In

those deplorable circumstances, there has arisen a swelling not far from the probable seat of the disorder, and yet without any discoverable communication with it. This swelling has come to an abscess; in consequence of which the pulse has soon returned to its natural state, as have also the appetite, flesh, and strength. What nature has performed in those rare cases, Dr. Heberden acquaints us, he has often endeavoured to imitate, by making issues or applying blisters near the seat of the disease; but he cannot say with the same success.

It seems at present, Dr. Heberden observes, the opinion of many practitioners, that the gangrenes will be stopped, and suppuration become more kindly, by the use of bark; and therefore this remedy is always either advised or permitted in the irregular fever joined with suppurations and gangrenes; but he affirms he does not remember ever to have seen any good effect from the bark, in this fever, unattended with an apparent ulcer; and even in gangrenes it so often fails, that in successful cases, where it has been administered, there must be room for suspicion that the cure was owing to another cause. Dr. Heberden acknowledges, at the same time, that he never saw any harm from the bark in these, or indeed in any other cases, except a purging or sickness, of no consequence, where it has happened to disagree with the stomach, or where the latter has been loaded, by taking the medicine too fast; especially in dry boluses, wrapped in wafer-paper.

In hectic illnesses, where all other means have proved ineffectual, a journey to Bath is usually proposed by the friends, and wished for by the sick; but Dr. Heberden justly observes, that, besides the fatigue, and many inconveniences of a journey to a dying person, the Bath waters are peculiarly hurtful in this fever, which they never fail to increase, and thereby aggravate the sufferings, and hasten the death of the patient.

ORDER II. PHLEGMASIÆ; OR, INFLAMMATIONS.

GENUS VIII. PHLOGOSIS; *Heat and painful Tension of some External or Internal Part.*

This disease is a synocha fever, accompanied with an inflammation of some particular part, either external or internal, and consequently varies very much in its form, and the degree of danger attending it, according to the situation and functions of the part affected with topical inflammation.

For the cure of inflammations, Dr. Cullen lays down the following indications. 1. To remove the remote causes when they are evident, and continue to operate. 2. To take off the phlogistic diathesis affecting the whole system or the particular part. 3. To take off the spasm of the particular part, by remedies, applied to the whole system, or to the part itself.

This means of removing the remote causes will readily occur, from considering the particular nature and circumstances of the different kinds. Acrid matters must be removed, or their action must be prevented, by the application of demulcents. Compressing and over-stretching powers must be taken away; and, from their several circumstances, the means of doing so will be obvious.

The means of taking off the phlogistic diathesis of the system are the same with those already mentioned, under the cure for synocha. The means of taking off the spasm also from the particular part, are much the same with those already mentioned. Only it is to be remembered, that topical bleedings, such as cupping with scarification, applying leeches, &c. are in this case much more indicated; and that some of the other remedies are to be directed more particularly to the part affected, as shall be more fully considered when we treat of those diseases attended with particular inflammations.

When a tendency to suppuration is perceived, the proper indication is to promote the production of perfect pus as much as possible. For this purpose various remedies, supposed to possess a specific power, have been proposed; but it does not appear that any of them are possessed of a virtue of this kind; and, in our author's opinion, all that can be done is to favour the suppuration; by such applications as may support a moderate heat in the part, by some tenacity confine the perspiration, and by an esollient quality may weaken the cohesion of the teguments, and favour their erosion. As all abscesses are occasioned by the effusion of fluids, and as in the case of certain effusions a suppuration becomes not only unavoidable, but desirable, it may be supposed that most of the means of procuring a resolution by diminishing the force of circulation, &c. ought to be avoided. But as we observe on the one hand, that a certain degree of increased impetus, or of the original symptoms of inflammation, is necessary to produce a proper suppuration, so it is then especially necessary to avoid those means of resolution which may diminish too much the force of circulation. And, on the other hand, as the impetus of the blood, when violent, is found to prevent the proper suppuration; so, in such cases, though a tendency to suppuration may have begun, it may be proper to continue those means of resolution which moderate the force of the circulation. For further observations respecting abscesses, see the Article ABSCESS.

When an inflammation has taken a tendency to gangrene, that event is to be prevented by every possible means; and these must be different, according to the nature of the several causes; but after a gangrene has in some degree taken place, it can be cured only by the separation of the dead from the living parts. This, in certain circumstances can be performed, and most properly, by the knife.

MEDICINE.

In other cases it can be done by exciting a suppuratory inflammation on the verge of the living part, whereby its cohesion with the dead part may be every where taken off, so that the latter may fall off by itself. While this is doing, it is proper to prevent the further putrefaction of the part, and its spreading wider. For this purpose various antiseptic applications have been proposed: but Dr. Cullen is of opinion, that while the teguments are entire, these applications can hardly have any effect; and, therefore, that the fundamental procedure must be to scarify the part, so as to reach the living substance, and, by the wounds made there, to excite the suppuration required. By the same incisions also we give access to antiseptics, which may both prevent the progress of the putrefaction in the dead, and excite the inflammation necessary on the verge of the living parts.

When the gangrene proceeds from the loss of tone, and when this, communicated to the neighbouring parts, prevents that inflammation which is requisite to the separation of the dead parts from the living, it will be necessary to obviate this loss of tone by tonic medicines given internally; and for this purpose the Peruvian bark has been found to be most effectual. But when the gangrene arises from the violence of inflammation, the bark may not only fail of proving a remedy, but may do harm: for its power, as a tonic, is especially suited to those cases of gangrene which proceed from an original loss of tone, as in the case of palsy and cedema; or in those cases where a loss of tone takes place, while the original inflammatory symptoms are removed.

On the other hand, Mr. Bell is of opinion, that incisions made with a view to admit the operation of antiseptic medicines in gangrenes, as well as the remedies themselves, must be pernicious, by reason of irritation they occasion, and by the danger of wounding blood-vessels, nerves, tendons, &c. also by allowing free passage for the putrescent fluids into the parts not yet affected. And unless they are carried so deep as to reach the sound parts, application of the antiseptic kind can never have any effect in answering the purpose for which they were intended. The same author also remarks, that all the advantages commonly observed, from the great number of applications recommended for gangrene, are obtained with more ease, and generally too with more certainty, from the use of some gentle stimulating embrocation; which, by exciting a slight irritation upon the surface, especially when assisted by a free use of the bark, produces, for the most part, such a degree of inflammation as is wished for. With this view he has frequently known a weak solution of sal ammoniac, a drachm of the salt to two ounces of vinegar and six of water, for a mixture of a very proper strength for every purpose of this kind. But the degree of stimulus can easily be either increased or diminished, according to circumstances, by using a larger or smaller proportion of the salt.

Whenever, either by the means recommended, or by a natural exertion of the system, a slight inflammation appears, between the diseased and sound parts, we may in general, with tolerable certainty, expect, that in due time the parts will be separated; and when a full suppuration is once fully established, there can be little doubt that the mortified parts will be soon and easily removed.

A complete separation being effected, the remaining sore is to be treated in the manner described under the article GANGRENE; with a proper attention, at the same time, to the support of the general system, by the continuance of a nourishing diet, the bark and such quantities of wine as may seem necessary.

With regard to the bark, however, it is proper to take notice of another case of mortification in which it is likewise unsuccessful; as well as in that attended with a high degree of inflammation; and that is, in those mortifications of the toes and feet common in old people, or which arise from any cause increasing the rigidity of the vessels to such a degree as to prevent the motion of the fluids through them. In this case Mr. Pott has discovered, that all kinds of warm applications are unsuccessful; but that by the free use of opium, together with sedatives and relaxants externally applied, he has frequently seen the tumefactions of the feet and ankles subside, the skin recover its natural colour, and all the mortified parts separate in a very short time, leaving a clean sore. But as to scarifications, or any other attempt to separate artificially the mortified from the sound parts, he thinks them very prejudicial, by giving pain, which is generally of itself violent in this disease; and which seems to have a great share in producing the other evils.

GENUS IX. OPHTHALMIA; or Inflammation of the Eyes.
Cause. From the distinctions which authors have invented in the ophthalmia, it is evident, that by far the greatest part of them are symptomatic, or merely the consequences of other disorders present in the habit; and therefore the remedies must be directed towards the removal of these primary disorders; and when they are gone the ophthalmia will be removed of course. The inflammation of the eye may be considered as of two kinds; according as it is seated in the membranes of the ball of the eye, when it is named *ophthalmia membranarum*; or as it is seated in the sebaceous glands placed in the tarsus, or edges of the eye-lids, in which case it may be termed *ophthalmia tarfi*. These two kinds are very frequently connected together, as the one may excite the other; but they are still to be distinguished, according as the one or the other may happen to be the primary affection.

The inflammation of the membranes of the eye affects especially and most frequently, the adnata, and appears in a turgescence of its vessels; so that the red vessels, which are naturally there, become not only increased in size, but may more appear than in a natural state.

The *ophthalmia membranarum* requires the remedies proper for inflammation in general; and when the deeper seated membranes are affected, and especially when a pyrexia is present, large general bleedings may be necessary. But this last is seldom the case; and, for the most part, the ophthalmia is an affection purely local, accompanied with little or no pyrexia. General bleedings therefore have little effect upon it, and the cure is chiefly to be obtained by topical bleedings, that is, blood drawn from the vessels near the inflamed part; and opening the jugular vein, or the temporal artery, may be considered as in some measure of this kind. It is commonly sufficient to apply a number of leeches round the eye; and it is perhaps still better to draw blood by cupping and scarifying upon the temples. In many cases, the most effectual remedy is to scarify the internal surface of the interior eye-lid, and to cut the turgid vessels upon the adnata itself.

Besides blood-letting, purging, as a remedy suited to inflammation in general, has been considered as peculiarly adapted to inflammation in any part of the head, and therefore to ophthalmia; and it is sometimes useful: but for the reasons given before, with respect to general bleeding, purging, in the case of ophthalmia does not prove useful in any proportion to the evacuation excited. For relaxing the spasm in the part, and taking off the determination of the fluids to it, blistering near the part has commonly been found useless.

Ophthalmia, as an external inflammation, admits of topical applications. All those, however, which increase the heat, and relax the vessels of the part, prove hurtful; and the admission of cool air to the eye, and the application of cooling and astringent medicines, which at the same time do not produce irritation, prove useful. In the cure of this distemper indeed, all irritation must carefully be avoided, particularly that of light; and the only certain means of doing this is by keeping the patient in a dark chamber.

In the *ophthalmia tarfi*, the same medicines may be necessary as are already recommended for the *ophthalmia membranarum*. However, as the *ophthalmia tarfi* many often depend upon an acrimony deposited in the sebaceous glands of the part, so it may require various internal remedies, according to the variety of the acrimony in fault; for which we must refer to the consideration of scrophula, syphilis, or other diseases, with which this ophthalmia may be connected; and where these shall not be evident, certain remedies, more generally adapted to the evacuation of acrimony, such as mercury may be employed. In the *ophthalmia tarfi*, it almost constantly happens that some ulcerations are formed on the tarsus. These require the application of mercury and copper, which alone may sometimes cure the whole affection; and they may be useful even when the disease depends upon a fault of the whole system.

Both in the *ophthalmia membranarum*, and in the *ophthalmia tarfi*, it is necessary to obviate that gluing together of the eye-lids, which commonly happens in sleep; and which may be done by insinuating a little of any mild unctuous medicine between the eye-lids, before the patient shall go to sleep.

The slighter kinds of inflammations, from the dust or the sun, may be removed by fomenting with warm milk and water, adding a small portion of brandy; and by anointing the borders of the eye lids with *unguentum tutie*, or the like, at night, especially when those parts are excoriated and sore. But in bad cases, after the inflammation has yielded a little to evacuations, the *coagulum albuminum* of the London dispensatory, spread on lint, and applied at bed time, has been found the best external remedy. Before the use of the latter, the solution of white vitrol is prescribed with advantage; and in violent pains it is of service to foment frequently with a decoction of white poppy-heads.

GENUS X. PHRENTIS, PHRENZY, or Inflammation of the Brain.
The true phrenitis, or inflammation of the membranes or substance of the brain, is very rare as an original disease: but as a symptom of others much more frequent.

Description. The signs of an impending frenzy, are immoderate and continual watchings; or, if any sleep is obtained, it is disturbed with dreams and gives no refreshment; acute and lasting pains, especially in the hind part of the head and neck; little thirst, a great and slow respiration, as if proceeding from the bottom of the breast; the pulse sometimes small and slow, sometimes quick and frequent; a suppression of urine; and forgetfulness. The distemper, when present, may be known by the following signs: The veins of the head swell, and the temporal arteries throb much; the eyes are fixed, sparkle, and have a fierce aspect; the speech is incoherent, and the patient behaves very roughly to the bye-standers, with furious attempts to get out of bed, not indeed continually, but returning as it were by paroxysms; the tongue is dry, rough, yellow, or black; there is a coldness of the external parts; a proneness to anger; chattering of the teeth; a trembling of the hands, with which the sick seem to be gathering themselves, and actually do gather the naps off the bed clothes.

Cause:

MEDICINE.

Causes of, and Persons subject to, this Disorder. People of a hot and bilious habit of body, and such as are of a passionate disposition, are apt to fall into a phrenzy. The same danger are those in who use much spices, or are given to hot and spirituous liquors; who have been exposed more than usual to the sun, or obliged to undergo immoderate studies or watchings; who are subject to head-achs, or in whom some customary hæmorrhages have been stopped; or the disease may arise from some injury offered to the head externally. Dr. Pringle observes, that the phrenitis, when considered as an original disease, is apt to attack soldiers in the summer season, when they are exposed to the heat of the sun, and especially when asleep and in liquor. A symptomatic phrenzy is also more frequent in the army than elsewhere, on account of the violence done to all fevers, when the sick are carried in waggons from the camp to an hospital, where the very noise, or light alone, would be sufficient, with more delicate natures, to raise a phrenzy.

Prognosis. Every kind of phrenzy, whether idiopathic, or symptomatic, is attended with a high degree of danger; and, unless removed before the fourth day, a gangrene or sphacelus of the meninges readily takes place, and the patient dies delirious. The following are the most fatal symptoms: a continual and furious delirium, with watching; thin watery urine, white fæces, the urine and stools running off involuntarily, or a total suppression of these excretions; a ready disposition to become stupid, or to faint; trembling, rigor, chattering of the teeth, convulsions, hiccup, coldness of the extremities, trembling of the tongue, shrill voice, a sudden cessation of pain, with apparent tranquillity. The following are favourable: Sweats, apparently critical, breaking out; a seeming effort of nature to terminate the disease by a diarrhoea; a large hæmorrhage from the nose; swellings of the glands behind the ears; hæmorrhoids.

Cure. This is not different from the cure of inflammation in general; but here the most powerful remedies are to be immediately employed. Large and repeated bleedings are especially necessary, and these too taken from vessels as near as possible to the part affected. The opening the temporal artery has been recommended, and with some reason; but as the practice is attended with some inconveniences, perhaps the opening of the jugular viens may prove more effectual; with which, however, may be joined the drawing of blood from the temples by cupping and scarifying. It is also probable that purging may be of more use in this than in some other inflammatory affections, as it may operate by revulsion. For the same purpose of revulsion, warm pediluvia are a remedy, but rather ambiguous. The taking off the force of the blood in the vessels of the head by an erect posture is generally useful. Blistering is also useful, but chiefly when applied near to the part affected. In short, every part of the antiphlogistic regimen is here necessary, and particularly the admission of cold air. Even cold substances applied to the head have been found useful; and the application of such refrigerants as vinegar is certainly proper. Opiates are hurtful in every inflammatory state of the brain. On the whole, however, it must be remarked, that practitioners are very uncertain with regard to the means proper to be used in this disease; and the more so, that the symptoms by which the disease is commonly judged to be present, appear sometimes without any internal inflammation; and on the other hand, dissections have shewn that the brain has been inflamed, where few of the peculiar symptoms of inflammation had appeared before.

GENUS XI. CYNANCHE *Tonsillaris*; the Inflammatory QUINSY.

Description. This is an inflammation of the mucous membrane of the fauces, affecting principally that congeries of mucous follicles which forms the tonsils; and from thence spreading along the velum and uvula, so as frequently to affect every part of the mucous membrane. The disease appears by some tumour and redness of the parts; is attended with a painful and difficult deglutition; a troublesome clamminess of the mouth and throat; a frequent, but difficult, excretion of mucus; and the whole is accompanied with pyrexia. The inflammation and tumour are commonly at first most considerable in one tonsil; and afterwards, abating in that, increase in the other. This disease is not contagious.

Causes of, and Persons subject to, the Disorder. This disease is commonly occasioned by cold externally applied, particularly about the neck. It affects especially the young and sanguine; and a disposition to it is often acquired by habit. It occurs especially in the spring and autumn, when vicissitudes of heat and cold frequently take place.

Prognosis. This species of quinsy terminates frequently by resolution, sometimes by suppuration, but hardly ever by gangrene; though in some cases sloughy spots appear on the fauces: the prognosis therefore is generally favourable.

Cure. Here some bleeding may be necessary; but large and general evacuations are seldom beneficial. The opening of the angular veins seems to be an insignificant remedy, according to Dr. Cullen, but is recommended as efficacious by Sir John Pringle: and leeches set on the external fauces are serviceable. The inflammation may be often relieved by moderate astringents, and particularly by acids, applied to the parts affected. In many cases, nothing has been found to give more relief than the vapour of warm water received into the fauces.

Besides these, blistering and rubefacient medicines are applied with success, as well as antiphlogistic purgatives; and every part of the antiphlogistic regimen is to be observed, except the application of cold. Sir John Pringle recommends a thick piece of flannel moistened with two parts of common sweet oil, and one of spirit-of-hartshorn, (or in a larger proportion, if the skin will bear it,) applied to the throat, and renewed once every four or five hours. By this means the neck, and sometimes the whole body, is put into a sweat, which, after bleeding, either carries off or lessens the inflammation. When the disease takes a tendency to suppuration, nothing will be more useful than the taking into the fauces the steams of warm water. When the abscess is attended with much swelling, if it break not spontaneously, it ought to be opened by a lancet; and this does not require much caution, as even the inflammatory state may be relieved by some scarification of the tonsils. Dr. Cullen has never seen any case requiring bronchotomy.

THE MALIGNANT, PUTRID, OR ULCEROUS SORE THROAT.

No account of this distemper was published in this country till the year 1748, when a very accurate one was drawn up by Dr. Fothergill, and in 1752 by Dr. Huxham. The latter observes, that this disease was preceded by long, cold, and wet seasons; by which probably the bodies of people were debilitated, and more apt to receive contagion, which possibly also might be produced by the stagnant and putrid waters.

He observes that in a few hours after the seizure, and sometimes cotemporary with it, a swelling and soreness of the throat was perceived, and the tonsils became very tumid and inflamed, and many times the parotid and maxillary glands swelled very much, and very suddenly, even at the very beginning; sometimes so much as even to threaten strangulation. The fauces also very soon appeared of a high florid red, or rather of a bright crimson colour, very shining and glossy; and most commonly on the uvula, tonsils, velum palatinum, and back part of the pharynx, several whitish or ashy-coloured spots appeared scattered up and down, which oftentimes increased very fast, and soon covered one or both the tonsils, uvula, &c. those in the event proved sloughs of superficial ulcers, which sometimes, however, eat very deep into the parts. The tongue at this time, though only white and moist at the top, was very foul at the root, and covered with a thick yellowish or brown coat. The breath also now began to be very nauseous; which offensive smell increased hourly, and in some became at length intolerable, and that too sometimes even to the patients themselves. The nostrils likewise in many were greatly inflamed and excoriated, continually dripping down a most sharp ichor, or sanious matter, so excessively acrid, that it not only corroded the lips, cheeks, and hands of the children that laboured under the disease, but even the fingers and arms of the very nurses that attended them: a sudden stoppage of this rheum from the mouth and nostrils actually choked several children; and some swallowed such quantities of it, as occasioned excoriations of the intestines, violent gripings, dysentery, &c. nay, even excoriations of the anus and buttocks. Not only the nostrils, fauces, &c. were greatly affected by this extremely sharp matter, but the wind-pipe itself was sometimes much corroded by it, and pieces of its internal membrane were spit up, with much blood and corruption; and the patients lingered on for a considerable time, and at length died tabid; though there were more frequent instances of its falling suddenly and violently on the lungs, and killing in a peripneumonic manner.

An early and kindly eruption, however, was most commonly a very good omen; and, when succeeded by a very copious desquamation of the cuticle, one of the most favourable symptoms that occurred; but when the eruption turned of a dusky or livid colour, or prematurely or suddenly receded, every symptom grew worse, and the utmost danger impended, especially if purple, or black, spots appeared up and down, as sometimes happened; the urine grew limpid, and convulsions came on, or a fatal suffocation soon closed the tragedy.

The disease was generally at the height about the fifth or sixth day in young persons, in the elder not so soon; and the crisis many times was not till the eleventh and twelfth, and then very imperfect: some adults, however, were carried off in two or three days; the distemper either falling on the lungs, and killing in a peripneumonic manner, or on the brain; and the patient either died raving or comatose. In some, the disease brought on a very troublesome cough, purulent expectoration, hæmoptoe, and hectic; in which they lingered on for several weeks, and then died tabid.

In some few patients our author observed, some time before the fatal period, not only the face bloated, fallow, shining, and greasy as it were, but the whole neck vastly swollen, and of a cadaverous look; and even the whole body became in some degree œdematous; and the impression of a finger would remain fixed in a part, the skin not rising again as usual; an indication that the blood stagnated in the capillaries, and that the elasticity of the fibres was quite lost.

Prognosis. This may be easily gathered from the above description. The malignant and putrid tendency of the disease is evident, and an increase of the symptoms which arise from that putrescent disposition of the body must give an unfavourable prognosis; as, on the contrary, a decrease of these, and an apparent increase

MEDICINE.

increase of the *viz vite*, are favourable; in general, what is observed to be favourable in this, and *vice versa*.

Cure. In this the septic tendency of the disease is chiefly to be kept in view. The debility with which it is attended, renders all evacuations by bleeding and purging improper, except in a few instances where the debility is less, and the inflammatory symptoms more considerable. The fauces are to be preserved from the effects of the acrid matter poured out upon them, and are therefore to be frequently washed by antiseptic gargles or injections; and the putrescent state of the whole system should be guarded against and corrected by internal antiseptics, especially by the Peruvian bark given in the beginning, and continued through the course of the disease. Emetics, both by vomiting and nauseating, prove useful. When any considerable tumour occurs, blisters, applied externally, will be of service, and in any case may be proper to moderate the inflammation.

GENUS XII. PNEUMONIA. PNEUMONIC INFLAMMATION.

Under the general head of *Pneumonia*, are comprehended all inflammations of the thoracic viscera, or membrane lining the inside of that cavity; as the symptoms do not sufficiently distinguish the seat of the affection, nor does a difference in the situation of the affected place make any difference in the cure.

Description. Pneumonic inflammation, however various in the seat, always discovers itself by pyrexia, difficult breathing, cough, and pain in some part of the thorax. It almost always comes on with a cold stage, and is accompanied with the other symptoms of pyrexia; though, in some few instances, the pulse may not be more frequent, nor the heat of the body increased beyond what is natural. Sometimes the pyrexia is from the beginning accompanied with the other symptoms: but frequently is formed some hours before them, and particularly before the pain is felt. The pain is also different in different cases, and felt in different parts of the thorax, but most frequently in one side. It has been said to affect the right side more frequently than the left; but this is uncertain, and we are sure that the left side has been very often affected. Sometimes it is felt as it were under the sternum; sometimes in the back, between the shoulders; and, when in the sides, its place has been higher or lower, more forward or backward; but the place of all others most frequently affected is about the sixth or seventh rib, near the middle of its length, or a little more forward.

But as the symptoms never clearly indicate where the seat of the disease is, there is but little foundation for the different names by which it hath been distinguished. The term *pleurisy* is improperly limited to that inflammation which begins in and chiefly affects the *pleura costalis*; but this is a rare occurrence; and that because the pneumonia much more frequently begins in the pleura, investing the lungs, producing all the symptoms which belong to what has been called the *pleuritis vera*. It seems probable, that every acute inflammation begins in membranous parts; and in every dissection of persons dead of peripneumony, the external membrane of the lungs, or some part of the pleura, has appeared to have been considerably affected. An inflammation of the pleura covering the upper surface of the diaphragm, has been distinguished by the appellation of *paraphrenitis*, as supposed to be attended with the peculiar symptoms of delirium, *risus sardonicus*, and other convulsive motions: but it is certain that an inflammation of that portion of the pleura, and affecting also even the muscular substance of the diaphragm, has often taken place without any of the symptoms abovementioned; nor do any accounts of dissections support the opinion that an inflammation of the pleura covering the diaphragm is attended with delirium more commonly than any other pneumonic inflammation. It is to be observed, however, that though the inflammation may begin in one particular part of the pleura, the morbid affection is commonly communicated to the whole extent of the membrane.

The pneumonic inflammation, like others, may terminate by resolution, suppuration, or gangrene: but it has also a termination peculiar to itself; namely, when it is attended with an effusion of blood into the cellular texture of the lungs, which, soon interrupting the circulation of the blood through the viscus, produces a fatal suffocation. This indeed appears to be the most common termination of pneumonic inflammation when it ends fatally; for upon the dissection of almost every person dead of this disease, it appears that such an effusion had happened. It seems likewise probable, that an effusion of this kind is sometimes made into the cavity of the bronchiae; for in some persons, who have died after labouring under a pneumonic inflammation, for a few days only, the bronchiae have been found filled with a considerable quantity of ferous and thickish fluid, which must be considered rather as the effusion abovementioned, having had its thinner parts taken off by respiration, than as a *pus* so suddenly formed in the inflamed part.

Dr. Cullen is of opinion that the effusion into the bronchiae abovementioned, often concurs with the effusion of red blood into the cellular substance of the lungs, to occasion the fatal suffocation which frequently terminates peripneumony; that the effusion of serum alone may have this effect: and that the serum poured out in a certain quantity, rather than any debility in the powers of

expectoration, is the cause of that cessation of spitting which precedes the fatal event; for in many cases the expectoration has ceased, when no other symptoms of debility have appeared, and when, upon dissection, the bronchiae have been full of liquid matter. Nay, it is even probable, that in some cases, such an effusion may take place without any symptoms of violent inflammation which had appeared before, and thus account for those unexpected fatal terminations which have sometimes happened.

The evacuation most frequently attending, and seeming to have the greatest effect in promoting resolution, is an expectoration of a thick, white, or yellowish matter, a little streaked with blood, copious, and brought up without much or violent coughing. Very frequently the resolution of this disease is attended with, and perhaps produced by, a sweat, which is warm, fluid, copious, over the whole body, and attended with an abatement of the frequency of the pulse, heat of the body, and other febrile symptoms.

Causes of, and Persons subject to, the Disorder. The remote cause of pneumonic inflammation is commonly cold applied to the body, obstructing perspiration, and determining to the lungs, while at the same time the lungs themselves are exposed to the action of cold. These circumstances operate chiefly when an inflammatory diathesis prevails in the system; and therefore, upon persons of the greatest vigour, in cold climates, in the winter season, and particularly in the spring, when vicissitudes of heat and cold are frequent. This disease, however, may arise in any season when such varieties take place. Other remote causes also may have a share in producing this distemper; such as every means of obstructing, straining, or otherwise injuring, the pneumonic organs.

Prognosis. In pneumonic inflammations a violent pyrexia is always dangerous. The danger, however, is chiefly denoted by the difficulty of breathing. When the patient can lie on one side only; when he can lie on neither side, but only on his back; when he cannot breathe with tolerable ease, except when the trunk of his body is erect; when even in this posture the breathing is very difficult, and attended with a turgescence and flushing of the face, with partial sweats about the head and neck, and an irregular pulse, these circumstances mark the difficulty of breathing in different degrees; and consequently, in proportion, the danger of the disease. A frequent violent cough, aggravating the pain, is always the symptom of an obstinate disease; and as the disease is seldom or never resolved without some expectoration, so a dry cough must always be an unfavourable symptom.

When the pains which had at first affected one side only, shall afterwards spread into the other; or when, leaving the side first affected, they pass entirely into the other; these are always marks of a dangerous disease. A delirium coming on during a pneumonic inflammation is always a symptom denoting much danger. If the disease continues beyond the 14th day, it will terminate in a suppuration or phthisis. The termination by gangrene is much more rare than has been imagined: and when it does occur, it is usually joined with the termination by effusion; the symptoms of the one being hardly distinguishable from those of the other.

Cure. This must proceed upon the general plan mentioned under Synocha; but, on account of the importance of the part affected, the remedies must be employed early, and as fully as possible. Venesection is chiefly to be depended on; and may be done in either arm as the surgeon finds most convenient; and the quantity taken away ought in general to be as large as the patient's strength will allow. The remission of pain, and the relief of respiration during the flowing of the blood, may limit the quantity to be then drawn; but if these symptoms of relief do not appear, the bleeding should be continued till the symptoms of a beginning syncope come on. It is seldom that one bleeding, however large, will cure this disease; and though the pain and difficulty of breathing may be much relieved by the first bleeding, these symptoms commonly, and after no long interval, recur, often with as much violence as before. In this case the bleeding is to be repeated even on the same day, and perhaps to the same quantity as before. Sometimes the second bleeding may be larger than the first. There are persons, who, by their constitution, are ready to faint even upon a small bleeding; and in such persons this may prevent the drawing so much blood at first as a pneumonic inflammation may require: but as the same persons are found to bear after-bleedings better than the first, this allows the second and subsequent bleedings to be larger, and to such a quantity as the symptoms of the disease may seem to require.

Bleedings are to be repeated according to the state of the symptoms, and they will be more effectual when practised in the course of the first three days than afterwards; but they are not to be omitted though four days of the disease may already have elapsed. If the physician has not been called in time, or the first bleedings have not been sufficiently large, or even though they should have procured some remission, yet upon the return of the urgent symptoms, bleeding may be repeated at any time within the first fortnight, or even after that period, if a suppuration be not evident, or if after a seeming solution the disease shall have returned.

In a more advanced state, and when the symptoms have suffered a considerable remission, we may then trust the cure to the expectoration

MEDICINE.

toration alone. It is not observed that bleeding, during the first day of the disease, stops expectoration; on the contrary, it hath been often found to promote it; and it is only in a more advanced state of the disease, when the patient has been already exhausted by large evacuations and a continuance of his illness, that bleeding seems to put a stop to expectoration; and even then, this stoppage seems not to take place so much from the powers of expectoration being weakened by bleeding, as by its favouring the serous effusion in the bronchiz, already taken notice of.

Besides bleeding, every part of the antiphlogistic regimen ought here to be carefully employed: the patient must keep out of bed as much as he can bear; must have plenty of warm diluting drinks, impregnated with vegetable acids, accompanied with nitre or some other cooling neutral salt; and the belly also ought to be kept open by emollient glysters or cooling laxative medicines. Vomiting is dangerous; but it hath been found useful to exhibit emetics in nauseating doses; and in a somewhat advanced state of the disease, these doses have been found the best means of promoting expectoration. Fomentations and poultices to the pained part have been found useful; but blistering is found to be much more effectual. A blister, however, ought not to be applied till at least one bleeding hath been premised, as venesection is less effectual when the irritation of a blister is present. If the disease is moderate, a blister may be applied immediately after the first bleeding; but in violent cases, where it may be presumed that a second bleeding may soon be necessary after the first, it will be proper to delay the blister till after the second bleeding, when it may be supposed that the irritation occasioned by the blister will be over, before another bleeding becomes necessary. It may frequently be of use in this disease to repeat the blistering; and in that case the plaisters should always be applied somewhere on the thorax, for, when applied to more distant parts, they have little effect. The keeping the blistered parts open, and making what is called a perpetual blister, has much less effect than a fresh blistering.

Many methods have been proposed for promoting expectoration, but none appear to be sufficiently effectual; and some of them, being acrid stimulant substances, are not very safe. The gums, usually employed, seem to be too heating; the squills less so; but they are not very powerful, and sometimes inconvenient by the constant nausea they occasion. The volatile alkali may be of service as an expectorant, but it ought to be reserved for an advanced state of the disease. Mucilaginous and oily demulcents appear to be useful, by allaying that acrimony of the mucus which occasions too frequent coughing; and which coughing prevents the stagnation and thickening of the mucus, and thereby its becoming mild. The receiving the steams of warm water into the lungs, impregnated with vinegar, has often proved useful in promoting expectoration; and for this purpose the machine, called the *inhaler*, lately invented by Mr. Mudge, surgeon at Plymouth, promises to be of great service; but, of all others, the antimonial emetics, given in nauseating doses, promise to be the most powerful for promoting expectoration. The kermes mineral hath been greatly recommended; but doth not seem to be more efficacious than emetic tartar, or antimonial wine; and the dose of the kermes is much more uncertain than that of the others.

Though this disease often terminates by a spontaneous sweating, this evacuation ought not to be excited by art, unless with much caution. If, however, the sweats be partial and clammy only, and a great difficulty of breathing still remain, it will be very dangerous to encourage them.

Physicians have differed much with regard to the use of opiates in pneumonic affections. It appears, however, that, in the beginning of the disease, and before bleeding and blistering have produced some remission of the pain, and of the difficulty of breathing, opiates have a very bad tendency, by their encreasing the difficulty of breathing and other inflammatory symptoms; but in a more advanced state of the disease, when the difficulty of breathing has abated, and when the urgent symptom is a cough, proving the chief cause of the continuance of pain and want of rest, opiates may be employed with great advantage and safety.

VOMICA, or Abscess of the Lungs.

This sometimes follows pneumonia, though the case is not frequent. The symptoms of it so much resemble the phthisis, that it can most properly be treated of under that head.

GENUS XIII. CARDITIS, or Inflammation of the HEART.

Description. This disease is attended with all the symptoms of pneumonia, but in a higher degree; it is besides said to be accompanied with hydrophobic symptoms, fainting, palpitation of the heart, a seeming madness, sunk and irregular pulse, watery eyes, and a dejected countenance, with a dry and black tongue. On dissection, the heart and pericardium are found very much inflamed, and even ulcerated, with many polypous concretions.

Causes, &c. The same as in pneumonia.

Prognosis. In the carditis the prognosis is more unfavourable than in the pneumonia; and, indeed, unless the disease very quickly terminates, it must prove fatal, on account of the constant and violent motion of the heart, which exasperates the inflammation, and increases all the symptoms.

Cure. Here bleeding is necessary in as great a degree as the patient can possibly bear, together with blistering, and the antiphlo-

gistic regimen likewise carried to a greater height than in the pneumonia; but the general method is the same as in other inflammatory diseases.

GENUS XIV. GASTRITIS, or Inflammation of the STOMACH.

Description. The inflammation of the stomach is attended with great heat and pain in the epigastric region, extreme anxiety, an almost continual and painful hiccup, with a most painful vomiting of every thing taken into the stomach. Sometimes a temporary madness ensues; and there is an instance in the Edinburgh Medical Essays, of the disorder being attended with an hydrophobia. The pulse is generally more sunk than in other inflammations, and the fever inclines to the nature of a typhus. The disorder is commonly of the remitting kind, and, during the remissions, the pulse frequently intermits. During the height of the disease, a mortal phrenzy frequently supervenes. The disease terminates on the fourth, seventh, ninth day, or from the eleventh to the fifteenth; and is more apt to end in a gangrene than pneumonic inflammations, and more frequently in a ichtrus than in an abscess.

Causes, &c. The inflammation of the stomach may arise from any acrid substance taken into it; from a vehement passion; too large draughts of cold liquor, especially when the person is very hot; from a surfeit; a stoppage of perspiration; repulsion of the gout; opiates; inflammations of the neighbouring viscera; or from external injuries, such as wounds, contusions, &c. It affects chiefly those of a plethoric habit, and hot bilious constitution.

Prognosis. This disease is always very dangerous, and the prognosis doubtful, which also must always be in proportion to the severity of the symptoms. A cessation of pain, coldness about the præcordia, great debility, with a languid and intermitting pulse, with an abatement of the hiccup, denote a gangrene and speedy death. From the sensibility of the stomach also, and its great connection with the rest of the system, it must be obvious that an inflammation of it, by whatever causes produced, may be attended with fatal consequences. The tendency to suppuration may be known by the symptoms continuing but in a moderate degree for more than one or two weeks, and by a considerable remission of the pain, while a sense of weight, and an anxiety, still remain. When an abscess has been formed, the frequency of the pulse is at first abated: but soon after it encreases, with frequent cold shiverings, and an exacerbation in the afternoon and evening; followed by night-sweats, and other symptoms of hectic fever. These at length prove fatal, unless the abscess open into the cavity of the stomach, the pus be evacuated by vomiting, and the ulcer soon healed.

Cure. It appears from dissections, that the stomach may very often be inflamed when the characteristic marks of it have not appeared; and therefore we cannot lay down any general rules for the cure of this disease. When the symptoms appear in the manner above described, the cure is to be attempted by large and repeated bleedings employed early in the disease; and from these we are not to be deterred by the weakness of the pulse, for it has commonly become fuller and softer after the operation. A blister ought also to be applied to the region of the stomach; and the cure will be assisted by fomentations of the whole abdomen, and by frequent emollient and laxative glysters. The irritability of the stomach in this disease will admit of no medicines being thrown into it; and if any can be supposed necessary, they must be exhibited in glysters. Diluting drinks may be tried; but they must be of the very mildest kind, and given in small quantities at a time. Opiates, in whatever manner exhibited, are very hurtful during the first days of the disease; but when the violence of the disease shall have abated, and when the pain and vomiting recur at intervals only, opiates given in glysters may frequently be employed with advantage. A tendency to gangrene in this disease is to be obviated only by the means just now mentioned; and when it does actually supervene, it admits of no remedy. A tendency to suppuration is to be obviated by the same means employed early in the disease. After a certain period it cannot be prevented by any means whatever; and, when actually begun, must be left to nature; the only thing that can be done by art to avoid all irritation.

GENUS XV. ENTERITIS, or Inflammation of the INTESTINES.

Description. This disease shews itself by a fixed pain in the abdomen, attended with fever, vomiting, and costiveness. The pain is often felt in different parts of the abdomen, but more frequently spread over the whole, and is particularly violent about the navel.

Causes, &c. Inflammations of the intestines may arise from the same causes as those of the stomach; though commonly the former will more readily occur from cold applied to the lower extremities, or to the belly itself. It is also found supervening on the spasmodic colic, incarcerated hernia, and volvulus.

Prognosis. Inflammations of the intestines have the same terminations with those of the stomach, and the prognosis in both cases is much the same.

Cure. The cure of enteritis is in general the same with that of gastritis: but in the former there is commonly more access to the introduction of liquids, of acid, accepsent, and other cooling remedies, and even of laxatives; but as a vomiting frequently attends the enteritis, care must be taken not to excite that vomiting by the quantity

MEDICINE.

quantity or quality of any thing thrown into the stomach. With regard to the suppuration and gangrene of the intestines following the enteritis, the same thing is to be understood as is mentioned under the GASTRITIS.

Erysipetulous ENTERITIS. Concerning this nothing farther can be said, than what had been already delivered concerning the gastritis.

GENUS XVI. HEPATITIS; or, *Inflammation of the LIVER.*

Description. The inflammation of the liver is thought to be of two kinds, acute, and chronic: but the latter very often does not discover itself except by an abscess found in the liver after death, and which is supposed to have been occasioned by some degree of inflammation; for this reason the chronic inflammation cannot be described, and we shall only here treat of the acute hepatitis.

The acute hepatitis is attended with a considerable fever; a frequent, strong, and hard pulse; high coloured urine; an acute pain in the right hypochondrium, increased by pressing upon the part. The pain is very often in such a part of the side as to make it appear like a pleurisy; and frequently like that, is increased on inspiration. The disease is also commonly attended with a cough, which is generally dry, but sometimes moist; and when the pain thus resembles a pleurisy, the patient cannot lie easily except on the side affected. The pain is frequently extended to the clavicle, and to the top of the shoulder, and is attended sometimes with hiccup, and sometimes with vomiting. Some have added jaundice, or a yellowness in the eyes, to the symptoms of this distemper; but experience shews that it hath often occurred without any such symptom.

Causes, &c. The remote causes of hepatitis are not always to be discerned, and many have been assigned on a very uncertain foundation. It has been supposed that the disease may be an affection either of the extremities of the hepatic artery, or those of the *vena portarum*; but of the last there is no proof, nor is the supposition at all probable. The inflammation on the concave surface of the liver, may be readily communicated to the gall bladder and biliary ducts: and this perhaps is the only case of idiopathic hepatitis, attended with jaundice.

Prognosis. The inflammation of the liver, like others, may end by resolution, suppuration, or gangrene; and the tendency to the one or to the other of those events may be known from what has been already mentioned concerning the prognosis in gastritis. The resolution of hepatitis is often the consequence of, or is attended with evacuations of different kinds. An hæmorrhage, sometimes from the nose, and sometimes from the hæmorrhoidal vessels, gives a solution of the disease. Sometimes the same thing is accomplished by a bilious diarrhœa; and sometimes the resolution is attended with sweating, and an evacuation of urine, depositing a copious sediment. Sometimes it may be cured by an erysipelas appearing in some external part. When the disease hath ended in suppuration, the pus collected may be discharged by the biliary ducts; or, if the suppurated part does not adhere any where closely to the neighbouring parts, into the cavity of the abdomen: but if, during the first state of inflammation, the affected part of the liver shall have formed a close adhesion to some of the neighbouring parts, the discharge after suppuration may be various, according to the different seat of the abscess.

Cure. For the cure of hepatitis, we must have recourse to the general means of removing other inflammatory disorders. Bleeding is to be used according to the degree of fever and pain. Blitters are to be applied: fomentations of the external parts, emollient glysters, gentle laxatives, diluents and refrigerents, are also useful. But when a suppuration has been formed, and the abscess points outwardly, the part must be opened, the pus evacuated, and the ulcer healed according to the ordinary method in use for healing abscesses and ulcers in other parts.

GENUS XVII. SPLENITIS; or, *Inflammation of the SPLEEN.*

Description. This disease, according to *Junker*, comes on with a remarkable shivering, succeeded by a most intense heat and very great thirst; a pain and tumour are perceived in the left hypochondrium, and the paroxysms for the most part assume a quartan form. When the patients expose themselves for a little to the free air, their extremities immediately grow very cold. If an hæmorrhage happens, the blood flows out of the left nostril. The other symptoms are the same with those of the hepatitis. Like the liver, it is also subject to a chronic inflammation, which often happens after agues, and is commonly called the *ague cake*.

Causes, &c. The causes of this distemper are, in general, the same with those of other inflammatory disorders; but those which determine the inflammation to that particular part more than another, are very much unknown. It attacks persons of a very plethoric and sanguine habit of body rather than others.

Prognosis. What hath been said of the inflammation of the liver applies also to that of the spleen, though the latter is less dangerous than the former. Here also a vomiting of black matter which in other acute diseases is such a fatal omen, sometimes proves critical, according to the testimony of *Junker*. Sometimes the hæmorrhoids prove critical; but very often the inflammation terminates by schirrus.

Cure. This is not at all different from what hath been already laid down concerning the hepatitis.

GENUS XVIII. NEPHRITIS; or, *Inflammation of the KIDNES.*

Description. The nephritis has the same symptoms in common with other inflammations; but its distinguishing mark is the pain in the region of the kidney, which is sometimes obtuse and sometimes pungent. The pain is not increased by the motion of the trunk of the body, so much as a pain of the rheumatic kind affecting the same region. It may also frequently be distinguishing by its shooting along the course of the ureter, and is frequently attended with a drawing up of the testicle, and a numbness of the limb on the side effected; though indeed these symptoms most commonly attend the inflammation arising from a calculus in the kidney or ureter. The disease is also attended with frequent vomiting, and often with costiveness and colic pains. The urine is most commonly of a deep red colour, and is voided frequently, and in a small quantity at a time. In more violent cases the colour is commonly colourless.

Causes, &c. The remote causes of this disease may be various; as external contusion, violent or long continued riding; strains of the muscles of the back incumbent on the kidneys; various acrids, in the course of circulation, conveyed to the kidney; and perhaps some other internal causes not yet well known; the most frequent is that of calculous matter obstructing the *tubuli uriniferi*, or calculi, formed in the pelvis of the kidneys, and either sticking there, or fallen in the ureter.

Prognosis. This is not different from that of other inflammatory diseases.

Cure. This is to be attempted by bleeding, external fomentation, frequent emollient glysters, antiphlogistic purgatives, and by the free use of mild and demulcent liquids. The use of blitters is scarce admissible, or at least will require great care to avoid any considerable absorption of the cantharides.

GENUS XIX. CYSTITIS; or, *Inflammation of the BLADDER.*

The inflammation of the bladder, from internal causes, is a very rare distemper; and when it does at any time occur, is to be cured in the same manner with other inflammations, avoiding only the use of cantharides. When the disease arises from the internal use of these flies, camphire is recommended, besides other cooling medicines, and particularly cooling and emollient glysters.

GENUS XX. HYSTERITIS; or, *Inflammation of the UTERUS.*

Description. The disease is often confounded with that called the *puerperal*, or *child-bed fever*; but is very essentially different from it, as will be shewn in its proper place. The inflammation of the uterus is often apt to terminate by gangrene: there is a pain in the head with delirium; and the uterine region is so exceedingly tender, that it cannot bear the most gentle pressure without intolerable pain. When the *fundus uteri* is inflamed, there is great heat, throbbing and pain, above the *pubes*; if its posterior part, the pain is more confined to the loins and rectum, with a tenesmus; if its interior part it shoots from thence towards the neck of the bladder, and is attended with a frequent irritation to make water, which is voided with difficulty; and if its sides, or the ovaria, are affected, the pain will then dart into the inside of the thighs.

Causes, &c. Inflammations of the uterus, and indeed of the rest of the abdominal viscera, are very apt to take place in lying-in women: the reason of which seems to be the sudden change produced in the habit, and an alteration in the course of the circulating blood by the contraction of the uterus after delivery. The pressure of the gravid uterus being suddenly taken off from the *aorta descendens* after delivery, the resistance to the impulse of the blood passing through all the vessels derived from it, and distributed to the contiguous viscera, will be considerably lessened: it will therefore rush into those vessels with a force superior to their resistance, and by putting them violently on the stretch, may occasion pain, inflammation and fever. This contraction of the uterus also renders its vessels impervious to the blood which had freely passed through them for the service of the child, during pregnancy; and consequently a much larger quantity will be thrown upon the contiguous parts, which will still add to their distention, and increase their tendency to inflammation.

Prognosis. An inflammation of the uterus generally may be expected to produce an obstruction of the lochia; but the fever produced seldom proves mortal, unless the inflammation is violent, and ends in a gangrene.

Cure. This is to be attempted by the same general means already recommended, and the management of this disorder entirely coincides with that of the puerperal fever.

GENUS XXI. RHEUMATISMUS; or, *THE RHEUMATISM.*

THE ACUTE RHEUMATISM.

Description. The rheumatism is particularly distinguished by pains affecting the joints, and for the most part the joints alone; but sometimes also the muscular parts. Very often they shoot along the course of the muscles, from one joint to another, and are always much increased by the action of the muscles belonging to the joint or joints affected. The larger joints are those most frequently affected, such as the hip joint and knees of the lower extremities.

MEDICINE.

extremities, and the shoulders and elbows of the upper ones. The ancles and wrists are also frequently affected; but the smaller joints, such as those of the toes or fingers, seldom suffer. The pains do not commonly remain long in the same joint, but frequently shift from one to another, and sometimes return to joints formerly effected; and in this manner the disease often continues for a long time. The pyrexia hath an exacerbation every evening, and is most considerable during the night, when the pains also become more violent; and it is at the same time that the pains shift their place from one joint to another. These seem to be also increased during the night, by the body being covered more closely, and kept warmer.

A joint, after having been for some time affected with pain, commonly becomes also affected with some swelling and redness, which is painful to the touch. It seldom happens that a swelling coming on does not take off the pain entirely, or secure the joint against a return of it. The blood is always fizy. The acute rheumatism differs from all other inflammatory diseases, in not being liable to terminate in suppuration: this rarely happens; but the disease sometimes produces effusions of a transparent gelatinous fluid into the sheaths of the tendons.

Sometimes the rheumatism will continue for several weeks; however it seldom proves fatal, and it is rare that the pyrexia continues to be considerable for more than two or three weeks. While the pyrexia abates in its violence, if the pains of the joints continue, they are less violent, more limited in their place, being confined commonly to one or a few joints only; and are less ready to change their place.

Causes, &c. This disease is frequent in cold, and more uncommon in warm climates. It appears most frequently in autumn and spring; less frequently in winter, whilst the frost is constant; and very seldom during the heat of summer. It may, however, occur, at any season, if vicissitudes of heat and cold be for the time frequent. For the most part, the acute rheumatism arises from the application of cold to the body, when unusually warm, or when the cold is applied to one part of the body, whilst the other parts are kept warm; or lastly, when the application of cold is long continued, as when moist or wet cloaths are applied to any part of the body. These causes may affect persons of all ages; but the rheumatism seldom appears either in very young or in elderly persons, and most commonly occurs from the age of puberty to that of thirty-five. These causes may also affect persons of any constitution, but they most commonly affect those of a sanguine temperament.

The proximate cause of rheumatism hath by many been supposed to be a lentor in the fluids obstructing the vessels of the part. While we cannot find either evidence or reason for supposing that the rheumatism depends on any change in the state of the fluids, we must conclude that the proximate cause of it is the same with that of other inflammations not depending upon a direct stimulus.

In the case of rheumatism, it is supposed that the most common remote cause of it, that is, cold applied, operates especially on the vessels of the joints, these being less covered by a cellular texture than those of the intermediate parts of the limbs. It is farther supposed, that the application of cold produces a constriction of the extreme vessels, and at the same time an increase of tone or phlogistic diathesis in the course of them, from which arises an increased impetus of the blood, and at the same time a resistance to the free passage of it, and consequently inflammation and pain. It is also supposed, that the resistance formed excites the *vis medicatrix*, to a further increase of the impetus of the blood; and to support this, a cold stage arises, a spasm is formed, and a pyrexia and phlogistic diathesis are produced in the whole system.

Hence the cause of rheumatism appears to be exactly analogous to that of inflammations depending on an increased afflux of blood to a part, while it is exposed to the action of cold. But there seems to be further in this disease some peculiar affection of the muscular fibres. These seem to be under some degree of rigidity; and therefore less easily admit of motion, and are pained upon the exertions of it. This also seems to be the affection which gives opportunity to the propagation of pains from one joint to another, and which are most severely felt in the extremities, terminating in the joints, because, beyond these the oscillations are not propagated. This affection of the muscular fibres explains the manner in which strains and spasms produce rheumatic affections; and on the whole shews, that with an inflammatory affection of the sanguiferous system, there is also, in rheumatism, a peculiar affection of the muscular fibres, which has a considerable share in producing the phenomena of the disease.

Cure. Here we must remember, that in the acute rheumatism there is an inflammatory affection of the parts, and a phlogistic diathesis of the whole system. The cure therefore requires, in the first place, an antiphlogistic regimen, and particularly a total abstinence from animal food, and from all fermented, or spirituous liquors: substituting a mild vegetable or milk diet, and the plentiful use of soft diluting liquors. On this principle, blood-letting is the chief remedy of acute rheumatism. The blood is to be drawn in large quantity; and the bleeding is to be repeated in proportion to the frequency, fulness, and hardness of the pulse, and the violence of the pain. For the most part, large and repeated bleedings, dur-

ing the first days of the disease, seem to be necessary, and accordingly have been very much employed; but to this some bounds are to be set; for very profuse bleedings occasion a slow recovery, and, if not absolutely effectual, are ready to produce a chronic rheumatism.

To avoid that debility of the system which general bleedings are apt to occasion, the urgent symptom of pain may be often relieved by topical bleedings; and when any swelling or redness have come upon a joint, the pain may very certainly be relieved by topical bleedings; but as the pain and continuance of the disease seem to depend more upon the phlogistic diathesis of the whole system than upon the affection of particular parts, so topical bleedings will not supply the place of the general bleedings proposed above.

To take off the phlogistic diathesis prevailing in this disease, purging may be useful, if procured by medicines which do not stimulate the whole system, as neutral salts, and other medicines which have a refrigerant power. Purging, however, is not so useful as bleeding, in removing phlogistic diathesis; and when the disease has become general and violent, frequent stools are inconvenient, and even hurtful, by the motion and pain which they occasion.

In this disease external applications are of little service. Fomentations, in the beginning of the disease, rather aggravate than relieve the pains. The rubefacients and camphire are more effectual; but they generally only shift them from one part to another, and do not prove any cure of the general affection. Blistering may also be very effectual in removing the pain from a particular part, but will be of little use, except where the pains are much confined to a particular part.

The several remedies abovementioned, moderate the violence of the disease, and sometimes remove it entirely; but they sometimes fail, and leave the cure imperfect. The attempting a cure by large and repeated bleedings is attended with many conveniences; and the most effectual and safe method of cure is, after some general bleedings, for taking off, or at least diminishing, the phlogistic diathesis, to employ sweating, conducted by the rules laid down when speaking of the cure of synocha. Opiates, except where they are directed to procure sweat, always prove hurtful in every stage of this disease. The Peruvian bark has been supposed a remedy in some cases; but it is seldom found useful, and is frequently hurtful. It seems only fit for those cases in which the phlogistic diathesis is much abated, and at the same time the exacerbations of the disease are manifestly periodical, with considerable remissions interposed. Calomel, and other preparations of mercury, have been recommended in some cases of acute rheumatism; they are only useful in cases approaching to the nature of the chronic kind.

GENUS XXII. CHRONIC RHEUMATISM.

Description. When the pyrexia attending the acute rheumatism hath ceased; when the swelling and redness of the joints are entirely gone, but pains still continue to affect certain joints, which remain stiff, feel uneasy upon motion, changes of weather, or in the night-time only; the disease is then called the *chronic rheumatism*, as it often continues for a very long time.

The limits between the acute and chronic rheumatisms are not always exactly marked. When the pains are still ready to shift their place; when they are especially severe in the night-time; when, at the same time they are attended with some degree of pyrexia, and with some swelling, and especially some redness, of the joints; the disease is to be considered as partaking of the nature of the acute rheumatism. But when there is no longer any degree of pyrexia remaining; when the pained joints are without redness; when they are cold and stiff; when they cannot easily be made to sweat; or when, while a free and warm sweat is brought out on the rest of the body, it is only clammy and cold on the pained joints; and when further, the pains of these are increased by cold, and relieved by heat, applied to them; the case is to be considered as that of a purely chronic rheumatism.

The chronic rheumatism may affect different joints; but is especially apt to affect those which are surrounded with many muscles, and those of which the muscles are employed in the most constant and vigorous exertions. Such is the case of the vertebrae of the loins, the affection of which is named *lumbago*; or of the hip-joint, when the disease is named *ischias*, or *sciatica*.

The distinction of the rheumatic pains from those resembling them which occur in the scurvy and scurvy must be obvious, either from the seat of the pains, or from the concomitant symptoms peculiar to those diseases. The distinction of the rheumatism from the gout will be more fully understood from what is laid down in the following genus.

Causes, &c. The phenomena of the purely chronic rheumatism, lead us to conclude, that its proximate cause is an atony both of the blood-vessels and of the muscular fibres of the part affected, together with such a degree of rigidity and contraction in the latter as frequently attend them in a state of atony.

Cure. From the view just now given of the proximate cause of chronic rheumatism, the indication of cure must be, to restore the activity and vigour of the vital principal in the part. The remedies are either external or internal.

The external are, the supporting the heat of the part, by keeping it constantly covered with flannel; the increasing the heat of the

MEDICINE.

the part by external heat, applied either in a dry or humid form; the diligent use of the flesh brush, or other means of friction; the application of electricity in sparks or shocks; the application of cold water by effusion or immersion; the application of essential oils of the most warm and penetrating kind; the application of salt brine; and lastly, the employment either of exercise, of the part itself as far as it can easily bear, or by riding, or other mode of gestation.

The internal remedies are, 1. Large doses of essential oils drawn from resinous substances, such as turpentine. 2. Substances containing such oils, as guaiac. 3. Volatile alkaline salts. 4. These or other medicines directed to procure sweat; and 5. Calomel, or some other preparation of mercury, in small doses, continued for some time. Besides these, there are several others recommended; as bleeding, general and topical; burning, blistering, and issues; but these are only useful when the disease still partakes of the nature of the acute rheumatism.

GENUS XXIII. ODONTALGIA, the TOOTH-ACH.

Description. This well known disease makes its attack by a most violent pain in the teeth, most frequently in the *molars*, but more rarely in the *incisori*, reaching sometimes up to the eyes, and sometimes backward into the cavity of the ear. At the same time there is a manifest determination to the head, and a remarkable tension and inflation of the vessels take place, not only in the parts next to that where the pain is seated, but over the whole head.

Causes, &c. The tooth-ach is sometimes merely a rheumatic affection, arising from cold, but more frequently from a carious tooth. It is also a symptom of pregnancy, and takes place in some nervous disorders; it may attack persons at any time of life, though it is most frequent in the young and plethoric.

Cure. Many empirical remedies have been proposed for the cure of the tooth-ach, but none have in any degree answered the purpose. When the affection is purely rheumatic, blistering behind the ear will almost always remove it; but when it proceeds from a carious tooth, the pain is much more obstinate. In this case it hath been recommended to touch the pained part with a hot iron, or with oil of vitriol, in order to destroy the aching nerve; to hold strong spirits in the mouth; to put a drop of oil of cloves into the hollow of the tooth, or a pill of equal parts of opium and camphire. The Peruvian bark hath also been recommended, and perhaps with more justice, on account of its tonic and antiseptic powers; but very often all these remedies will fail, and the only infallible cure is to draw the tooth.

GENUS XXIV. PODAGRA, the GOUT.

The Regular Gout.

Description. What we call a *paroxysm of the gout*, is principally constituted by an inflammatory affection of some of the joints. This sometimes comes on suddenly, without any warning, but is generally preceded by several symptoms; such as the ceasing of a sweating which the feet had commonly been affected with before; an unusual coldness of the feet and legs; a frequent numbness, alternating with a sense of prickling along the whole of the lower extremities; frequent cramps of the muscles of the legs; and an unusual turgescence of the veins. These symptoms take place for several days, sometimes for a week or two, before a paroxysm comes on; but commonly, upon the day immediately preceding it, the appetite becomes greater than usual.

The circumstances of paroxysms are the following. They come on most commonly in the spring; and sooner or later, according as the vernal heat succeeds sooner or later to the winter's cold; and, perhaps, sooner or later also, according as the body may happen to be more or less exposed to vicissitudes of heat and cold. The attacks are sometimes felt first in the evening, but more commonly about two or three o'clock of the morning. The paroxysm begins with a pain affecting one foot, most commonly in the ball or first joint of the great toe, but sometimes in other parts of the foot. With the coming on of this pain, there is commonly more or less of a cold shivering; which, as the pain increases, gradually ceases; and is succeeded by a hot stage of pyrexia, which continues for the same time with the pain itself. From the first attack, the pain becomes, by degrees, more violent, and continues in this state, with great restlessness of the whole body, till next midnight, after which it gradually remits; and, after it has continued for twenty-four hours from the commencement of the first attack, it commonly ceases entirely; and, with the coming on of a gentle sweat, allows the patient to fall asleep. The patient, upon coming out of this sleep in the morning, finds the pained part affected with some redness and swelling, which, after having continued for some days, gradually abate.

When the disease, after having thus remained for some time in a joint, ceases entirely, it generally leaves the person in very perfect health, enjoying greater ease and alacrity in the functions of both body and mind than he had for a long time before experienced. At the beginning of the disease, the returns of it are sometimes only once in three or four years; but, as it advances, the intervals become shorter, and at length the attacks are annual; afterwards they come twice each year; and at length recur several times during the whole course of autumn, winter, and spring; and

as, when the fits are frequent, the paroxysms become also longer; so, in the advanced state of the disease, the patient is hardly ever tolerably free from it, except perhaps for two or three months in summer.

The progress of the disease is also marked by the parts which it affects. At first, it commonly affects one foot only; afterwards every paroxysm affects both feet, the one after the other; and, as the disease proceeds, it not only affects both feet at once, but, after having ceased in the foot which was secondly attacked, returns again into the first, and perhaps a second time also into the other. Its changes of place are not only from one foot to another, but from the feet into other joints, especially those of the upper and lower extremities; so that there is hardly a joint of the body that on one occasion or other is not affected. It sometimes affects two different joints at the same time, but more commonly is at any one time severe in a single joint only, and passes successively from one joint to another, so that the patient's affliction is often protracted for a long time.

When the disease has often returned, and the paroxysms have become very frequent, the pains are commonly less violent than they were at first; but the patient is more affected with sickness, and the other symptoms of the atonic gout, which shall be hereafter mentioned.

After the first paroxysm of the disease, the joints which have been affected are entirely restored to their former suppleness and strength; but after the disease has recurred very often, the joints affected do neither so suddenly nor entirely recover their former state, but continue weak and stiff; and these effects at length proceed to such a degree, that the joints lose their motion entirely.

In many persons, but not in all, after the disease has frequently recurred, concretions of a chalky nature are formed upon the outside of the joints, and, for the most part, immediately under the skin. The matter seems to be deposited at first in a fluid form, afterwards becoming dry and firm. In their firm state, these concretions are a friable earthy substance, entirely soluble in acids. After they have been formed, they contribute, with other circumstances, to destroy the motion of the joint. In most persons who have laboured under the gout for many years, a nephritic affection comes on, and discovers itself by all the symptoms which usually attend calculous concretions in the kidneys, and which we shall have occasion to describe in another place. All that is necessary to be observed here is, that the nephritic affection alternates with paroxysms of the gout; and that the two affections, the nephritic and the gouty, are hardly ever present at the same time. This also may be observed, that children of gouty or nephritic parents commonly inherit one or other of these diseases; but which ever may have been the principal disease of the parent, some of the children have the one, and some the other. In some of them, the nephritic affection occurs alone, without any gout supervening; and this happens to be frequently the case of the female children of gouty parents. In the whole of the account already given, we have described the most common form of the disease.

The principal circumstance, in what we term the *regular gout*, is the inflammatory affection of the joints; and whatever symptoms we can perceive to be connected with, or to depend upon, the disposition which produces that inflammatory affection, but without its taking place or being present at the same time, we name the *irregular gout*. Of such irregular gout there are three different states, which we name the *ATONIC*, the *RETROCEDENT*, and the *MISPLACED Gout*.

The *first* is, when the gouty diathesis prevails in the system; but, from certain causes, does not produce the inflammatory affection of the joints. In this case the morbid symptoms which appear, are chiefly affections of the stomach, such as loss of appetite, indigestion, and its various circumstances of sickness, nausea, vomiting, flatulency, acid eructations, and pains in the region of the stomach. These symptoms are frequently accompanied with pains and cramps in several parts of the trunk, and the upper extremities of the body, which are relieved by the discharge of wind from the stomach. Together with these affections of the stomach, there commonly occurs a costiveness; but sometimes a looseness, with cholic pains. These affections of the alimentary canal are often attended with all the symptoms of hypochondriasis, as dejection of mind, a constant and anxious attention to the slightest feelings, an imaginary aggravation of these, and an apprehension of danger from them. In the same atonic gout, the viscera of the thorax also are sometimes affected; and palpitations, faintings, and asthma occur. In the head also aches, giddiness, apopleptic and paralytic affections. When the several symptoms now mentioned occur in habits, having the marks of a gouty disposition, this may be suspected to have laid the foundation of them; and especially when either, in such habits, a manifest tendency to the inflammatory affection has formerly appeared, or when the symptoms mentioned are intermixed with, and are relieved by some degree of the inflammatory gout. In such cases there can be no doubt of considering the whole as a state of the gout.

Another state of the disease we name the *retrocedent gout*. This occurs when an inflammatory state of the joints has, in the usual manner, come on, but without arising to the ordinary degree of pain and inflammation; or at least without these continuing for

MEDICINE.

the usual time, or without their receding gradually in the usual manner; these affections of the joints suddenly and entirely cease; while some internal part becomes affected. The internal part most commonly affected is the stomach; which then is affected with anxiety, sickness, vomiting, or violent pain; but sometimes the internal part is the heart, which gives occasion to a syncope; sometimes it is the lungs, which are affected with asthma; and sometimes it is the head, given occasion to apoplexy or palsy. In all these cases there can be no doubt of the symptoms being all a part of the same disease, however different the affection may seem to be in the part which it attacks.

The third state of irregular gout which we name the *misplaced*, is when the gouty diathesis, instead of producing the inflammatory affection of the joints, produces an inflammatory affection of some internal part, and which appears from the same symptoms that attend the inflammation of those parts, arising from other causes. Whether the gouty diathesis does ever produce such inflammation of the internal parts without having first produced it in the joints, or if the inflammation of the internal part be always a translation from the joints previously affected, we dare not determine; but, even supposing the latter to be always the case, we think the difference of the affection of the internal part must still distinguish the *misplaced* from what we have named the *retrocedent* gout.

With regard to the misplaced gout, Dr. Cullen, whom we here follow, tells us, that he never met with any case of it in his practice, nor does he find any distinctly marked by practical writers, except that of a pneumonic inflammation.

It is commonly supposed, that there are some cases of rheumatism which are scarcely to be distinguished from the gout; but these, our author thinks, are but few; and that the two diseases may be for the most part distinguished with great certainty, by observing the predisposition, the antecedents, the parts affected, the recurrences of the disease, and its connection with the system; which circumstances, for the most part, appear very differently in the two diseases.

Causes, &c. The gout is generally an hereditary disease; but some persons, without any hereditary disposition, seem to acquire it: and in some an hereditary disposition may be counteracted from various causes. It attacks the male sex especially; but it sometimes, though more rarely, attacks also the female. The females liable to it are those of the more robust and full habits; and it very often happens to those before the menstrual evacuation hath ceased. Dr. Cullen hath also found it occurring in several females whose menstrual evacuation were more abundant than usual.

The gout seldom attacks eunuchs; and when it does, seems to fall upon those who happen to be of a robust habit, to lead an indolent life, and to live very full. It attacks especially men of robust and large bodies, who have large heads, are of full and corpulent habits, and whose skins are covered with a thicker *rete mucosum*, which gives a coarser surface. To speak in the style of the ancient physicians the gout will seldom be found to attack those of a sanguine, or such as are of a purely melancholic temperament: but very readily those of a *choleric-sanguine* temperament. It is however, very difficult to treat this matter with precision. The gout seldom attacks persons employed in constant bodily labour, or those who live much upon vegetable aliment. It does not commonly attack men till after the age of 35; and generally not till a still later period. There are indeed instances of the gout appearing more early; but these are few in comparison of the others. When the gout does appear early in life, it seems to be in those who have the hereditary disposition very strong, and to whom the remote causes, hereafter mentioned, have been applied in a very considerable degree.

The occasional causes of the disease seem to be of two kinds. First, those which induce a plethoric state of the body. Secondly, those which, in plethoric habits, induce a state of debility. Of the first kind are a sedentary, indolent manner of life, and a full diet of animal food. Of the second kind of occasional causes which induce debility, are excess in venery; intemperance in the use of intoxicating liquors; indigestion, produced either by the quantity or quality of the aliments; excessive evacuations; the ceasing of usual labour; a sudden change from a very full to a very spare diet; the large use of acids and acescent; and lastly, cold applied to the lower extremities. The former seem to act by increasing the predisposition; the latter are commonly the exciting causes, both of the first attacks, and of the repetitions of the disease.

With respect to the *proximate* cause of the gout, it hath generally been thought that it depends on a certain morbid matter always present in the body; and that this matter, by certain causes, thrown upon the joints or other parts, produces the several phenomena of the disease.

Cure. In entering upon this, we must observe, in the first place, that a cure has been commonly thought impossible; and we acknowledge it to be very probable, that the gout, as a disease of the whole habit, and very often depending upon original confirmation, cannot be cured by medicines, the effects of which are always very transitory, and seldom extend to the producing any considerable change of the whole habit. It would perhaps have been happy for gouty persons if this opinion had been implicitly received by them; as it would have prevented their having been so often the dupes of self-interested pretenders, who have either amused them

with inert medicines, or have rashly employed those of the most pernicious tendency. We are much disposed to believe the impossibility of a cure of the gout by medicines; and more certainly still inclined to think, that, whatever may be the possible power of medicines; yet no medicine for curing the gout has hitherto been found; although almost every age has presented a new remedy, all hitherto offered have, very soon after, been either neglected as useless, or condemned as pernicious.

Dr. Cullen contends, that a great deal can be done towards the cure of the gout by a regimen: and is firmly persuaded, that any man, who, early in life, will enter upon the constant practice of bodily labour, and of abstinence from animal food, will be preserved entirely from the disease.

Whether there be any other means of radically curing the gout, the Doctor is not ready to determine. There are histories of cases of the gout, in which it is said, that by great emotions of mind, by wounds, and by other accidents, the symptoms have been suddenly relieved, and never again returned; but how far these accidental cures might be imitated by art, or would succeed in other cases, is at least extremely uncertain.

The practices proper and necessary in the treatment of the gout, are to be considered under two heads: *First*, As they are to be employed in the intervals of paroxysms; or, *secondly*, As during the time of these. In the intervals of paroxysms, the indications are, to prevent altogether the return of paroxysms; or at least to render them less frequent, and more moderate. During the time of paroxysms the indications are, to moderate the violence and shorten the duration of them, as much as can be done with safety.

1. It has been already observed, that the gout may be entirely prevented by constant bodily exercise, and by a low diet; and Dr. Cullen is of opinion, that this prevention may take place even in persons who have hereditary dispositions to the disease. Even when the disposition has discovered itself by several paroxysms of inflammatory gout, he is persuaded that labour and abstinence will absolutely prevent any returns of it for the rest of life. These, therefore, are the means of answering the first indication to be pursued in the intervals of paroxysms.

Exercise, in persons disposed to the gout is directed to two purposes. One of these is the strengthening of the tone of the extreme vessels; and the other, the guarding against a plethoric state. For the former, if exercise be employed early in life, and before intemperance has weakened the body, a very moderate degree of it will answer the purpose; and for the latter, if abstinence be at the same time observed, little exercise will be necessary. With respect to exercise, this in general is to be observed, that it should never be violent; for, if violent, it cannot be long continued, and must always endanger the bringing on an atony in proportion to the violence of the preceding exercise. In more advanced states of the disease, however, when there is some disposition to a paroxysm, much walking will bring it on; either as it weakens the tone of the lower extremities, or as it excites an inflammatory disposition in them; and thus it seems to be, that strains or contusions often bring on a paroxysm of the gout.

Abstinence, the other part of our regimen for preventing the gout, is of more difficult application. If an abstinence from animal food be entered upon early in life, while the vigour of the system is yet entire, there is no doubt of its being both safe and effectual; but, if the motive of this diet shall not have occurred till the constitution hath been broken by intemperance, or by the decline of life, a low diet may then endanger the bringing on an atonic state, the safety of an abstemious course may be greater or less, according to the management of it. It is animal food which especially disposes to the plethoric and inflammatory state, and that food is to be therefore especially avoided; but, on the other hand, it is vegetable aliment of the lowest quality that is in danger of weakening the system too much, by not affording sufficient nourishment, and more particularly of weakening the tone of the stomach by its acescency. It is therefore a diet of a middle nature, that is to be chosen; and milk is precisely of this kind, as containing both animal and vegetable matter. The farinaceous seeds are next to be chosen; and are the food most proper to be joined with milk.

With respect to drink, fermented liquors are useful only when they are joined with animal food, and that by their acescency; and their stimulus is only necessary from custom. When, therefore, animal food is to be avoided, fermented liquors are unnecessary, and by increasing the acescency of vegetables, the liquors may be hurtful. The stimulus of fermented, or spirituous liquors is not necessary to the young and vigorous, and, when much employed, impairs the tone of the system. These liquors therefore are to be avoided, except so far as custom and the declining state of the system may have rendered them necessary. For preventing or moderating the regular gout, water is the only proper drink.

By obviating the predisposition, and by avoiding the exciting causes, the gout may be entirely prevented; but, as the measures necessary for this purpose, will, in most cases, be pursued with difficulty, and even with reluctance, men have been very desirous to find a medicine which might answer the purpose, without any restraint on their manner of living. To gratify this desire, physicians have proposed, and, to take advantage of it, empirics have feigned many

MEDICINE.

many remedies, as we have already observed. Of what nature several of these remedies have been, it is difficult to say: but of those which are unknown, we conclude, from their having been only of temporary fame, and from their having soon fallen into neglect, that they have been either inert or pernicious, and therefore shall make no enquiry after them; and shall now remark only upon one or two known remedies for the gout which have been lately in vogue.

One of these is what has been named in England the *Portland-powder*. This is not a new medicine, but is mentioned by Galen, and with some little variation in its composition, has been mentioned by the writers of almost every age since that time. It appears to have been at times in fashion, and to have again fallen into neglect; and our author thinks that this last has been owing to its having been found to be, in many instances, pernicious. In every instance we have known of its exhibition for the length of time prescribed, the persons who had taken it were indeed afterwards free from any inflammatory affection of the joints; but they were affected with many symptoms of the atonic gout; and all, soon after finishing their course of the medicine, have been attacked with apoplexy, asthma, or dropsy, which proved fatal.

Another remedy which has had the appearance of preventing the gout, is an alkali in various forms; such as the fixed alkali, both mild and caustic, lime-water, soap, and absorbent earths. Since it became common to exhibit these medicines in nephritic and calculous cases, it has often happened that they were given to those who were at the same time subject to the gout; and it has been observed, that under the use of these medicines, gouty persons have been longer free from the fits of their disease. That, however, the use of these medicines has entirely prevented the returns of gout, Dr. Cullen observes, that he never pushed the use of those medicines for a long time, being apprehensive that the long continued use of them might produce a hurtful change in the state of the fluids.

As the preventing the gout depends very much on supporting the tone of the stomach, and avoiding indigestion; so costiveness, by occasioning this, is very hurtful to gouty persons. It is therefore necessary for such persons to prevent or remove costiveness, and, by a laxative medicine, when needful; but it is at the same time proper, that the medicine employed should be such as may keep the belly regular, without much purging. Aloetics, rhubarb, magnesia alba, or flowers of sulphur, may be employed, as the one or the other may happen to be best suited to particular persons.

2. These are the several measures to be pursued in the intervals of the paroxysms; and we are next to mention the measures proper during the time of them.

As during the time of paroxysms the body is in a feverish state, no irritation should then be added to it: and every part, therefore, of the antiphlogistic regimen, except the application of cold, ought to be strictly observed. Another exception to the general rule may occur, when the tone of the stomach is weak, and when the patient has been before much accustomed to the use of strong drink; for then it may be allowable, and even necessary, to give some animal food, and a little wine.

That no irritation is to be added to the system during the paroxysms of gout, except in the cases mentioned, is entirely agreed upon among physicians: but it is a more difficult matter to determine whether, during the time of paroxysms, any measures may be pursued to moderate the violence of re-action, and of inflammation. Dr. Sydenham has given it as his opinion, that the more violent the inflammation and pain, the paroxysms will be the shorter, as well as the interval between the present and the next paroxysm longer: and if this opinion be admitted as just, it will forbid the use of any remedies which might moderate the inflammation; which is, to a certain degree, undoubtedly necessary for the health of the body. On the other hand, acute pain presses for relief; and, although a certain degree of inflammation may seem absolutely necessary, it is not certain but that a moderate degree of it may answer the purpose: and it is even probable, that, in many cases, the violence of inflammation may weaken the tone of the parts, and thereby invite a return of paroxysms. It seems to be in this way, that, as the disease advances, the paroxysms become more frequent.

From these last considerations it seems probable, that, during the time of paroxysms, some measures may be taken to moderate the violence of the inflammation and pain; and, particularly, that, in its first paroxysms, and in the young and vigorous, blood-letting at the arm may be practised with advantage: but this practice cannot be repeated often with safety; because blood-letting not only weakens the tone of the system, but may also contribute to produce plethora. However, bleeding by leeches on the foot, and upon the inflamed part, may be practised and repeated with greater safety; and instances have been known of its having been practised with safety, to moderate and shorten paroxysms; but how far it may be carried we have not had experience enough to determine.

Camphire, and some aromatic oils, have the power of allaying the pain, and of removing the inflammation from the part affected: but these remedies commonly make the inflammation only shift from one part to another, and therefore with the hazard of its falling upon a part where it may be more dangerous; and they have sometimes rendered the gout retrocedent.

From these reflections it will appear, that some danger must attend every external application to the parts affected, during a paroxysm; and that therefore the common practice, of committing the person to patience and flannel alone is established upon the best foundation. Opiates give the most certain relief from pain; but, when given in the beginning of gouty paroxysms, occasion these to return with greater violence. When, however, the paroxysms shall have abated in their violence, but still continue to return, so as to occasion painful and restless nights, opiates may then be given with safety and advantage, especially in the case of persons advanced in life, and who have been often affected with the disease. When, after paroxysms have ceased, some swelling and stiffness shall remain in the joints, these symptoms are to be discussed by the diligent use of the flesh-brush. Purging, immediately after a paroxysm, will be always employed with the hazard of bringing it on again.

Thus far of the *REGULAR GOUT*. We now proceed to consider the management of the disease when it has become *IRREGULAR*.

1. In the *atonic* gout, the cure is to be accomplished by carefully avoiding all debilitating causes; and by employing, at the same time, the means of strengthening the system in general, and the stomach in particular.

For strengthening the system in general, we recommend frequent exercise on horseback, and moderate walking. Cold bathing also may answer the purpose; and may be safely employed, if it appear to be powerful in stimulating the system, and be not applied when the extremities are threatened with any pain. For supporting the tone of the system in general, when threatened with atonic gout, some animal food ought to be employed, and the more acescent vegetables ought to be avoided. In the same case, some wine also may be necessary: but it should be in moderate quantity, and of the least acescent kinds: and if every kind of wine shall be found to increase the acidity of the stomach, ardent spirits and water must be employed.

For strengthening the stomach, bitters and the Peruvian bark may be employed; but care must be taken that they be not constantly employed for any great length of time. The most effectual medicine for strengthening the stomach is iron, which may be employed under various preparations; but the best appears to be the rust, in fine powder, which may be given in very large doses. For supporting the tone of the stomach, aromatics may be employed, but should be used with caution, as the frequent and large use of them have an opposite effect; and they should therefore be given only in compliance with former habits, or for palliating present symptoms. When the stomach happens to be liable to indigestion, gentle vomits may be frequently given, and proper laxatives should be always employed to obviate or to remove costiveness.

In the atonic gout, or in persons liable to it, to guard against cold is especially necessary; and the most certain means of doing this is by repairing to a warm climate during the winter season. In the more violent cases, blistering the lower extremities may be useful; but that remedy should be avoided when any pain threatens the extremities. In persons liable to the atonic gout, issues may be established in the extremities, as in some measure a supplement to the disease.

2. A second case of the irregular gout is the *retrocedent*. When this affects the stomach and intestines, relief is to be instantly attempted by the free use of strong wines, joined with aromatics, and given warm; or, if these shall not prove powerful enough, ardent spirits must be employed, and are to be given in a large dose. In moderate attacks, ardent spirits, impregnated with garlic or with assafoetida, may be employed; or, even without the ardent spirits, a solution of assafoetida, with the volatile alkali, may answer the purpose. Opiates are often an effectual remedy; and may be joined with aromatics, as in the *electuarium thebaicum*; or they may be usefully joined with volatile alkali and camphire. Musk has likewise proved useful in this disease. When the affection of the stomach is accompanied with vomiting, this may be encouraged by taking draughts of warm wine, at first with water, and afterwards without it; having at length recourse, if necessary, to some of the remedies abovementioned, and particularly the opiates. In like manner, if the intestines be affected with a diarrhoea, this is at first to be encouraged, by taking plentifully of weak broth; and when this shall have been done sufficiently, the tumult is to be quieted by opiates.

When the retrocedent gout shall affect the lungs, and produce asthma, this is to be cured by opiates, by antispasmodics, and perhaps by blistering on the back or breast. When the gout, leaving the extremities, shall affect the head, and produce pain, vertigo, apoplexy, or palsy, our resources are very precarious. The most probable means of relief is, blistering the head; and, if the gout shall have receded entirely from the extremities, blisters may be applied to these also. Together with these blisterings, aromatics and the volatile alkali, may be thrown into the stomach.

3. The third case of the irregular gout is the *misplaced*; that is when the inflammatory affection of the gout, instead of falling upon the extremities, falls upon some internal part. In this case, the disease is to be treated by blood-letting, and by such other remedies as would be proper in an idiopathic inflammation of the same parts.

ORDER

MEDICINE.

ORDER III. EXANTHEMATA.

CONTAGIOUS DISEASES.

GENUS XXV. PESTIS, *the* PLAGUE.

Description. The circumstances peculiarly characteristic of this disease, especially of its more violent and dangerous states, are, 1. The great loss of strength in the animal functions which often appears early in the disease. 2. The stupor, giddiness, and consequent staggering, which resembles drunkenness, or the head-ach, and various delirium, all of them denote a great disorder in the functions of the brain. 3. Anxiety, palpitation, syncope, and especially the weakness and irregularity of the pulse, denote a considerable disturbance in the action of the heart. 4. Nausea and vomiting, particularly the vomiting of bile, which shews an accumulation of vitiated bile in the gall-bladder, and biliary ducts, and from thence derived into the intestines and stomach; which denote a considerable spasm, and loss of tone in the extreme vessels on the surface of the body. 5. The buboes and carbuncles, which denote an acrimony prevailing in the fluids; and, lastly, The petechiæ, hæmorrhages, and colliquative diarrhœa, which denote a putrescent tendency prevailing, in a great degree, in the mass of blood.

To these characteristics of the plague, we shall add one, mentioned by Sir John Pringle, which, though perhaps less frequent than the others, yet seems worthy of notice. It is this, That in the plague there is an extraordinary enlargement of the heart and liver. In nine dissections of bodies, dead of the plague, at Marseilles, this extraordinary enlargement of the heart is taken notice of in them all, and of the liver in seven of them. The account was sent to the Royal Society, by M. Didier, one of the physicians to the King of France, and hath been published in the Philosophical Transactions.

The author takes notice, that the heart and liver were of double the natural size. The preternatural enlargement, Dr. Pringle thinks, is owing to the relaxation of the solid parts, by which means they become unable to resist the impetus of the blood, and therefore are easily extended; as in the case of infancy, where the growth is remarkably quick; and a similar enlargement he takes notice of in the scurvy, and other putrid diseases.

Causes, &c. From a consideration of the symptoms abovementioned may be concluded, that the plague is owing to a specific contagion, oftener suddenly producing the most considerable debility in the nervous system or moving powers, and of a general putrescency in the fluids.

Prevention. Here we refer to all those methods of preventing and removing the incipient contagion of putrid fevers, which have been so fully enumerated. The disease never arises in the northern parts of Europe; but in consequence of being imported from some other country. The magistrate's first care therefore ought to be to prevent the importation; and this may generally be done by a due attention to bills of health, and to the proper performance of quarantines. The quarantines of persons may, with safety, be much less than 40 days; and if this were allowed, the execution of the quarantine would be more exact and certain, as the temptation to break it would be in a great measure avoided.

With respect to the quarantine of goods, it cannot be perfect, unless the suspected goods be unpacked, duly ventilated, and other means be employed for correcting the infection they may carry; and if all this be properly done, it is probable that the time commonly prescribed for quarantine may be also shortened. A second measure, in the way of prevention is required, when an infection has reached and prevailed in any place, to prevent that infection from spreading into others. This can only be done by preventing the inhabitants or the goods of any infected place from going out of it, till they have undergone a proper quarantine. The third measure, and which ought to be employed with great care, is, to prevent the infection from spreading among the inhabitants of a place in which it has arisen; and, in this case, a great deal may be done by the magistrate. 1. By allowing as many of the inhabitants as are free from infection, and are not necessary to the service of the place, to go out of it. 2. By discharging all assemblies, or unnecessary intercourse of the people. 3. By ordering some necessary communications to be performed without contact. 4. By making such arrangements and provisions as may render it easy for the families remaining to shut themselves up in their own houses. 5. By allowing persons to quit houses where an infection appears, upon condition that they go into lazarettoes. 6. By ventilating, and purifying, and destroying, at the public expence, all infected goods. 7. By avoiding hospitals, and providing separate apartments for infected persons. The fourth and last part of the business of prevention respects the conduct of persons necessarily remaining in infected places, especially those obliged to have some communication with persons infected. Those obliged to remain in places infected, but not to have any near communication with the sick, must avoid all near communication with other persons or their goods; and it is probable that a small distance will serve, if, at the same time, there be no stream of air to carry the effluvia of persons or goods to some distance. Those who are obliged to have a near communication with the sick, ought

to avoid any of the debilitating causes which render the body susceptible of infection, as a spare diet, intemperance in drinking, excess in venery, cold, fear, or other depressing passions of the mind. A full diet of animal food is also to be avoided, because it increases the irritability of the body, and favours the operation of contagion; and indigestion, whether from the quantity or quality of the food, contributes very much to the same.

Besides these, it is probable that the moderate use of wine and spirituous liquors, moderate exercise, and the cold bath, may be of use; tonic medicines also, of which the Peruvian bark is deservedly accounted the chief, may also be used with great probability of success. If any thing is to be expected from antiseptics, Dr. Cullen thinks camphire preferable to any other. In general, however, every one is to be indulged in the medicine of which he hath the best opinion, provided it is not evidently hurtful.

Cure. Here the indications are the same as in fever in general, but are not all equally important. The measures for moderating the violence of reaction, which operate by diminishing the action of the heart and arteries, have seldom any place here, excepting that the antiphlogistic regimen is generally proper. Some physicians have recommended bleeding, and Sydenham even seems to think it an effectual cure; but many other physicians deem it, for the most part, unnecessary, and in many cases hurtful. Purging has also been recommended; and in some degree it may be useful, in drawing off the putrescent matter frequently present in the intestines; but a large evacuation this way may certainly be hurtful.

The moderating the violence of re-action, as far as it can be done, by taking off the spasm of the extreme vessels, is a measure of the utmost necessity in the cure of the plague; and the whole of the means formerly mentioned, as suited to this indication, are extremely proper. The giving an emetic at the first approach of the disease, would probably be of great service; and it is probable, that at some other periods of the disease, emetics might be useful, both by evacuating bile abounding in the alimentary canal, and by taking off the spasm of the extreme vessels.

From some principles with respect to fever in general, and with respect to the plague in particular, that after the exhibition of the first vomit, the body should be exposed to sweat; but this sweat should be raised only to a moderate degree, though it must be continued for 24 hours or more, if the patient bears it easily.

The sweating is to be excited and conducted according to the rules laid down under *SYNOCHA*; and must be promoted by the plentiful use of diluents, rendered more grateful by vegetable acids, or more powerful by being impregnated with some portion of neutral salts. To support the patient under the continuance of the sweat, a little weak broth, acidulated with the juice of lemons, may be given frequently, and sometimes a little wine, if the heat of the body be not considerable. If sudorific medicines are judged necessary, opiates will be found most effectual and safe; but they should not be combined with aromatics, and probably may be more effectual if joined with a portion of emetics, and of neutral salts. But if, notwithstanding the use of emetics and sudorifics in the beginning, the disease should still continue, the cure must turn upon the use of means for obviating debility and putrescency; and for this purpose tonic medicines, especially the Peruvian bark, and cold drink are the most proper.

GENUS XXVI. VARIOLA; *the* SMALL POX.

Description. In the *distinct* small pox, the disease begins with a synocha or inflammatory fever. It generally comes on with some symptoms of a cold stage, and commonly with a considerable languor and drowsiness. A hot stage is soon formed, and becomes more considerable on the second and third day. During this course children are liable to frequent startings from their slumbers; and adults, if they are kept a-bed, are disposed to much sweating. On the third day, children are sometimes affected with one or two epileptic fits. Towards the end of the third day the eruption commonly appears, and gradually increases during the fourth; appearing first on the face, and successively on the inferior parts, so as to be completed over the whole body on the fifth day. From the third day the fever abates, and by the fifth it entirely ceases. The eruption appears first in small red spots, hardly prominent, but by degrees rising into pimples. There are generally but few on the face; but even when more numerous, they are separate and distinct from one another. On the fifth or sixth day a small vesicle, containing an almost colourless fluid, appears on the top of each pimple. For two days these vesicles increase in breadth only, and there is a small hollow pit in their middle, so that they are not raised into spheroidal pustules till the eighth day. These pustules, from their first formation, continue to be surrounded with an exactly circular inflamed margin, which when they are numerous diffuses some inflammation over the neighbouring skin, so as to give somewhat of a damask rose colour to the spaces between the pustules. As the pustules increase in size, the face swells considerably, if they are numerous on it; and the eye-lids particularly are so much swelled, that the eyes are entirely shut. As the disease proceeds, the matter in the pustules becomes by degrees more opaque and white, and at length assumes a yellowish colour. On the eleventh day the swelling of the face is abated, and the pustules seem quite full. On the top of each a darker

M E D I C I N E.

darker spot appears; and at this place the pustule on the eleventh day, or soon after, is spontaneously broken, and a portion of the matter oozes out; in consequence of which the pustule is shrivelled, and subsides; while the matter oozing out dries, and forms a crust upon its surface. Sometimes only a little of the matter oozes out, and what remains in the pustule becomes thick and even hard. After some days, both the crusts and the hardened pustules fall off, leaving the skin which they covered of a brownish red colour; nor doth it resume its natural colour till many days after. In some cases, where the matter of the pustules has been more liquid, the crusts formed by it are later in falling off, and the part they covered suffers some desquamation, which occasions a small hollow or pit in it.

On the legs and hands the matter is frequently absorbed; so that at the height of the disease, these pustules appear as empty as vesicles. On the tenth and eleventh days, as the swelling of the face subsides, a swelling arises in the hands and feet; but which again subsides as the pustules come to maturity. When the pustules on the face are numerous, some degree of pyrexia appears on the tenth and eleventh days, but disappears again after the pustules are fully ripened; or perhaps remains in a very slight degree till the pustules on the feet have finished their course; and it is seldom that any fever continues longer in the distinct small pox. When the pustules are numerous on the face, upon the sixth or seventh day some uneasiness in the throat, with a hoarseness in the voice, comes on, and a thin liquid is poured out from the mouth. These symptoms increase with the swelling of the face; and the liquids of the mouth and throat becoming thicker are with difficulty thrown out; and there is at the same time some difficulty in swallowing, so that liquids taken in to be swallowed are frequently rejected or thrown out by the nose. But all these affections of the fauces are abated as the swelling of the face subsides.

In the confluent small-pox all the symptoms above-mentioned are much more severe. The eruptive fever particularly is more violent; the pulse is more frequent and more contracted, approaching to that state of pulse which is observed in typhus. The coma is more considerable, and there is frequently a delirium. Vomiting also frequently attends, especially at the beginning of the disease. In very young infants epileptic fits are sometimes frequent on the first days of the disease, and sometimes prove fatal before any eruption appears, or they usher in a very confluent and putrid small-pox. The eruption appears more early on the third day, and it is frequently preceded or accompanied with an erysipelatous efflorescence. Sometimes the eruption appears in clusters like the measles. When the eruption is completed, the pimples are always more numerous upon the face, and at the same time smaller and less eminent. Upon the eruption the fever suffers some remission, but never goes off entirely; and after the fifth or sixth day it increases again, and continues to be considerable throughout the remaining part of the disease. The vesicles formed on the top of the pimples appear sooner; and while they increase in breadth, they do not retain a circular, but are every way of an irregular figure. Many of them run into one another, inasmuch that very often the face is covered with one vesicle rather than with a number of pustules. The vesicles, as far as they are any way separated, do not arise to a spheroidal form, but remain flat, and sometimes the whole of the face is of an even surface. When the pustules are in any measure separated, they are not bounded by an inflamed margin; but the part of the skin that is free from pustules is commonly pale and flaccid. The liquor that is in the pustules changes from a clear to an opaque appearance, and becomes whitish or brownish, but never acquires the yellow colour and thick consistence that appears in the distinct small-pox. The swelling of the face, which only sometimes attends the distinct small-pox, always attends the confluent kind; it also comes on more early, and arises to a greater height, but abates considerably on the tenth or eleventh day. At this time the pustules or vesicles break and shrivel; pouring out at the same time a liquor, which is formed into brown or black crusts, which do not fall off for a long time after. Those of the face, in falling off, leave the skin subject to a desquamation, which pretty certainly produces pittings. On the other parts of the body the pustules of the confluent small-pox are more distinct than on the face; but never acquire the same maturity and consistence of pus as in the properly distinct kind. The salivation, which sometimes only attends the distinct small-pox, very constantly attends the confluent; and both the salivation and the affection of the fauces above-mentioned, are, especially in adults, in a higher degree. In infants a diarrhoea comes frequently in place of a salivation.

In this kind of small-pox there is often a very considerable putrescency of the fluids, as appears from petechie, serous vesicles, under which the skin shews a disposition to gangrene, and from bloody urine or other hæmorrhages; all of which symptoms frequently attend this disease. In the confluent small-pox also, the fever, which had only suffered a remission from the eruption to the maturation, at or immediately after this period is frequently renewed again with considerable violence. This is what has been called the *secondary fever*, and is of various duration and event.

Causes, &c. It is evident that the small-pox is originally produced by a contagion; and that this contagion is a ferment with

respect to the fluids of the human body, which assimilates a great part of them to its own nature; and it is probable, that the quantity thus assimilated is, in proportion to their several bulks, nearly the same in different persons. This quantity passes again out of the body, partly by insensible perspiration, and partly by being deposited in pustules; but if the quantities generated be nearly equal, the quantities passing out of the body the two ways above-mentioned are very unequal in different persons. The causes which determine more of the variolous matter to pass by perspiration, or to form pustules, are probably certain circumstances of the skin, which determine more or less of the variolous matter to stick in it, or to pass freely through it. The circumstance of the skin, which seems to determine the variolous matter to stick in it, is a certain state of inflammation depending much on the heat of it: thus we have many instances of parts of the body, from being more heated, having a greater number of pustules than other parts. Thus parts covered with plasters, especially those of the stimulant kind, have more pustules than others. Certain circumstances also, such as adult age, and full living, determining to a phlogistic diathesis, seem to produce a greater number of pustules, and *vice versa*. It is therefore probable, that an inflammatory state of the whole system, and more particularly of the skin, gives occasion to a greater number of pustules; and the causes of this may produce most of the other circumstances of the confluent small-pox, such as the time of eruption, the continuance of the fever, the effusion of a more putrescent matter and less fit to be converted into pus, together with the form and other circumstances of the pustules.

Prognosis. The more exactly the disease retains the form of the distinct kind, it is the safer; and the more completely the disease takes the form of the confluent kind, it is the more dangerous. It is only when the distinct kind shews a great number of pustules on the face or otherwise, by fever or putrescency, approaching to the circumstances of the confluent, that the distinct kind is attended with any danger.

In the confluent kind the danger is always very considerable; and the more violent and permanent the fever is, the greater the danger; and especially in proportion to the increase of the symptoms of putrescency. When the putrid disposition is very great, the disease sometimes proves fatal before the eighth day; but in most cases death happens on the eleventh, and sometimes not till the fourteenth or seventeenth day. Though the small-pox may not prove immediately fatal, the more violent kinds are often followed by a morbid state of the body, sometimes of very dangerous event. These consequences, according to Dr. Cullen, may be imputed sometimes to an acrid matter produced by the preceding disease, and deposited in different parts; and sometimes to an inflammatory diathesis produced and determined to particular parts of the body.

Cure. The art of medicine hath never yet afforded a method of preventing the eruption of the small-pox after the contagion is received; all that can be done is, to render the disease more mild, which is generally effected by INOCULATION. It is not to be supposed that the mere giving of the infection artificially could make any difference in the nature of the disease, was it not that certain precautions are commonly used in the case of those who are inoculated, which cannot be used in the case of those who receive them naturally. These measures, according to Dr. Cullen, are chiefly the following.

1. The choosing for the subject of inoculation persons otherwise free from the disease, and not liable from their age or otherwise to any incidental disease.
2. The choosing that time of life which is most favourable to a mild disease.
3. The choosing for the practice a season most favourable to a mild disease.
4. The preparing the person to be inoculated, by enjoining abstinence from animal-food for some time before inoculation.
5. The preparing the person by courses of mercurial and antimonial medicines.
6. The taking care at the time of inoculation to avoid cold, intemperance, fear, or other circumstances which might aggravate the future disease.
7. After these preparations and precautions, the choosing a fit matter to be employed in inoculation, by taking it from a person of a sound constitution, and free from any disease, or suspicion of it; by taking it from a person who has had the small-pox of the most benign kind; and lastly, by taking the matter from such person as soon as it has appeared in the pustules, either on the part inoculated, or on other parts of the body.
8. The introducing, by inoculation, but a small portion of the contagious matter.
9. After inoculation, the continuing of the vegetable diet, at the same time employing frequent purging.
10. Both before and after inoculation, taking care to avoid external heat, either from the sun, artificial fires, warm chambers, much clothing, or being much in bed; and, on the contrary, exposing the person to a free and cool air.
11. Upon the appearance of the eruptive fever, the rendering that moderate by the employment of purgatives; by the use of cooling and antiseptic acids; and especially by exposing the person frequently to a cool air, at the same time giving freely of cold drink.
12. After the eruption, the continuing the application of cool air, and the use of purgatives, during the course of the disease, till the pustules are fully ripened.

As the common infection may often seize persons under a diff-

M E D I C I N E.

ceased state, which may render the small pox more violent, it is evident that inoculation must have a great advantage by avoiding such concurrence. But as the avoiding of this may in the mean time frequently leave persons exposed to the common infection, it is well worth while to inquire what are the diseased states which should restrain from the practice of inoculation.

Though inoculation hath been practised with safety upon persons of all ages, yet there is reason to conclude, that adults are more liable to a violent disease than persons of younger years. At the same time it is observed, that children, in the time of their first dentition, are liable from the irritation of that, to have the small-pox rendered more violent; and that infants, before the time of dentition, upon receiving the contagion of the small-pox are liable to be afflicted with epileptic fits, which frequently prove fatal. Hence it is evident, that though circumstances may admit and approve of inoculation at any age, yet for the most part it will be advantageous to choose persons after the first dentition is over, and before the time of puberty. The operation of inoculation may be performed at any season of the year: yet as it is certain that the cold of winter may increase the inflammatory, and the heats of summer increase the putrescent, state of the small-pox, it is highly probable that inoculation may have some advantage from avoiding the extremes either of cold or heat.

As the use of animal food may increase both the inflammatory and putrescent state of the human body, so it must render persons, in receiving the contagion of the small-pox, less secure against a violent disease: and therefore inoculation may derive some advantage by enjoining abstinence from animal food, for some time before the operation is performed: but we are of opinion, that a longer time is necessary than what is commonly prescribed.

It has commonly been supposed, that inoculation derives some advantage from the choice of the matter employed in it; but it is very doubtful if any choice be here necessary, or can be of any benefit in determining the state of the disease. It is not indeed probable that there is any difference of contagion producing the small-pox; for there are innumerable instances of the contagion arising from a person who labours under the distinct small-pox producing the confluent kind, and the contrary. Since the practice of inoculation hath been introduced, it hath also been observed, that the same variolous matter would in one person produce the distinct, and in another the confluent small-pox. Is it therefore highly probable, that the difference of the small-pox does not depend upon any difference of the contagion, but upon some difference in the state of the persons to whom it is applied, or in the state of certain circumstances concurring with the application of the contagion.

Some have supposed, that inoculation has an advantage over the natural infection, by introducing only a small portion of contagious matter into the body; but this is by no means well ascertained. It is not known what quantity of contagion is introduced into the body by the common infection of the small-pox: and it is probable the quantity is not great; nor, though it were larger than that thrown in by inoculation, is it certain what the effects would be. A certain quantity of ferment may be necessary to excite fermentation in a given mass; but when that quantity is given, the fermentation and assimilation, are extended to the whole mass: and we do not find that a greater quantity than is just necessary, either increases the activity of the fermentation, or more certainly secures the assimilation of the whole. In the case of the small-pox, a considerable difference in the quantity of the contagion introduced, hath not shewn any effects in modifying the disease.

Purging has the effect of diminishing the activity of the sanguiferous system, and of obviating the inflammatory state of it; and therefore it is probable, that the frequent use of cooling purgatives gives a considerable advantage to the practice of inoculation; and probably this is also obtained by diminishing the determination to the skin.

It is probable that the state of the small-pox depends very much upon the state of the eruptive fever; and particularly in avoiding the inflammatory state of the skin; and therefore it is also probable, that the measures taken for moderating the eruptive fever, and inflammatory state of the skin, afford the greatest improvement which has been made in the practice of inoculation. It hath been the practice of inoculators to continue the use of purgatives and the application of cold air after the eruption; but it cannot be said to give any particular advantages to inoculation, and the employment of purgatives seems often to have lead to an abuse. When the state of the eruption is determined, when the number of pustules is very small, and the fever hath entirely ceased, the safety of the disease may be said to be ascertained, and further remedies absolutely superfluous: in such cases therefore the use of purgatives is unnecessary, and may be hurtful.

It remains now only to consider the treatment of the small-pox, when the symptoms shall be violent, as may sometimes happen, even after inoculation and every remedy and precaution have been used. The cause of this is not ascertained, but it seems to be a putrescent tendency of the fluids. When therefore, from the prevailing of the small-pox as an epidemic, and more especially when it is known that a person not formerly affected with the disease has been exposed to the infection, if such person should be attacked with the symptoms of fever, there can be little doubt

that it is the fever of the small-pox, and therefore he is to be treated in every respect as if he had the disease received by inoculation.

It frequently happens, especially in infants, that during the eruptive fever of the small-pox, convulsions occur. Of these, if only one or two fits appear on the evening preceding the eruption: they give a prognostic of a mild disease, and require no remedy: but if they occur more early, are violent, and frequently repeated, they are very dangerous, and require a speedy remedy; and here bleeding and blistering are of no service, the only effectual medicine is an opiate given in a large dose.

These are the remedies necessary during the eruptive fever; and if, upon the eruption, the pustules on the face are distinct, and their number few, the disease requires no further remedies. But when, upon the eruption, the number of pimples on the face is considerable, when they are not distinct; and especially if, upon the fifth day, the fever does not suffer a considerable remission; the disease still requires a great deal of attention. If, after the eruption, the fever shall still continue, the avoiding of heat and the continuing to expose the body to a cool air will still be proper.

If the fever is considerable, with a full hard pulse, in an adult person, a bleeding will be necessary, and more certainly a cooling purgative: but it will be seldom necessary to repeat the bleeding, as a loss of strength very soon comes on; but the repetition of a purgative, or the frequent use of laxative glysters, is commonly advantageous. When a loss of strength, with other marks of a putrescent tendency of the fluids, appears, the Peruvian bark must be given in substance, and in a large quantity. In the same case, the use of acids and of nitre is advantageous, and commonly it is proper also to give wine very freely. From the fifth day of the disease throughout the whole course of it, it is proper to give an opiate once or twice a day; taking care at the same time to obviate costiveness, by purgatives or by laxative glysters. From the eighth to the eleventh day of a violent disease, it will be proper to lay on blisters successively on different parts of the body, and that without regard to the parts being covered with pustules. Blisters are also to be applied to the external fauces, in case of difficult deglutition, and viscid saliva and mucus, which are thrown out with difficulty, at the same time that detergent gargles are to be diligently used. During the whole course of this disease, when a considerable fever is present, antimonial medicines may be given in nauseating doses with advantage, and these commonly answer the purpose of purgatives. The remedies above-mentioned are frequently proper from the fifth day till the suppuration is finished. But as after that period the fever is sometimes continued and increased; or as sometimes, when there was little or no fever before, a fever now arises and continues with considerable danger; this is called the *secondary fever*, and requires a particular treatment.

When the secondary fever follows the distinct small-pox, and the pulse is full and hard, the case is to be treated as an inflammatory affection, by bleeding and purging; but the secondary fever which follows the confluent kind, is to be considered as a putrid disease, and bleeding is improper. Some purging may be necessary, but the remedies to be chiefly depended upon are the Peruvian bark and acids. When the secondary fever first appears, whether after a distinct or confluent small-pox, it is useful to exhibit an antimonial emetic, in nauseating doses, but in such a manner as to produce some vomiting. For avoiding the pits which frequently follow the small-pox, no method hitherto proposed seems to be sufficiently certain.

GENUS XXVII. VARICELLA, or the CHICKEN-POX.

This is a very slight disease; and is attended with so little danger, that it would not merit any notice, if it were not apt to be confounded with the small-pox, and thus give occasion to an opinion that a person might have the small-pox twice in his life; or they are apt to deceive into a false security those who have never had the small-pox, and make them believe that they are safe, when in reality they are not.

The patients scarce suffer any thing throughout the whole progress of this illness, except some languidness of strength and spirits and appetite, all which is probably owing to the confining of themselves to their chamber. Remedies are not likely to be much wanted in a disease attended with hardly any inconvenience, and which in so short a time is certainly cured of itself. The principal marks by which the chicken-pox may be distinguished from the small-pox are,

1. The appearance, on the second or third day from the eruption, of that vesicle full of serum upon the top of the pock.
2. The crust, which covers the pocks on the fifth day; at which time those of the small-pox are not at the height of their suppuration. Foreign medical writers hardly ever mention the name of this distemper; and the writers of our own country scarce mention any thing more of it than its name. From the great similitude between the two distempers, it is probable, that, instead of the small-pox, some persons have been inoculated from the chicken-pox; and that the distemper which has succeeded, has been mistaken for the small-pox by hasty or unexperienced observers.

GENUS XXVIII. RUBEOLA, the MEASLES.

Description. This disease begins with a cold stage, which is soon followed by a hot, with the ordinary symptoms of thirst, heat, anorexia, anxiety, sickness, and vomiting; and these are

M E D I C I N E.

more or less considerable in different cases. Sometimes from the beginning, the fever is sharp and violent; often, for the first two days, it is obscure and inconsiderable; but always becomes violent before the eruption, which commonly happens on the fourth day. This eruptive fever, from the beginning of it, is always attended with hoarseness, a frequent hoarse dry cough, and frequently with some difficulty of breathing. At the same time, the eye-lids are somewhat swelled; the eyes are a little inflamed, and pour out tears; and with this, there is a coryza, and frequent sneezing. For the most part, a constant drowsiness attends the beginning of this disease. The eruption appears first in small red points; but soon after, a number of these appear in clusters, which do not arise in visible pimples, but, by the touch, are found to be a little prominent. This is the case on the face: but, in other parts of the body, the prominence, or roughness, is hardly to be perceived. On the face, the eruption retains its redness, or has it increased for two days: but, on the third, the vivid redness is changed to a brownish red; and, in a day or two more, the eruption entirely disappears, while a mealy desquamation takes place. During the whole time of the eruption, the face is somewhat turgid, but seldom considerably swelled. Sometimes, after the eruption has appeared, the fever ceases entirely: but this is seldom the case; and more commonly the fever continues or is increased after the eruption, and does not cease till after the desquamation. After the same period, also, a diarrhoea frequently comes on, and continues for some time. It is common for measles, even when they have not been of a violent kind, to be followed by inflammatory affections, particularly ophthalmia and phthisis. If the blood be drawn from a vein in the measles, with the circumstances necessary to favour the separation of the gluten, this always appears separated, and lying on the surface of the crassamentum, as in inflammatory diseases. For the most part, the measles, even when violent, are without any putrid tendency; but in some cases, such a tendency appears both in the course of the disease, and especially after the ordinary course of it is finished. See Dr. Watson, in London Med. Obs. vol. iv. art. 11.

Causes. The measles are occasioned by some kind of contagion, the nature of which is not understood; and which, like the former, affects a person only once in their lives.

Prognosis. From the description of this distemper already given, it appears that the measles are attended with a catarrhal affection, and by an inflammatory diathesis to a considerable degree; and therefore the danger of them is to be apprehended chiefly from the coming on of a pneumonic inflammation.

Cure. From the consideration mentioned in the prognosis, it will be obvious, that the remedies especially necessary are those which may obviate and diminish the inflammatory diathesis; and therefore, in a particular manner, blood-letting. This remedy may be employed at any time in the course of the disease, or after the ordinary course of it is finished. It is to be employed more or less, according to the urgency of the symptoms of fever, cough, and dyspnoea; and generally may be employed very freely. But, as the symptoms of pneumonic inflammation seldom come on during the eruptive fever; and, as this is sometimes violent, immediately before the eruption, though a sufficiently mild disease be to follow, bleeding is seldom very necessary during the eruptive fever, and may often be reserved for the times of greater danger which are perhaps to follow. Assistance may also be drawn from cooling purgatives; and particularly from blistering on the sides, or between the shoulders. The dry cough may be alleviated by the large use of demulcent pectorals, mucilaginous, oily, or sweet. For moderating and quieting the cough in this disease, opiates certainly prove the most effectual means, whenever they can be safely employed. In the measles, in which an inflammatory state prevails to a considerable degree, opiates may be supposed to be inadmissible; and, in those cases in which a high degree of prexia and dyspnoea shew either the presence, or at least the danger, of pneumonic inflammation, opiates might be very hurtful: but, in cases in which the dyspnoea is not considerable, and in which bleeding, to obviate or abate the inflammatory state, has been duly employed; in such cases, while the cough and watchfulness are the urgent symptoms, opiates may be safely exhibited, and with great advantage. In all the exanthemata, there is an acrimony diffused over the system, which gives a considerable irritation; and, for obviating the effects of this, opiates are useful, and always proper, when no particular contra-indication prevails.

When the desquamation of the measles is finished, though then there should be no disorder remaining, physicians have thought it necessary to purge the patient several times, with a view to draw off the dregs of this disease, that is, a portion of the morbid matter which is supposed to remain long in the body.

From our late experience of the use of cold air in the eruptive fever of the small-pox, some physicians have been of opinion that the practice may be transferred to the measles; but experience determines our opinion to the contrary. We are certain, that external heat may be very hurtful in the measles, as in most other inflammatory diseases: and, therefore, that the body ought to be kept in a moderate temperature during the whole course of the measles. Analogy, though so often the resource of physicians, is frequently fallacious; and further, though the analogy with the

small-pox might lead to the application of cold air during the eruptive fever of the measles, the analogy with catarrh is greatly against the practice. When the eruption is upon the skin, we have had many instances of cold air making it disappear, and thereby producing much disorder in the system; and we have also had frequent instances of this disorder being removed by restoring the heat of the body, and thereby again bringing out the eruption.

GENUS XXIX. SCARLATINA. The SCARLET FEVER.

The Mild SCARLET FEVER.

The mild scarlet fever is described by Sydenham, who tells us that he can scarce account it a disease; and indeed nothing more seems to be necessary in the treatment of it than an antiphlogistic regimen, avoiding the application of cold air and cold drink. The disease however sometimes rages epidemically, and is attended with very alarming symptoms, bearing no small resemblance to the cynanthe maligna, in which case it is called *scarlatina anginosa*.

The *Scarlatina Anginosa*, or SCARLET FEVER, with ulcerated sore Throat.

The best description of this distemper hath been published by Dr. Withering in the year 1778. This disease made its appearance, we are told, at Birmingham and the neighbouring villages, about the middle of May 1778. It continued all its force and frequency to the end of October; varying, however, in some of its symptoms, as the air grew colder. In the beginning of November it was rarely met with; but towards the middle of that month, when the air became warmer, it increased again, and in some measure resumed those appearances it possessed in the summer months, but which it had lost during the cold winds in October. It affected children more than adults; but seldom occurred in the former under two years of age, or in the latter when once they had passed their fiftieth year.

Description. With various general symptoms of fever, the patient at first complains of a dejection of spirits, a slight soreness or rather stiffness in the neck, with a sense of straitness in the muscles of the neck and shoulders, as if they were bound with cords. The second day of the fever this soreness in the throat increases; and the patients find a difficulty in swallowing; but the difficulty seems less occasioned by the pain excited in the attempt, or by the straitness of the passage, than by an inability to throw the necessary muscles in action. The skin feels hot and dry, but not hard; and the patients experience frequent, small, pungent pains, as if touched with the point of a needle. The breath is hot and burning to the lips, and thirst makes them wish to drink; but the tendency to sickness, and the exertions necessary in deglutition, are so unpleasant, that they seldom care to drink much at a time. They have much uneasiness also from want of rest during the night. In the morning of the third day, the face, neck, and breast, appear redder than usual: in a few hours this redness becomes universal, and increases to such a degree of intensity, that the face, body, and limbs, resemble a boiled lobster in colour, and are evidently swollen. Upon pressure the redness vanishes, but soon returns again. The skin is smooth to the touch, nor is there the least appearance of pimples or pustules. The eyes and nostrils partake more or less of the general redness; and in proportion to the intensity of this colour in the eyes, the tendency to delirium prevails. Things continue in nearly this state for two or three days longer, when the intense scarlet gradually abates, a brown colour succeeds, and the skin becoming rough, peels off in small scales. The tumefaction subsides at the same time, and the patients gradually recover their strength and appetite. During the whole course of the disease, the pulse is quick, small, and uncommonly feeble; the urine small in quantity; the sub-maxillary glands somewhat enlarged and painful to the touch. The velum pendulum palati, the uvula, the tonsils, and gullet, as far as the eye can reach, partake of the general redness and tumefaction.

These are the most usual appearances of this disorder; but it too frequently assumes a much more fatal form. In some children the delirium commences in a few hours after the first attack; the skin is intensely hot; the scarlet colour appears on the first or second day, and they die very early on the third. Others again, who survive this rapid termination, instead of recovering, as is usual, about the time the skin begins to get its natural colour, fall into a kind of lingering, and die at last in the course of six or eight weeks.

In adults, circular livid spots were frequently observed about the breasts, knees, and elbows; also large blotches of red, and others of white intermixed, and often changing places.

Happy would it be, our author observes, if the baneful influence of this disorder terminated with the febrile symptoms. But in ten or fifteen days from the cessation of the fever, and when a complete recovery might be expected, another train of symptoms occur, which at last frequently terminate fatally. The patients, after a few days amendment, feel a something that prevents their farther approach to health; an unaccountable languor and debility prevails; a stiffness in the limbs, an accelerated pulse, disturbed sleep, disinclination to food, and a scarcity of urine. These symptoms, we are told, are soon succeeded by swellings of a real dropsical nature, forming sometimes an anasarca, and on other occasions an ascites.

Dr. Withering, after examining the accounts given of this disease by different authors, proceeds to the diagnosis. It may be distinguished

M E D I C I N E.

distinguished, he observes, from the petéchiæ fever, by the eruption in the latter appearing seldom before the fourth day, by the regularity and distinctness of the spots, and by its principally occupying the neck, the back, and the loins. On the other hand, in the scarlet fever, the eruption generally appears about the third day; consists either of broad blotches, or else one continued redness, which spreads over the face and the whole body.

In the fever called *purpura*, the pustules are prominent, keep their colour under pressure, and never appear early in the disease; whereas in the scarlet fever, the eruption appears more early, is not prominent, but perfectly smooth to the touch, and becomes quite white under pressure.

Although the *purple fever* and *scarlatina* may be connected by some general cause, yet our author takes occasion to observe that they cannot be mere modifications of the same eruption: for examples occur, he says, of the same person being first seized with one of these disorders, and afterwards with the other; but he never met with an instance of the same person having the scarlet fever twice; and he believes it to be as great an improbability as a repetition of the small-pox.

Causes. Our author affirms that the immediate cause of this disease is a poison of a peculiar kind, communicable by contagion. 2. That this poison first takes possession of the mucous membrane lining the fauces and the nose; and either by its action upon the secretory glands, or upon the mucus itself, assimilates that mucus to its own nature. 3. That it is from this beginning, and from this only, that it spreads to the stomach, &c. and at length acts upon the system at large. 4. That its first action upon the nerves, is of a sedative or debilitating nature. 5. That in consequence of certain laws of the nervous system, when the debilitating effects operate upon the sensorium commune, a re-action takes place; and that this re-action is, *ceteris paribus*, proportioned to the debilitating power. 6. That, in consequence of this re-action of the nervous system, the vibratory motion of the capillary blood-vessels dependent thereon is greatly increased; an unusually large quantity of blood is accumulated in those vessels; the heart and large blood vessels are deprived of their customary proportion; and hence, though stimulated to more frequent contraction, the pulse must necessarily be feeble. 7. That as violent exertions are followed by debility, upon the cessation of the fever, the capillary vessels, which had acted with such unusual violence, are left in a state of extreme debility, and are long in recovering their tone; hence it is that so many patients afterwards become dropical. Our author now proceeds to the consideration of the different remedies, which either are at present in common use, or have been recommended as proper in this disease.

Cure. Blood-letting has been recommended by authors; but such was the state of the pulse in this disorder, at least during the summer months, that it was not in any instance thought advisable to take away blood. In some cases, indeed, where the fiery redness of the eyes seemed to demand the use of leeches, they were had recourse to, but never with any advantage. In the harvest months, when the pulse was more firm, and when suffocation seemed to be threatened from the swelling in the fauces, blood-letting was sometimes advised, but still with less advantage than one would have expected in almost any other situation.

Vomiting. This, our author observes, seems to be the remedy of nature; and he is surprised how it should have been omitted by several authors, who have gone before him. Vomiting, he says, most amply fulfils the indications arising both from a consideration of the cause and of the effects; and a liberal use of the remedy he holds forth as the true foundation for successful practice in scarlet-fever and sore-throat. His common form of emetic is a combination of tartar emetic and ipecacuanha, given in pretty smart doses; and these are to be repeated at least once in 48 hours, and in the worst cases so often as twice in 24 hours.

Purgings. The action of purgatives is considered by our author as altogether repugnant to the curative indications in this disease; for the poison, as formerly remarked, being received into the system by the fauces, the operation of a purge, instead of discharging it, can only promote its diffusion along the alimentary canal; and in fact, we are told, that when even a spontaneous purging supervenes in this disease, the patients sink so amazingly fast, that it is not within the reach of art to support them.

Injected gargles of contrayerva decoction, sweetened with oxymel of squills, &c. were found very beneficial in bringing always large quantities of viscid ropy stuff from the fauces.

Animal food and fermented liquors were denied the patients, and nothing allowed but tea, coffee, chocolate, milk and water, gruel, barley-water, and such articles. With respect to the dropical disorder which so frequently succeeds to this complaint, it was never observed, our author remarks, when the preceding symptoms had been properly treated.

Our author concludes his essay with an enumeration of several cases, treated according to the principles above laid down. The successful termination of these cases demonstrates the propriety of the practice which he has recommended.

ORDER IV. HÆMORRHAGIÆ; Hemorrhages.

GENUS XXX. HÆMOPYSIS, or spitting of BLOOD.

Description. The hæmoptysis commonly begins with a sense

of weight and anxiety in the chest, some uneasiness in breathing, pain of the breast or other parts of the thorax, and some sense of heat under the sternum; and very often it is preceded by a fastidious taste in the mouth. Immediately before the appearance of blood, a degree of irritation is at the top of the larynx. The person attempts to relieve this by hawking, which brings up a little florid and somewhat frothy blood. The irritation returns; and in the same manner blood of a similar kind is brought up, with some noise in the wind-pipe, as of air passing through a fluid. Sometimes however, at the very first, the blood comes up with coughing, or at least somewhat of coughing accompanies the hawking above-mentioned. The blood is sometimes at first in a very small quantity, and soon disappears; but in other cases, especially when it frequently recurs, it is in greater quantity, and often continues to appear at times for several days together. It is sometimes profuse, but rarely in such a quantity, as either by its excess or by a sudden suffocation to prove immediately mortal. It is not always easy to discover whether the blood evacuated by the mouth proceeds from the internal surface of the mouth itself, from the fauces or adjoining cavities of the nose, from the stomach, or from the lungs. It is however, very necessary to distinguish the different cases, by the following considerations.

1. When the blood proceeds from some part of the internal surface of the mouth, it comes out without any hawking or coughing; and generally, upon inspection, the cause is evident.

2. When blood appears from the fauces, or adjoining cavities of the nose, it may be brought out by hawking, and sometimes by coughing. In this case there may be a doubt concerning its real source, and the patient may be allowed to please himself with the thoughts that the blood doth not come from the lungs. But the physician must remember that the lungs are much more frequently the source of hæmoptysis than the fauces. The latter seldom happens but to persons who have before been liable to an hæmorrhage from the nose, or to some evident cause of erosion; and in most cases, by looking into the fauces, the distillation of the blood from thence will be perceived.

3. When blood proceeds from the lungs, the manner in which it is brought up will commonly shew from whence it comes; but independent of that, it may also be known from the causes of hæmoptysis from the lungs, to be afterwards mentioned, having preceded.

4. When vomiting accompanies the throwing out of blood from the mouth, we may generally know the source from whence it proceeds, by considering that blood does not proceed so frequently from the stomach as from the lungs; that blood proceeding from the stomach commonly appears in greater quantity than from the lungs. The pulmonary blood also is usually of a florid colour, and mixed with a little frothy mucus only; but the blood from the stomach is of a darker colour, more grumous, and mixed with the other contents of the stomach. The coughing or vomiting, as the one or the other happens first to arise, may sometimes point out the source of the blood; and this hath also its peculiar antecedent signs and causes.

Causes, &c. An hæmoptysis may be produced at any time of life by external violence; and, in adult persons, while the arterial pelthora prevails in the system, i. e. from the age of 16 to 35, an hæmoptysis may at any time be produced merely by a plethoric state of the lungs. More frequently, however, it arises from a faulty proportion between the capacity of the lungs and that of the rest of the body. Thus it is often an hereditary disease, which implies a peculiar and faulty conformation.

This disease especially happens to persons who discover the smaller capacity of their lungs by the narrowness of their chest. It happens also to persons of slender delicate make, of which a long neck is a mark; to persons of much sensibility and irritability, and therefore of quick parts; to persons who have formerly been liable to hæmorrhages from the nose; to those who have suffered a suppression of any usual hæmorrhage, the most frequent instance of which is in females, who have suffered a suppression of their menstrual flux; and lastly, to persons who have suffered the amputation of any considerable limb.

One of the exciting causes, and perhaps a frequent one, is external heat; which, even when in no great degree, brings on the disease in spring, and the beginning of summer, while the heat rarifies the blood more than it relaxes the solids, which had before been contracted by the cold of winter. Another exciting cause is any violent exercise of respiration. In the predisposed, also, the disease may be occasioned by any degree of external violence.

Prognosis. The hæmoptysis may sometimes be no more dangerous than a hæmorrhage from the nose; as when it happens to females in consequence of a suppression of their menses; when without any marks of predisposition, it arises from external violence; or, from whatever cause arising, when it leaves no cough, dyspnoea, or other affection of the lungs, behind it. But even in these cases, a danger may arise from too large a wound being made in the vessels of the lungs, from any quantity of red blood being left to stagnate in the cavity of the bronchiæ, and particularly from any determination of the blood being made into the vessels of the lungs, which by renewing the hæmorrhage may have these consequences.

Cure.

MEDICINE.

Cure. On this subject Dr. Cullen differs from those who prescribe chalybeates and the Peruvian bark in the cure of hæmoptysis. Both of these, he observes, contribute to increase the phlogistic diathesis then prevailing in the system, and the hæmoptysis from predisposition is always accompanied with such a diathesis. Instead of these, therefore, he recommends blood-letting in greater or smaller quantity, and more or less frequently repeated as the symptoms shall direct. At the same time cooling purgatives are to be employed, and every part of the antiphlogistic regimen is to be strictly enjoined. In the London Medical Observations, the use of nitre is greatly recommended by Dr. Dickson, to whom its efficacy was known by Dr. Letherland, physician to St. Thomas's Hospital. The most commodious method of exhibiting it he found was in an electuary. Four ounces of conserve of roses were made into an electuary with half an ounce of nitre; of which the bulk of a large nutmeg was directed to be given, four, six, or eight times a day, according to the urgency of the case. The good effects of this, our author tells us, have often astonished him; and when given early in the disease, he says he can depend as much upon it for the cure of an hæmoptysis, as on the bark for the cure of an intermittent. He agrees with Dr. Cullen, however, that in those cases where there is any hardness in the pulse, and which almost always happens, there is a necessity for venesection. A cool regimen, and quiet of body and mind, are certainly useful; but Dr. Cullen observes, that some kinds of gestation, such as sailing, and travelling in an easy carriage on smooth roads, have often proved a remedy. When the cough is very troublesome, it is absolutely necessary to exhibit frequently a small dose of an opiate. Dr. Dickson also informs us, that the nitre joined with *Spermaceti*, or *pulv. e tragacanth. comp.* has produced equally good effects with the electuary above-mentioned; in the composition of which the Doctor at first considered the conserve only as a vehicle for the nitre, though he means not to insinuate that the former is totally destitute of efficacy.

PHTHISIS, or CONSUMPTION of the LUNGS.

Sometimes, notwithstanding all the care we can take, the hæmoptysis will degenerate into a phthisis pulmonalis, or consumption of the lungs; and sometimes an hæmoptysis will be the consequence of this dangerous disorder. It hath been indeed supposed, that an ulceration of the lungs, or phthisis, was the natural and almost necessary consequence of an hæmoptysis; but, this is in general a mistake; for there are many instances of an hæmoptysis from external violence without being followed by any ulceration. The same thing hath often been observed where the hæmoptysis arose from an internal cause; and this not only in young persons, when the disease returned for several times, but when it has often recurred during the course of a long life; and it may easily be conceived, that a rupture of the vessels of the lungs, as well as of the vessels of the nose, may be sometimes healed. The causes of phthisis, therefore, may be reduced to five heads. 1. An hæmoptysis. 2. A suppuration of the lungs in consequence of a pneumonia. 3. A catarrh. 4. An asthma; and, 5. Tubercles.

A phthisis, indeed, most commonly arises from tubercles. Dr. Simmons informs us, that he has had opportunities of inspecting the bodies of several people who died in this way, and never found them totally absent. He hath likewise seen them in subjects of different ages, who had been troubled with no symptoms of an affection of the breast during their lifetime. In these, however, they were small, and few in number. This proves that they may exist without inconvenience till they begin to disturb the functions of the lungs by their size and number; or till some degree of inflammation is excited, either by accidental causes, or by certain changes that take place within their substance; for as yet we know but little of their true nature. These little tumours vary in their consistence; in some they are composed of a pulpy substance, and in others approach more to the nature of scirrhus. They are most commonly formed in consequence of a certain constitutional predisposition; but whatever is capable of occasioning a morbid irritability of the lungs seems to be capable of generating them. Thus the spasmodic asthma frequently ends in tubercles and consumption; and it is not unusual for millers, stone-cutters, and others, to die consumptive, from their being so constantly exposed to dust, which in these cases probably acts by producing similar concretions; and Dr. Kirkland observes, that scythe-grinders are subject to a disease of the lungs, from particles of sand mixing with iron dust, which among themselves they call the *grinders rot*. Tubercles likewise often have their source from a scrophulous acrimony; and some eminent physicians have supposed that the generality of pulmonary consumptions are of this kind. This notion, however, they have carried too far: they have probably been misled by these tuberculous concretions which, without good reason, have been supposed to be diseased glands, and of course analogous to the glandular affections we meet with in the scrophula. Tubercles may likewise sometimes be owing to the sudden repulsion of cutaneous eruptions, or of the matter of exanthemata, &c. or to other causes.

The persons who are most liable to consumption are those of a fair complexion, fine and soft skin, florid cheeks, and a slender make; with high cheek bones, hollow temples, long neck, narrow chest and a remarkable prominence of the processes of

the os sacrum. To these marks we may add, that of *sound teeth*, which, as the disease advances, usually become of a milky white colour, and more or less transparent. Of those who are carried off by this disease, Dr. Simmons asserts, the greater number will be found never to have had a carious tooth.

Persons of the above description often remain for a long time without feeling any other inconvenience than some oppression at the breast in moist weather; or in hot apartments. Their breathing is easily hurried, sometimes by the slightest motion; and they become languid, paler, and thinner. All this while, however, they feel no heat or painful sensation in the breast. As the evil increases, the patient begins to be attacked with a slight, frequent, and dry cough, which is most troublesome in the night time. This, however, by proper care, is often relieved; and the patient remains in this state for a considerable time, and even for many years, if he is sensible of his danger, and careful to guard against it by a suitable manner of living. More commonly, however, we find the cough increasing, and sometimes accompanied with more or less of catarrh. This is usually ascribed to cold; and but too generally neglected, till the disease becomes alarming by its obduracy and its effects. This may be considered as the *beginning*, or *first period*, of the disease. During this stage, the cough is sometimes dry from the first; and sometimes, when it sets in the form of a catarrh, is attended with more or less expectoration of mucus.

Description. When the disease has been neglected, or our attempts to remove it in the beginning have failed, both of which circumstances but too frequently happen, the patient begins to complain of a soreness, and of slight lancinating pains shooting through the breast, sometimes in the direction of the mediastinum, and sometimes confined chiefly to one side. The soreness is pretty constant, and much increased by the cough. The pain in the side often prevents the patient from lying on the side affected; and this inability of lying, except on one side, frequently occurs even when no such pain is felt. In this stage of the disease, flushing heats are felt in the palms of the hand and soles of the feet: the breathing is short and laborious; and it is not long before the patient begins to expectorate a thin and frothy phlegm, at first in small quantities, coughed up with difficulty and soreness; and now and then streaked with blood: this may be considered as the *inflammatory period* of the disease, to which succeeds the *suppurative stage*. In the latter, the expectoration becomes more copious and purulent, the breath proportionably offensive, and the exacerbations of the hectic more considerable: an increased quickness of the pulse comes on about the middle of the day; but the most considerable paroxysm of the fever is at night, and at first continues till towards morning, commonly till three or four o'clock, when it terminates in a sweat, which usually begins upon the breast. As the disease advances, the sweats become more profuse, and sometimes come on almost as soon as the pulse begins to quicken, but without affording any relief to the patient. During the exacerbations, we observe a circumscribed redness of the cheeks, while the rest of the face is pale, and appears as if it were not clean washed. The costiveness that commonly accompanies the beginning of the disease is usually succeeded by a diarrhoea; the spitting lessens, and all the purulent matter seems to be carried downwards. The wasting of the fat and the loss of nourishment occasion the nails to curve inwards, the hair to fall off, and the eyes to sink in their sockets. In the mean time, the legs commonly swell; till at length death closes a scene which is melancholy to all but the patient himself, who in general continues sensible to the last moment, and even then indulges a vain hope of prolonging a miserable existence. In some cases, and that not unfrequently, a delirium comes on towards the close of the disease.

The hectic fever that attends this and some other chronic diseases, is evidently the effect of acrimony, and most commonly of pus absorbed and carried into the circulation. The nature of this acrimony, and the different irritability of different patients, are probably the sources of the variety we observe in fevers of this denomination; a variety which is doubtless much greater than we are aware of. Thus we find that the matter of the small-pox excites a fever of this kind; but this *secondary fever*, as it is called, differs from the hectic attendant on consumptions; nor does the latter correspond with that which sometimes accompanies the suppuration of a cancerous ulcer. In the pulmonary consumption, or at least in the third stage of it, the fever induced is truly of the putrid kind, and has been well denominated *febris hectica putrida* by the judicious Morton, who considers it as being combined with a peripneumonic or inflammatory fever, which recurs as often as fresh tubercles begin to inflame. For although we have named one period of the disease, the *inflammatory*, and another the *suppurative period*, yet we are not to suppose that the latter is exempt from inflammation. While matter is poured into the bronchiæ, or absorbed and carried into the system from one part of the lungs, other parts are in a crude state of inflammation, or advancing towards suppuration; so that, on examining the lungs of persons who die consumptive, we find some tubercles that are small and just formed, some that are large and full of matter, and others that are in a state of ulceration. This easily accounts for the occasional combination of inflammatory symptoms with those of the putrid hectic.

M E D I C I N E.

When the matter absorbed is a laudable pus, as in the case of a psoas abscess, we find the form of the hectic differing from either of those we have mentioned.

Cure. When the cough sets in the form of a catarrh, and appears to be occasioned by an increased secretion of a thin salivary mucus irritating the membrane of the trachea, all judicious practitioners agree in recommending an attention to regimen, the free use of diluting liquors, bland emulsions, small doses of nitre, the taking away a few ounces of blood if there be much inflammation, the inhaling the steams of warm water, and the occasional use of such a dose of elixir paregoricum as will be sufficient to allay the irritation of the bronchiae, and to promote a gentle moisture on the skin. These methods will generally be found to be efficacious, especially if the patient's chamber is of a moderate temperature, and he carefully avoids exposure to a cold, damp, or raw air, till the complaint is removed. In cases in which the cough has been obstinate, and the inflammatory symptoms considerable, Dr. Simmons has often experienced the great advantages of the warm bath, the heat of which did not exceed 92°. When this is had recourse to, the patient should remain in it only a very few minutes, and go soon afterwards to bed; but not with a view to force a sweat by an increased weight of bed-clothes, as is too often injudiciously practised.

Patients of a consumptive habit, who have had an attack of this kind at the beginning of winter, are particularly liable to a return of the complaint during the continuance of the cold season, on the slightest occasion and with greater violence. A relapse is therefore to be carefully guarded against; and nothing will be found to do this more effectually than the use of socks and a flannel under-waistcoat. The use of flannel has been condemned by several medical writers as increasing the insensible perspiration; but in the present case, to say nothing of some others in which it may not be useful, it will in general be found to have the best effects. It will prevent a too great determination to the lungs, and should not be left off till the approach of summer. In some few instances in which flannel was found to have a disagreeable effect, a piece of dimity, worn over the breast next the skin, prevented the return of colds and coughs in persons of a delicate habit, who had before been liable to them on the slightest occasions. In these cases, circumstances that are seemingly of the most trifling nature become of importance.

In the catarrhal cough just now mentioned, many practitioners are too eager to administer the Peruvian bark, with the view, as they term it, of *bracing up* the patient: but this never fails to increase the cough, and of course to do great and very often irreparable mischief. The oily remedies seldom fail to exasperate this cough, which at first is dry, frequent, and often extremely violent, but which seldom fails to give way to one or two gentle pukes, and the occasional use of mild purges. The cough, as in other cases, often continues from habit after the cause that gave rise to it has been removed, and may then be checked by opiates.

In these different periods of the disease, the curative indications are sufficiently obvious. To prevent the formation of fresh tubercles; to obviate the inflammation of those already formed; to promote their resolution; to allay morbid irritability, the cough, and other troublesome symptoms; and, above all, to check the tendency to hectic, are the views that every rational physician proposes to himself in the treatment of the genuine consumption. We know of no medicines that can exert their specific effects upon the lungs by dissolving tuberculous concretions; nor is it probable, from what we know of the animal economy, that any such will ever be discovered. Yet medicines that operate in a general manner upon the system, may, by promoting absorption, and diminishing the determination to the lungs, tend to disperse tubercles, or to prevent their formation. There are not wanting instances of wonderful recoveries in cases where the evil was supposed to be beyond the power of physic; and in some, where nature was left to herself; so that a physician who has observed the various and powerful resources nature has within herself, will be very cautious how he asserts that a disease is incurable.

The most formidable effects of ulcerated lungs are the absorption and consequent hectic. It seems evident, that, in many cases, death is brought on by this, rather than by the lungs themselves being rendered unfit for the purposes of respiration. So that if we can obviate the effects of the absorption, diminish the preternatural determination to the lungs, and fulfil the other general indications just now mentioned, we may very often enable nature to recover herself. It may be alledged indeed, that the physician's art has hitherto proved very unsuccessful in these cases; but may not this be owing to the remedies that are adopted being very often such as are inimical to the cure?

The bark is, perhaps, the most commonly employed of any, and often confided in as an ultimate resource in these cases. But besides this, the elixir of vitriol, the balsams, and frequent bleedings, have each had their partizans. The use of blisters and issues, opiates, a milk and vegetable diet, exercise, and change of air, are pretty generally recommended by all. Concerning the bark, Dehaute long ago observed, that it had been productive of great mischief in consumptive cases; and Dr. Fothergill, in a paper published by him on this subject, very judiciously remarks, that the

bark is so far from curing the hectic arising from distempered lungs, that, according to the best of his observations, it not only takes up that time which might probably have been better employed in the use of other medicines, but for the most part aggravates the disease beyond remedy. Indeed it will be found by every attentive observer, that, whenever pus, or any kind of matter excites an hectic, by being absorbed and carried into the circulation, the bark will never fail to exasperate the complaint, especially if it is accompanied with any degree of inflammatory diathesis, unless the matter has a free outlet from the system; as in the case of abscesses, for instance, in which we often find the bark productive of excellent effects. It is likewise well known to be used as a tonic, to obviate the effects of fluor albus, or any other immoderate evacuation in delicate persons, which, by enfeebling the system, very often lays the foundation of phthisis; but the moment we have reason to suspect that the lungs are ulcerated, it ought to be laid aside; and in the genuine tuberculous consumption, it is at all times inadmissible.

In phthisical complaints, a prudent trial of the bark seems necessary. Small doses of the decoction, either alone, or joined with the saline mixture of such other additions as the physician thinks proper, may be given. But if the breath becomes more tight and oppressed, the cough dry, the pulse more quick and hard, and especially if slight transitory pains or stitches about the thorax are more frequently complained of, a perseverance in the use of the bark will increase the disease. If such also should be the appearances in the progress of the disease, or, from whatever cause, if the bark is accompanied with such effects, the use of it ought to be withheld.

If, on the other hand, no pain, tightness, or oppression, is perceived, and there appears a manifest abatement of the symptoms, it will be advisable to proceed. The administration of this medicine, however, requires a judicious observer; and it ought neither to be given in the early inflammatory stage of this disease, nor be continued in any subsequent period, if it produces the effects abovementioned. By its tonic virtues it will often enable nature to conquer many difficulties. In confirmation of this remark, Dr. Fothergill farther observes, that he has seen it of use in promoting expectoration, when this became deficient from want of strength towards the end of peripneumonic fevers; but that it stops this discharge, changes slight wandering pains into such as are fixed, and increases them with all their consequences, in a variety of cases.

The elixir of vitriol is often exhibited in consumptive cases, with no less impropriety than the bark. This medicine, from its astringency, is obviously improper in the inflammatory state of the disease. But in the latter stage, when a general tendency to putrefaction takes place, it is serviceable in resisting the effect; it restrains the colliquative sweats; and if the lungs are not injured past repair, it is allowed to be a very useful auxiliary.

Various are the opinions concerning the efficacy of Bristol water in this disease. The experienced author last mentioned informs us, that he has seen many persons recover, from pulmonary diseases after drinking these waters, whose cure seemed to be doubtful from any other process; and he thinks this circumstance, added to the general reputation of the Bristol waters in phthisical cases, affords sufficient inducement to recommend the trial of them in the early stage of such complaints. It is, however, before the approach of a confirmed phthisis that patients ought to repair to Bristol; otherwise a journey thither will not only be without benefit, but may even prove detrimental. Some have imagined, that the journey, a better air, change of situation and of objects, have contributed to the patient's recovery; and these may doubtless be of advantage. It seems, however, that the water drank fresh at the pump, actually contains principles conducive to the recovery of patients affected with phthisical complaints. It seems to possess a slight calcareous slypticity, and perhaps the air it contains may also have an antiseptic quality. On the whole, it appears to be an efficacious medicine, and is often found of remarkable benefit to consumptive patients.

Change of air, sometimes even from good to bad, is of great consequence in all chronic diseases of the lungs. In consumptive cases, however, the air of all large cities is found to be particularly injurious. In this disease, the pulse, calm in the morning, becomes more frequent in the afternoon and night, attended with heat and other feverish symptoms. Exercise, therefore, at this time, can only add to the mischief of the fever. For this reason he prudently recommends to all hectic persons, especially those who shall travel to distant places on account of a better air, or the benefit expected from any particular water, that their travelling should be slow, confined to a very few hours, and only in the morning.

Horse exercise, however, seems to be chiefly beneficial in those cases where consumption is a secondary disease. It may likewise be useful in obviating an attack of phthisis, or in carrying off a dry husky cough in a person of a consumptive habit, when there is reason to suppose that no tubercles are as yet formed. On the other hand, in the confirmed phthisis, when the lungs are inflamed or ulcerated, much or violent exercise will be improper; and there have been instances where the death of the patient was evidently accelerated by it. Riding on horseback agitates the viscera more than walking, and is therefore preferable to it in many chronic diseases;

M E D I C I N E.

diseases; but when a preternatural determination to the lungs has taken place, it will be liable to increase the evil.

The best adapted diet in consumptive cases, is milk, particularly that of asses. It may however be remarked, that there are constitutions in which this salutary nutriment seems to disagree. A propensity to generate bile, or too strong a disposition to acedency, from a weakness of the digestive organs, both merit attention. Whey, either from cows or goats milk, appears to be more suitable in the former case; and for correcting acidity, lime-water may be added to the milk. Dr. Simmons observes, that the patient's taste should be consulted; and says that moderate use of animal food, where the salted and high-seasoned kinds are avoided, is not to be denied. Shell-fish, particularly oysters, are useful, as well as snails swallowed whole, or boiled in milk.

A remark which has been judiciously made by Dr. Fothergill, ought not to be omitted in the account of this disease. It is, that young delicate females, from the age of 15 or 16, and upwards, are often subject to consumptions. When the disease has advanced considerably, the *menfes*, if they have made their appearance, most generally cease. This alarms their female friends, and they call upon the physician to use his utmost endeavours for restoring the discharge; believing the cessation of it to be the immediate cause of the phthisical complaint. Induced by their solicitations, medicines have sometimes been administered, that, without obtaining this end, have tended to aggravate the distemper. This deficiency is often of no real disadvantage in those cases; and in many the evacuation would prove injurious, by diminishing the strength, which is already too much impaired. Even small bleedings at the regular periods, have often done more harm than good. A sudden suppression may require bleeding; but when the evacuation fails through want of strength, and from poverty of blood, the renewal of it increases the disease.

Besides these remedies, Dr. Simmons strongly recommends a frequent repetition of vomits. Many physicians have supposed that where there is any increased determination to the lungs, vomits do mischief; but our author is persuaded, that instead of augmenting they diminish this determination; and that much good may be expected from a prudent use of this remedy, than which none has a more general or powerful effect on the system. If any remedy is capable of dispersing a tubercle, he believes it to be vomits. The affections of the liver, that sometimes accompany pulmonary complaints, give way to repeated emetics sooner than to any other remedy. In several cases where the cough and the matter expectorated, the flushing heats, loss of appetite, and other symptoms, threatened the most fatal event, the complaints were greatly relieved, and in others wholly removed, by the frequent use of emetics. Other suitable remedies were indeed employed at the same time; but the relief the patients generally experienced after the emetic, was a sufficient proof of its salutary operation. By this, however, our author does not mean that vomits will be useful in every period of the disease, or in every patient. In general, it will be found that the earlier in the disease emetics are had recourse to, the more likely they will be to do good, and the less likely to do harm. The cases in which this may be reckoned improper, are commonly those in which the disease is rapid in its progress; or in that stage of it, when there is great debility, with profuse colluviate sweats.

With regard to the drains, such as blisters, issues, and setons, that are so frequently recommended in pulmonary complaints, there is less danger of abuse from them, than from the practice of venesection. The discharge they excite is not calculated to weaken the patient much; and the relief they have so often been found to afford, is a sufficient reason for giving them a trial. Blisters, as is well known, act in a twofold manner; by obviating spasm, and producing revulsion: Issues and setons act chiefly in the latter of these two ways; and in this respect their effects, though less sudden and less powerful at first, are more durable from the continuance of the discharge they occasion. It is perhaps hardly necessary to remark, that, if much service is to be expected from either of these remedies, they should be applied early in the disease. The ingenious Mr. Mudge, who experienced the good effects of a large scapular issue on his own person, very properly observes, that the discharge in these cases ought to be considerable enough to be felt. But it is seldom possible for us to prevail on the delicate persons, who are most frequently the victims of this disease, to submit to the application of a caustic between the shoulders. The discharge produced by a seton is by no means inconsiderable; and as in these cases there is generally some inflammatory stitch, some part of the breast that is more painful or more affected by a deep inspiration than the rest, a seton in the side, as near as can be to the seat of the inflammation, will be an useful auxiliary. Our author has seen it evidently of great use in several cases.

GENUS XXXI. HÆMORRHOIS, the HEMORRHOIDS, or PILES.

Description. The discharge of blood from small tumours on the verge of the anus constitutes what is called the *hemorrhoids* or *piles*. They are distinguished into the *external* and *internal*, according to the situation of the tumours, either without or within the anus. Sometimes, however, these tumours appear without

discharging any blood; and in this case they are called the *hemorrhoids cæcæ* or *blind piles*. Sometimes the disease appears without the verge of the anus in distinct separate tumours; but frequently only one tumid ring appears, seeming as it were the anus pushed without the body. Sometimes these tumours appear without any previous disorder of the body; but more frequently, before the blood begins to flow, and sometimes even before the tumours are formed, various affections are perceived in different parts of the body; as head-ach, vertigo, stupor, difficulty of breathing, sickness, colic pains, pain of the back and loins, and frequently a considerable degree of pyrexia; while along with these symptoms there is a sense of fullness, heat, itching, and pain, in and about the anus. Sometimes the disease is preceded by a serous discharge from the anus; and sometimes this serous discharge, accompanied with swelling, seems to come in place of the discharge of blood, and to relieve the above-mentioned disorders of the system. This serous discharge hath therefore been named the *hemorrhoids alba*.

In this disease the quantity of blood discharged is different upon different occasions. Sometimes it flows only when the person goes to stool, and commonly follows the discharge of *feces*. In other cases it flows without any discharge of *feces*; and then generally in consequence of the disorders above-mentioned, when it is also commonly in larger quantity. This is often very considerable, and, by the repetition, so great, that we could hardly suppose the body to bear it but with the hazard of life. Indeed, though rarely, it has been so great as to prove suddenly fatal, as probably was the case with *ARIUS* and *COPERNICUS*. These considerable discharges occur especially to persons who have been frequently liable to the disease. They often induce great debility, and frequently a leucophlegmatia or dropsy, which prove fatal. Sometimes the tumours and discharges of blood in this disease recur exactly at stated periods. In the decline of life it frequently happens, that the hæmorrhoidal flux, formerly frequent, ceases to flow; and in that case it generally happens that the persons are affected with apoplexy or palsy. Sometimes hæmorrhoidal tumours are affected with inflammation, which ends in suppuration, and gives occasion to the formation of fistulous ulcers in those parts.

The hæmorrhoidal tumours have often been considered as varices or dilatations of the veins; and in some cases varicose dilatations have appeared upon dissection. These, however, do not appear; and Dr. Cullen is of opinion that they are usually formed by an effusion of blood into the cellular texture of the intestine near to its extremity. When recently formed they contain fluid blood, but after they remain for some time they are usually of a firmer consistence.

Causes, &c. It would seem probable, that the hæmorrhoidal tumours are produced by some interruption of the free return of the blood from the rectum, by which a rupture of the extremities of the veins is occasioned. But considering that the hæmorrhage occurring here is often preceded by pain, inflammation, and a febrile state, and with many other symptoms which shew a connection of the topical affection with the state of the whole system, it is probable that the interruption of the venous blood produces a considerable resistance to the motion of the venous blood through the arteries, and consequently that the discharge of blood is commonly from the latter. Some have thought, that a difference of the hæmorrhoids, and of its effects upon the system, might arise from the difference of the hæmorrhoidal vessels from whence the blood issued. But we can scarce ever distinguish the vessels from which the blood flows; and the frequent inosculations of both arteries and veins belonging to the lower extremity of the rectum, will render the effects of the hæmorrhage much the same, from whatever source it proceeds.

With regard to the hæmorrhoids, they are, for the most part, merely a topical affection. They take place before the period of life at which a venous plethora happens. They happen to females, in whom a venous plethora determined to the hæmorrhoidal vessels cannot be supposed; and they happen to both sexes, and to persons of all ages, from causes which do not affect the system, and are manifestly suited to produce a topical affection only.

These causes are, in the first place, the frequent voiding of hard and bulky *feces*, which, by their long stagnation in the rectum, and especially when voided, must necessarily press upon the veins of it, and interrupt the course of the blood in them. For this reason the disease so frequently happens to those who are habitually costive. From the same causes, the disease happens frequently to those who are subject to a prolapsus ani. In voiding the *feces*, it almost always happens that the internal coat of the rectum is more or less protruded; and, during this protrusion, it sometimes happens that the sphincter ani is contracted: in consequence of this, a strong constriction is made, which preventing the fallen-out gut from being replaced, and at the same time preventing the return of blood from it, occasions a considerable swelling, and the formation of a tumid ring round the anus.

Upon the sphincter's being a little relaxed, as it is immediately after its strong contraction, the portion of the gut which had fallen out is commonly taken into the body again; but by the frequent repetition of the accident, the size and fulness of the ring formed by the prolapsed intestine is much increased. It is therefore more slowly and difficultly replaced; and in this consists the chief uneasiness of hæmorrhoidal persons. As the internal edge of this ring

M E D I C I N E.

is necessarily divided by clefts, the whole often puts on the appearance of a number of distinct swellings; and it also frequently happens, that some portions of it are more considerably swelled, become more protuberant, and form those small tumours more strictly called *hemorrhoids*, or *piles*.

From considering that the pressure of the feces, and other causes interrupting the return of venous blood from the lower extremity of the rectum, may operate a good deal higher up than that extremity, we may understand how tumours may be formed within the anus; and probably it also happens, that some of the tumours formed without the anus may continue when taken within the body, and even be increased by the causes just mentioned. Thus may the production of internal piles be explained, which, on account of their situation and bulk, are not protruded on the person's going to stool, and are therefore more painful.

The production of piles is particularly illustrated by this, that pregnant women are frequently affected with the disease. This is to be accounted for, partly by the pressure of the uterus upon the rectum, and partly by the colic habit to which pregnant women are liable. Many instances of piles happen for the first time during the state of pregnancy; and there are few women who have borne children, that are afterwards entirely free from piles. Purgatives also, especially those of the more acrid kind, and particularly aloetics, are apt to produce the piles, when frequently used; and as they stimulate particularly the great guts, they may be justly reckoned among the exciting causes of this disease.

Prognosis. Though the hemorrhoids are commonly, as we have said, to be esteemed a topical disease, they may, by frequent repetition, become habitual and connected with the whole system. It is to be particularly observed, that when the hemorrhoidal disease has either been originally, or has become a systematic affection, it then acquires a particular connection with the stomach; so that certain affections of the stomach excite the hemorrhoidal disease, and certain states of this disease excite the disorders of the stomach.

It hath been an almost universally received opinion, that the hemorrhoidal flux is a salutary evacuation, which prevents many diseases that would otherwise have happened; and that it even contributes to give long life: and as this opinion hath been strenuously adopted by Dr. Stahl, it hath had a very considerable influence on the practice of physic in Germany. But we can never expect to reap much benefit from this flux, which at first is purely topical; and, granting that it should become habitual, it is never proper to be encouraged. It is a nasty, disagreeable disease; ready to go to excess, and thereby to prove hurtful, and sometimes even fatal. At best it is liable to accidents, and thus to unhappy consequences. Even the first approaches of the disease are to be guarded against; and though it should have proceeded for some time, it ought always to be moderated and the necessity of it superseded.

Cure. When any evident cause for this disease is perceived, we ought immediately to attempt a removal of that cause. One of the most frequent remote causes is an habitual costiveness; which must be obviated by a proper diet, as the person's own experience will best direct: or if the management of diet be not effectual, the belly must be kept open by medicines, which may prove gently laxative, without irritating the rectum. In most cases it will be of advantage to acquire a habit with regard to time, and to observe it exactly. Another cause of the hemorrhoids to be especially attended to is the prolapsus ani, which is apt to happen on a person's having a stool. If this shall occur to any considerable degree, and be not at the same time easily and immediately replaced, it most certainly produces piles, or increases them when otherwise produced. Persons therefore who are liable to this prolapsus, should, after having been at stool, take great pains to have the gut immediately replaced, by lying down in an horizontal posture, and pressing gently upon the anus, till the reduction shall be completely obtained. When this prolapsus is occasioned only by the voiding of hard and bulky feces, it is to be removed by obviating the costiveness which occasions it. But in some persons it is owing to a laxity of the rectum; and in those it is often most considerable on occasion of a loose stool. In these cases, it is to be treated by astringents, and proper artifices to keep the gut in its place.

When the disease has frequently recurred from neglect, and is thus in some measure established, the methods above-mentioned are no less proper; but in this case some other measures must also be used. It is especially proper to guard against a plethoric state of the body; and therefore to avoid a sedentary life, full diet, and intemperance in the use of strong liquor, which in all cases of hemorrhagical flux is of the most pernicious consequence.

Exercise of all kinds is of great service in obviating and removing a plethoric state of the body; but upon occasion of the hemorrhoidal flux, when this is immediately come on, both walking and riding, as increasing the determination of the blood into the hemorrhoidal vessels, are to be avoided. At other times, when no such determination is already formed, these modes of exercise may be very properly employed.

Another method of removing plethora is by cold bathing; but this must be employed with caution. When the hemorrhoidal flux is approaching, it may be dangerous to divert it; but during the intervals of the disease, cold bathing may be employed with safety and advantage; and in those who are liable to a prolapsus

ani, the frequent washing of the anus with cold water may be useful. When the flux has actually come on, we are to moderate it as much as possible, by causing the patient to lie in a horizontal posture on a hard bed: by avoiding exercise in an erect posture, using a cool diet, and avoiding external heat. But with respect to the further cure of this disease, we must observe, that there are only two cases in which it is common for hemorrhoidal persons to call for medical assistance. The one is, when the affection is accompanied with much pain; and the other, when the piles are accompanied with excessive bleeding. In the first case, we must consider whether the piles are external or internal. The pain of the external piles happens especially when a considerable protrusion of the rectum has happened; and while it remains unreduced, it is strangled by the constriction of the sphincter; and at the same time no bleeding happens to take off the swelling of the protruded portion of the intestine; and sometimes an inflammation supervenes, which greatly aggravates the pain. In this case, emollient fomentations and poultices are sometimes of service, but the application of leeches is generally to be preferred.

In case of excessive bleeding, we are on all occasions to endeavour to moderate the flux, even where the disease has occurred as a critical discharge; for if the primary disease shall be entirely and radically cured, the preventing any return of the hemorrhoids seems entirely safe and proper. It is only when the disease arises from a plethoric habit, and from a stagnation of blood in the hypochondriac region, or when, though originally topical, it hath by frequent repetition become habitual, and has thereby acquired a connection with the system, that any doubt can arise about curing it entirely. In any of these cases, however, we are of opinion that it will be proper to moderate the bleeding, lest, by its continuance or repetition, the plethoric state of the body, and the particular determination of the blood into the hemorrhoidal vessels, be increased, and the return of the disease be too much favoured. In all cases of excessive bleeding, or any approach to it, astringents both internal and external may be safely and properly applied; not indeed to induce an immediate and total suppression; but to moderate the hemorrhage, and by degrees to suppress it altogether; while at the same time measures are taken for the removing the necessity of its recurrence. In case of a connection between the hemorrhoidal affection and the state of the stomach, the same method is to be used in the atonic gout.

GENUS XXXII. MENORRHAGIA, or Immoderate Flow of the MENSES.

Description. The quantity of the menstrual flux is different in different women, and likewise in the same woman at different times. An unusual quantity therefore is not always to be considered as morbid; but when a larger flow of the menses has been preceded by head-ach, giddiness, or dyspnoea; has been ushered in by a cold stage, and is attended with much pain of the back and loins, with a frequent pulse, heat and thirst; it may then be considered as preternaturally large. On the other hand, when the face becomes pale, the pulse weak, an unusual debility is felt in exercise, and the breathing is hurried by little labour; when the back becomes pained from any continuance in an erect posture, when the extremities become frequently cold, and when at night the feet appear affected with edematous swelling; from all these symptoms we may conclude, that the flow of the menses hath been immoderate, and has already induced a dangerous state of debility. The debility, induced in this case, often appears also by affections of the stomach, an anorexia, and other symptoms of dyspepsia; by a palpitation of the heart, and frequent faintings; by a weakness of mind, liable to strong emotions from slight causes, especially those presented by surprise. A flow of the menses attended with barrenness, in married women, may generally be considered as preternatural and morbid. Generally, also, that flow of the menses may be considered as immoderate, which is preceded and followed by a leucorrhoea.

Causes, &c. The proximate cause of the menorrhagia is either the effort of the uterine vessels preternaturally increased, or a preternatural laxity of the extremities of the uterine arteries. The remote causes may be, 1. Those which increase the plethoric state of the uterine vessels; as a full and nourishing diet, much strong liquor, and frequent intoxication. 2. Those which determine the blood more copiously and forcibly into the uterine vessels; as violent strainings of the whole body; violent shocks from falls; strokes or contusions on the lower belly; violent exercise, particularly in dancing; and violent passions of the mind. 4. Those which particularly irritate the vessels of the uterus; as excess in venery; the exercise of venery in the time of menstruation; a coactive habit, giving occasion to violent straining at stool; and cold applied to the feet. 4. Those which have forcibly overstrained the extremities of the uterine vessels; as frequent abortions, frequent child-bearing without nursing, and difficult tedious labours. Or, lastly, those which induce a general laxity; as living much in warm chambers, and drinking much of warm enervating liquors, such as tea, coffee, &c.

Cure. The treatment and cure of the menorrhagia, must be different, according to the different causes of the disease. In all cases, the first attention ought to be given to avoiding the remote causes, whenever that can be done; and by such attention the disease may

M E D I C I N E.

may be often entirely cured. When the remote causes cannot be avoided, or when the avoiding them has been neglected, and a copious menstruation has come on, it should be moderated as much as possible, by abstaining from all exercise at the coming on or during the continuance of the menstruation; by avoiding even an erect posture as much as possible; by shunning external heat, and therefore warm chambers and soft beds; by using a light and cool diet; by taking cold drink, at least as far as former habits will allow; by avoiding venery; by obviating costiveness, or removing it by laxatives which give little stimulus. The sex are commonly negligent, either in avoiding the remote causes, or in moderating the first beginnings of this disease. It is by such neglect that it so frequently becomes violent and of difficult cure; and the frequent repetition of a copious menstruation may be considered as a cause of great laxity in the extreme vessels of the uterus.

When the immoderate flow of the menses shall seem to be owing to a laxity of the vessels of the uterus, as may be concluded from the general debility and laxity of the person's habit; from the remote causes that have occasioned the disease; from the absence of the symptoms which denote increased action in the vessels of the uterus; from the frequent recurrence of the disease; and particularly from this, that the person in the intervals of menstruation is liable to a leucorrhœa; in such a case, the disease is to be treated, not only by employing all the means above-mentioned for moderating the hæmorrhage, but also by avoiding all irritation; every irritation having the greater effect in proportion as the vessels are more lax and yielding. If, in such a case of laxity, it shall appear that some degree of irritation concurs, opiates may be employed to moderate the discharge; but in using these much caution is requisite. If, notwithstanding these measures having been taken, the discharge shall prove very large, astringents, both external and internal, may be employed. In such cases, Dr. Hunter asks, May small doses of emetics be of service?

When the menorrhagia depends on the laxity of the uterine vessels, it will be proper, in the intervals of menstruation, to employ tonic remedies; as cold bathing, and chalybeates. The exercises of gestation also may be very useful, both for strengthening the whole system, and for taking off the determination of the blood to the internal parts. These remedies may be employed in all cases of menorrhagia, from whatever cause it may have proceeded, if it shall have already induced a considerable degree of debility in the body.

A B O R T I O N.

Description. The *fluor albus*, female weakness, or *whites*, as commonly called, is a disease of the womb and its contiguous parts; from which a pale coloured, greenish or yellow fluid is discharged, attended with loss of strength, pain in the loins, bad digestion, and a wan sickly aspect.

Causes, &c. The quantity, colour, and consistence of the discharge chiefly depend upon the time of its duration, the patient's habit of body, and the nature of the cause by which it was produced. Taking cold, strong liquor, immoderate heat and moisture, or violent exercise, are all observed to produce a bad effect, as to its quantity and quality.

Weakly women of lax solids, who have had many children, and long laboured under ill health, are of all others the most subject to this disagreeable disease; from which they unfortunately suffer more severe penance than others, as the nicest sensations are often connected with such a delicacy of bodily frame as subjects them to it.

In Holland it is very frequent, from the dampness of its situation; the surrounding air being so overcharged with moisture as to relax the body, stop perspiration, and throw it upon the bowels, or womb; producing in the first, a diarrhœa or flux; in the last, the *fluor albus*, or female weakness.

The discharge proceeds from the vessels subservient to menstruation; because, in delicate habits, where those vessels are weak, and consequently remain too long uncontracted, the *fluor albus* sometimes immediately follows the menses, and goes off by degrees as they gradually close. It also comes from the mucous glands of the womb, as is particularly evident in very young females of eight and ten years old; in whom, though very rarely, it has been observed, and where it must then necessarily have escaped from those parts; for the uterine vessels are not sufficiently enlarged for its passage at so early a period.

Sometimes, as in women with child, it proceeds from the passage to the womb, and not from the womb itself; which, during pregnancy, is closely sealed up, so that nothing can pass from thence till the time of labour. The application of those instruments called *peffaries*, from the pain and irritation they occasion, are also apt to bring on this discharge. Hence we may conclude, that this disease may happen although the blood is in a pure state. Here the fault seems to be placed in the vessels or strainers, by which the fluids are vitiated and changed from their natural qualities.

The *fluor albus* has been supposed to supply the want of the menses; because, where the first prevails, the last is generally either irregular, or totally wanting; but it might more properly be said, that the presence of the *fluor albus*, which is a preternatural evacuation, occasions the absence of that which is natural; as is

evident from the return of the menses, after the *fluor albus* has been taken away. Indeed, when this discharge appears about the age of 13 or 14, and returns once a month, with symptoms like those of the menses; then it may be deemed strictly natural, and therefore ought not to be stopped.

Prognosis. The *fluor albus* may be distinguished into two kinds. The first arises from a simple weakness, or the relaxation of the solids; which may either be *general*, where the whole bodily system is enervated and unstrung; or *partial*, where the womb only is thus affected, in consequence of hard labour, frequent miscarriages, a suppression or immoderate quantity of the menses, or a sprain of the back or loins.

In the first case, the discharge being generally mild; may be safely taken away. In the second, it may proceed from a vitiated, or impure blood, where the body, from thence, is loaded with gross humour, which nature for her own security and relief thus endeavours to carry off. In such cases, the discharge is often of a reddish colour, like that from old ulcerous sores; being sometimes so sharp as to excoriate the contiguous parts, and occasion a smarting and heat of urine.

A deep-seated, darting pain; with a forcing down, attending such a discharge, is a very dangerous and alarming sign, and indicates an ulceration or cancerous state of the womb. This malignant state of the disease, if of long continuance, is extremely difficult of cure; and disposes the patient to barrenness, a bearing down, the dropsy, or a consumption.

Cure, &c. The causes of those two kinds of this disease being different, so they will require a very different method of cure. To answer this intention; in the first case, nothing will be more proper than nourishing simple food, such as veal broths, jellies, fresh eggs, and milk diet. The acid fruits will also be proper; and the patient may take a restorative, strengthening infusion, which will give firmness to the body; and assist the weakened fibres of the womb in returning to their natural state.

The same method may be used with success, where the *fluor albus* follows the menses, as already observed.

The Tunbridge or Spa waters may be drank at the same time; and if necessary, an infusion of green tea; or pure smith's-forge-water, may be used with a womb-syringe as an injection twice a day. Should the disease prove uncommonly obstinate; the patient may go into the cold bath every other day; and also drink lime-water with milk, which will expedite the cure, and prevent a relapse. A volatile liniment, and afterwards a strengthening plaster, may be applied to the small of the back.

By way of caution, she should abstain from the immoderate use of tea; and be removed into a dry clear air; or if she is obliged to remain in one less proper, she may apply the flesh-brush, and wear a flannel shift next her skin, impregnated with the fumes of burning frankincense, or any of the grateful aromatic gums. Cold spring-water pumped on the loins, or a blistering plaster applied to the bottom of the spine or back, are both very powerful in their effects, and have sometimes succeeded after other remedies had been tried in vain.

In the second sort of the disease, where the discharge is sharp and of long standing, it would be extremely dangerous to suppress it suddenly, either by astringents internally taken, or applied as injections, until the blood is freed from its impurities by proper purgatives, and otherwise corrected by such medicines as not only carry off the sharp scorbutic salts and putrid juices, but also impart to it that soft balmy quality of which it had been deprived.

A purging potion may be taken twice a week, and in the intervals an alterative pill night and morning. After this course has been continued a fortnight or three weeks, she may begin with the strengthening, bitter infusion, or other tonic, in the quantity of a tea-spoonful twice a day, or more, as her stomach will allow.

The same sort of food and regimen will here be proper as in the first kind of the disease. The patient should abstain from malt liquors, and drink rice-water, in each pint of which half an ounce of gum arabic has been dissolved; or if she is weak, and of a cold bloated habit of body, a little French brandy may be added occasionally.

When she begins to take the bitter infusion, it will be proper to use the Tunbridge or Pyrmont water for common drink; but if those cannot conveniently be had, the *artificial Spa water*, impregnated with iron and fixed air, will make an excellent substitute. If it should render her costive, and occasion the head-ach; she may desist, and drink imperial water or a little fenna-tea sweetened with morna, till those complaints are removed.

In flann, as this is a malady of the most disagreeable kind, which, by long continuance or neglect, becomes difficult of cure, and often produces an ulceration of the womb, bearing down, barrenness, a dropsy, or consumption; it were to be wished, that women, on such occasions, would be more attentive to their own safety, by using possible means in due time, to prevent those disorders.

Dr. Leake says, he has attended more patients labouring under the *fluor albus* in the autumn than at any other season of the year, especially when the weather was uncommonly moist and cold: most of them were cured by change of diet, an increased perspiration, and the proper use of Peruvian bark with aromatics. He observed, that several about this time who escaped the disorder, were visited

M E D I C I N E.

with bad colds, a defluxion of rheum on the throat, or a diarrhoea, which were removed by a similar treatment.

As women are sometimes connected with those who do not conscientiously regard their safety, it is a circumstance of the utmost consequence to distinguish a fresh venereal infection from the *fluor albus* or whites; for, if the first is mistaken for the last, and is either neglected or treated accordingly, the disorder may unfortunately end in a confirmed lues or pox.

The following signs will best inform the patient whether there is occasion for her doubts or not.

A fresh infection, called *gonorrhœa*, is malignant and inflammatory; the *fluor albus* most commonly arises from relaxation and bodily weakness: and therefore, the remedies proper in the first disorder would render the last more violent, by locking up and confining the infectious matter.

In the gonorrhœa, the discharge chiefly proceeds from the parts contiguous to the urinary passage, and continues whilst the menses flow; but in the *fluor albus*, it is supplied from the cavity of the womb and its passage, and then the menses are seldom regular.

In the gonorrhœa, an itching, inflammation, and heat of urine, are the fore-runners of the discharge; the orifice of the urinary passage, is prominent and painful, and the patient is affected with a frequent irritation to make water. In the *fluor albus*, pains in the loins, and loss of strength, attend the discharge; and if any inflammation or heat of urine follow, they happen in a less degree, and only after a long continuance of the discharge, which, becoming sharp and acrimonious, excoriates the surrounding parts.

In the gonorrhœa, the discharge suddenly appears without any evident cause; but in the *fluor albus*, it comes on more slowly, and is often produced by irregularities of the menses, frequent abortion, sprains, or long-continued illness.

In the gonorrhœa, the discharge is greenish or yellow, less in quantity, and not attended with the same symptoms of weakness. In the *fluor albus* it is also often of the same colour, especially in bad habits of body, and after long continuance; but is usually more offensive, and redundant in quantity. See the article ABORTION.

ORDER V. PROFLUVIA, PYREXIA; with an increased Secretion. GENUS XXIII. THE CATARRH.

Description. The catarrh is an increased excretion of mucus from the mucous membrane of the nose, fauces, and bronchiæ, attended with pyrexia.

Practical writers and nosologists have distinguished the disease by different appellations, according as it happens to affect those different parts of the mucous membrane, the one part more or less than the other: but Dr. Cullen is of opinion, that the disease in those different parts is always of the same nature, and proceeds from the same cause in the one as in the other. Very commonly indeed those different parts are affected at the same time; and therefore there is little room for the distinction mentioned. The disease has been frequently treated of under the title of *tussis*, or cough; and a cough, indeed, always attends the chief form of catarrh, that is, the increased excretion from the bronchiæ; but it is so often also, a symptom of many other affections, which are very different from one another, that it is in our opinion improperly used as a generic title.

The disease generally begins with some difficulty of breathing through the nose, and with a sense of some fulness stopping up that passage. This again is often attended with some dull pain and a sense of weight in the forehead, as well as a stiffness in the motion of the eyes. These feelings, sometimes at their very first beginning, and always soon after, are attended with the distillation of a thin fluid from the nose, and sometimes from the eyes; and these fluids are often found to be somewhat acrid, both by their taste and by their fretting the parts over which they pass. These symptoms constitute the coryza and gravedo of authors, and are commonly attended with a sense of lassitude over the whole body. Sometimes cold shiverings are felt; at least the body is more sensible than usual to the coldness of the air; and with all this the pulse is more frequent than ordinary, especially in the evenings.

These symptoms have seldom continued long before they are accompanied with some hoarseness, and a sense of roughness and soreness in the trachea, with some difficulty of breathing, expressed by a sense of straitness in the chest, and with a cough which seems to arise from some irritation felt at the glottis. This cough is generally at first dry and painful, occasioning pains about the chest, and more especially in the breast; sometimes, together with these symptoms, pains resembling those of the rheumatism are felt in several parts of the body, particularly about the neck and head. With all these symptoms, the appetite is impaired, some thirst arises, and a feverish lassitude is felt all over the body. These symptoms mark the height and violence of the disease; but commonly it does not continue long. By degrees the cough becomes attended with a more copious excretion of mucus; which is at first thin, but gradually becoming thicker, is brought up with less frequent and less laborious coughing. The hoarseness and soreness of the trachea are also relieved or removed; and the febrile symptoms abating, the expectoration becomes again less, and the cough less frequent, till at length they cease altogether.

Such is generally the course of this disease, neither tedious nor

dangerous; but it is sometimes in both respects otherwise. When a catarrh has been occasioned by a violent cause, when it has been aggravated by improper management, and especially when it has been rendered more violent by fresh and repeated applications of cold, it often passes into a pneumonic inflammation, attended with the utmost danger.

Unless, however, such accidents as those happen, a catarrh, in found persons not far advanced in life, is always a slight and safe disease: but, in persons of a phthisical disposition, a catarrh may readily produce an hæmoptysis, or perhaps form tubercles in the lungs; and, more certainly in persons who have tubercles already formed in the lungs, an accidental catarrh may occasion the inflammation of these tubercles, and in consequences produce a phthisis pulmonalis.

In elderly persons, a catarrh sometimes proves a dangerous disease. Many persons as they advance in life, and especially after they have arrived at old age, have the natural mucus of the lungs poured out in greater quantity, and requiring a frequent expectoration. If, therefore, a catarrh happen to such persons, and increase the afflux of fluids to the lungs, with some degree of inflammation, it may produce the peripneumonia notha, which in such cases is very often fatal.

Causes, &c. The proximate cause of catarrh seems to be an increased afflux of fluids to the mucous membrane of the nose, fauces, and bronchiæ, along with some degree of inflammation affecting the same. The latter circumstance is confirmed by this, that, in the case of catarrh, the blood drawn from a vein commonly exhibits the same inflammatory crust which appears in the case of phlegmasiæ. The remote cause of catarrh is most commonly cold applied to the body. This application of cold producing catarrh is generally evident and observed; and would always be so, were men acquainted with and attentive to the circumstances which determine cold to act upon the body.

The application of cold which occasions a catarrh, probably operates by stopping the perspiration usually made by the skin, and which is therefore determined to the mucous membrane of the parts above-mentioned. As a part of the weight which the body daily loses by insensible evacuation, is owing to an exhalation from the lungs, there is probably a connection between this exhalation and the cutaneous respiration, so that the one may be increased according as the other is diminished; and therefore we may understand how the diminution of cutaneous perspiration, by the application of cold, may increase the afflux of fluids to the lungs, and thereby produce a catarrh.

Dr. Cullen observes that there are some observations of Dr. James Keil which may render this matter doubtful; but says there is a fallacy in those observations. The evident effects of cold in producing coryza, leave the matter, in general, without doubt; and there are several other observations which shew a connection between the lungs and the surface of the body.

Whether from the suppression of perspiration, a catarrh be produced merely by an increased afflux of fluids, or whether further the matter of perspiration be at the same time determined to the mucous glands, and there excites a particular irritation, may be uncertain; but our author thinks the latter supposition is most probable. Although, in the case of a common catarrh, which is in many instances sporadic, it may be doubtful whether any morbid matter be applied to the mucous glands; we are, however, certain that the symptoms of a catarrh do frequently depend upon such a matter being applied to these glands, as appears from the case of measles, chincough, and especially from the frequent occurrence of contagious and epidemical catarrhs.

The phenomena of contagious catarrhs have been much the same with those of the others; and the disease has always been particularly remarkable for this, that it has been the most widely and generally spreading epidemic known. It has seldom appeared in any one country of Europe without appearing successively in every different part of it; and, in some instances, it has been also transferred to America, and has been spread there in like manner, so far as we have had opportunities of being informed. The catarrh from contagion appears with nearly the same symptoms as those above-mentioned. It seems often to come on in consequence of the application of cold. It comes on with more cold shivering than the catarrh arising from cold alone; and the former does also not only sooner shew febrile symptoms, but to a more considerable degree. Accordingly, it more speedily runs its course, which is commonly finished in a few days. It sometimes ends by a spontaneous sweat; and this, in some persons, produces a miliary eruption. It is however, the febrile state of this disease especially, that is finished in a few days; for the cough and other catarrhal symptoms do frequently continue longer, and often when they appear to be going off, they are renewed by any fresh application of cold.

Cure. The cure of catarrh is nearly the same, whether it proceeds from cold or contagion; only in the latter case remedies are commonly more necessary than in the former. In the cases of a moderate disease, it is commonly sufficient to avoid cold, or to abstain from animal-food for some days, or perhaps for the same time to lie a-bed, and, by taking frequently some mild and diluent drink, a little warmed, to promote a very gentle sweat, and after this to take care to return very gradually only to the use of the free air.

M E D I C I N E.

air. When the disease is more violent, not only the antiphlogistic regimen, exactly observed, but various remedies also, become necessary. To take off the phlogistic diathesis, which always attends this disease, blood letting, more or less, according as the symptoms shall require, is the proper remedy. After blood-letting for restoring the determination of the fluids to the surface of the body, and at the same time for expediting the secretion of mucus in the lungs, which may take off the inflammation of its membrane, vomiting is the most effectual means. For the last mentioned purpose, it has been supposed that squills, gum-ammoniac, the volatile alkali, and some other medicines, might be useful; but their efficacy has never been found considerable: and if squills have ever been very useful, it seems to have been rather by their emetic than by their expectorant powers. When the inflammatory affections of the lungs seem to be considerable, it is proper, besides blood-letting, to apply blisters to the back or sides.

As a cough is often the most troublesome circumstance of this disease, so demulcents may be employed to alleviate it. But after the inflammatory symptoms are much abated, if the cough still remains, opiates afford the most effectual means of relieving it; and, in the circumstances just now mentioned, they may be very safely employed. After the inflammatory and febrile states of this disease are very much gone, the most effectual means of discharging all remains of the catarrhal affection, is by some exercise of gestation diligently employed.

Besides the remedies above-mentioned, Mr. Mudge, in a treatise on this disease, recommends the steam of warm water from the inhaler, as a most efficacious and safe remedy for a catarrh, and which indeed he seems to consider as little less than *infallible*: but he gives a caution to people in health, who may accidentally see his machine, not to make the experiment of breathing through cold water with it, or they will be almost certain of catching a severe cold with it. His directions for those troubled with the catarrh are as follow:

"In the evening, a little before bed-time, the patient, if of adult age, is to take three drachms, or as many tea-spoonfuls, of elixir pargoricum, in a glass of water: if the subject is younger, for instance, under five years old, one tea-spoonful; or within that and ten years, two. Each tea-spoonful contains somewhat less than one quarter of a grain of opium. About three quarters of an hour after, the patient should go to bed, and, being covered warm, the inhaler three parts filled with water nearly boiling, (which, from the coldness of the metal, and the time it ordinarily takes before it is used by the patient, will be of a proper degree of warmth,) and being wrapped up in a napkin, but so that the valve in the cover is not obstructed by it, is to be placed at the arm-pit, and the bed cloaths being drawn up and over it close to the throat, the tube is to be applied to the mouth, and the patient should inspire and expire through it about twenty minutes or half an hour.

"It is very evident, as the whole act of respiration is performed through the machine, that in inspiration the lungs will be filled with air which will be hot, and loaded with vapour, by passing through the body of water; and in expiration, all that was contained in the lungs will, by mixing with the steam on the surface of the water, be forced through the valve in the cover, and settle on the surface of the body under the bed-cloaths.

"The great use of this particular construction of the inhaler is this. First, as there is no necessity, at the end of every inspiration, to remove the tube from the mouth, in order to expire from the lungs the vapour which had been received into them, this machine may therefore be used with as much ease by children as older people. And, secondly, as a feverish habit frequently accompanies the disorder, the valve in that respect also is of the utmost importance: for a sweat, or at least a free perspiration, not only relieves the patient from the restless anxiety of a hot, dry, and sometimes parched skin, but is also, of all others, the most eligible evacuation for removing the fever; and it will be generally found, that, after the inhaler so constructed hath been used a few minutes, the warm vapour under the cloaths will, by settling upon the trunk, produce a sweat, which will gradually extend itself to the legs and feet.

"In a catarrhus fever, or any feverish habit attending this cough, it would be proper to take a draught of warm thin whey a few minutes before the inhaler is used; and after the process is over, the sweat which it has produced may be continued by occasional small draughts of weak warm whey or barley water. The sweating is by no means so necessary to the cure of the catarrhus cough, as that the success of the inhaler against that complaint at all depends upon it; yet I cannot help once more remarking, that when this disorder happens to be accompanied with a feverish habit, the advantages of this particular construction will be very important.

"After this respiratory process is over, the patient usually passes the night without the least interruption from the cough, and feels no farther molestation from it than once or twice in the morning to throw off the trifling leakage which, unperceived, had dripped into the bronchiae and vesicles during the night; the thinner parts of which being evaporated, what remains is soon got rid of with a very gentle effort.

"I cannot, however, take leave of this part of my subject, without pointedly observing, that if the patient means not to be

disappointed by my assurances or his own expectations, it is essentially necessary that the following remarks, with regard to the time and manner of using this process, should be strictly attended to.

"First, That as tender valetudinary people are but too well acquainted with the first notices of the disorder, the remedy must, or ought to be, used the same evening; which will, in an ordinary leisure, be attended with an immediate cure; but if the soreness of the respiratory organs, or the petulance of the cough, shew the cold which has been contracted to have been very severe, the inhaler, without the opiate, should be again repeated for the same time the next morning.

"Secondly, if the use of the inhaler, &c. is delayed till the second night, it will be always right to repeat it again the next morning without the opiate, but with it if the seizure has been violent.

"And, lastly, if the cough is of some days standing, it will be always necessary to employ both parts of the process at night and the succeeding morning, as the first simple inflammatory mischief is now most probably aggravated by an additional one of a chronic tendency.

"But if, through the want of a timely application, or a total neglect of this or any other remedy, the cough should continue to harass the patient, it is, particularly in delicate and tender constitutions, of the utmost consequence to attempt the removal of it as soon as possible, before any floating acrimony in the constitution (from the perpetual irritation) receives an habitual determination to an organ so essential to life as the lungs.

"If the patient expectorates with ease and freedom a thick and well-digested inoffensive phlegm, there is generally but little doubt of his spitting off the disorder, with common care, in a few days; and till that is accomplished, a proper dose of elixir pargoricum for a few successive nights will be found very useful in suppressing the fatiguing irritation and ineffectual cough, occasioned by a matter which, dripping in the early state of the disease into the bronchiae during the night, is commonly at that time too thin to be discharged by those convulsive efforts.

"If, however, notwithstanding a free and copious expectoration the cough should still continue, and the discharge, instead of removing the complaint, should itself, by becoming a disease, be a greater expence than the constitution can well support, it is possible that a tender patient may spit off his life through a weak relaxed pair of lungs, without the least appearance of purulence, or any suspicion of suppuration. In those circumstances, besides, as was mentioned before, increasing the general perspiration by the salutary friction of a flannel waistcoat, change of situation, and more especially long journeys on horseback, conducted as much as possible through a thin, sharp, dry air; will seldom fail of removing the complaint.

"But, on the contrary, if the cough should, at the same time that it is petulant and fatiguing to the breast, continue dry, husky, and without expectoration; provided there is reason to hope that no tubercles are forming, or yet actually formed, there is not perhaps a more efficacious remedy for it than half a drachm of gum ammoniacum, with 18 or 20 drops of laudanum, made into pills, and taken at bed-time, and occasionally repeated. This excellent remedy Sir John Pringle did me the honour to communicate to me; and I have according found it, in a great many instances, amazingly successful, and generally very expeditiously so; for it seldom fails to produce an expectoration, and to abate the distressing fatigue of the cough. In those circumstances I have likewise found the common remedy of *3℥s* or *℥ij* of *bal. sulph. amiat.* taken twice a-day, in a little powdered sugar, or any other vehicle, a very efficacious one. I have also, many times, known a salutary revulsion made from the lungs by the simple application of a large plaster, about five or six inches diameter, of *pix Burgund.* between the shoulders; for the perspirable matter, which is locked up under it, becomes so sharp and acrid, that in a few days it seldom fails to produce a very considerable itching, some little tendency to inflammation, and very frequently a great number of boils. This application should be continued (the plaster being occasionally changed) for three weeks or a month, or longer, if the complaint is not so soon removed.

"And here I cannot help observing, that, though seemingly a trifling, it is, however, by no means a useless caution to the tender patient, not to expose his shoulders in bed, and during the night, to the cold; but when he lies down to take care they are kept warm, by drawing the bed-cloaths up close to his back and neck.

"If, however, notwithstanding these means, the cough, continuing dry or unattended with a proper expectoration, should persevere in harassing the patient; it, at last, it should produce, together with a soreness, shooting pains through the breast and between the shoulders, attended also with shortness of the breath; and if, added to this, flushes of the cheeks after meals, scalding in the hands and feet, and other symptoms of a hectic, should accompany the disorder; there is certainly no time to be lost, as there is the greatest reason to apprehend that some acrimony in the habit is determined to the tender substance of the lungs, and that consequently tubercular suppurations will follow. In this critical and dangerous situation, I think I can venture to say, from long experience, that, accompanied with change of air and occasional bleedings, the patient will find his greatest security in a drain from a large scapular issue, assisted by a diet of asses milk and vegetables."

GENUS

MEDICINE.

GENUS XXXIV. DYSENTERIA, the DYSENTERY.

Description. The dysentery is a disease in which the patient has frequent stools, accompanied with much griping, and followed by a tenesmus. The stools, though frequent, are generally in small quantity; and the matter voided is chiefly mucus, sometimes mixed with blood. At the same time, the natural faeces seldom appear; and, when they do, it is generally in a compact and hardened form. This disease occurs especially in summer and autumn; at the same time with autumnal, intermittent, and remittent fevers; and with these it is often complicated. It comes on sometimes with cold shiverings and other symptoms of pyrexia; but more commonly the symptoms of the topical affection appear first. The belly is costive, with an unusual flatulence in the bowels. Sometimes, though more rarely, some degree of diarrhoea is the first appearance. In most cases, the disease begins with griping; and a frequent inclination to go to stool. In indulging this, little is voided, but some tenesmus attends it. By degrees the stool becomes more frequent, the griping more severe, and the tenesmus more considerable. With these symptoms there is a loss of appetite, and frequently sickness, nausea, and vomiting, also affecting the patient. At the same time there is always more or less of pyrexia present. It is sometimes of the remittent kind, and observes a tertian period. Sometimes the pyrexia is manifestly inflammatory, and very often of a putrid kind. These febrile states continue to accompany the disease during its whole course, especially when it terminates soon in a fatal manner. In other cases, the febrile state almost entirely disappears, while the proper dysenteric symptoms remain for a long time after.

Accompanied with these circumstances, the disease proceeds for a longer or a shorter time. When the pyrexia attending it is of a violent inflammatory kind, and more especially when it is of a very putrid nature, the disease often terminates fatally in a very few days, with all the marks of a supervening gangrene. When the febrile state is more moderate, or disappears altogether, the disease is often protracted for weeks, and even for months; but, even then, after a various duration, it often terminates fatally, and generally in consequence of a return and considerable aggravation of the inflammatory and putrid states. In some cases, the disease ceases spontaneously; the frequency of stools, the griping, and tenesmus, gradually diminishing, while natural stools return. In other cases, the disease, with moderate symptoms, continues long, and ends in a diarrhoea, sometimes accompanied with lenteric symptoms.

Causes. The dysentery often does manifestly arise from the application of cold, but the disease is always contagious; and, by the propagation of such contagion, independent of cold, or other exciting causes, it becomes epidemic, in camps and other places. It is, therefore, to be doubted if the application of cold ever produces the disease, unless where the specific contagion has been previously received into the body: and, upon the whole, it is probable that a specific contagion is to be considered as always the remote cause of this disease.

The common opinion has been that the disease depends upon an acrid matter thrown upon or by some means generated in the intestines, exciting their peristaltic motion, and thereby producing the frequent stools which occur in this disease. But this supposition cannot be admitted; for, in all the instances known, of acrid substances applied to the intestines, and producing frequent stools, as might be expected from acrid substances applied to any length of the intestines. This, however, is not the case in dysentery, in which the stools however frequent, are generally in very small quantity, and such as may be supposed to proceed from the lower parts of the rectum only. With respect to the superior portions of the intestines, and particularly those of the colon, it is probable they are under a preternatural and considerable degree of constriction: for, as we have said above, the natural faeces are seldom voided; and when they are, it is in a form which gives reason to suppose they have been long retained in the cells of the colon, and consequently that the colon had been affected with a preternatural constriction. This is confirmed by almost all the dissections which have been made of the bodies of dysenteric patients; in which, when gangrene had not entirely destroyed the texture and form of the parts, considerable portions of the great guts have been found affected with a very considerable constriction.

The proximate cause of dysentery, or at least the chief part of the proximate cause, seems to consist in a preternatural constriction of the colon, occasioning, at the same time, those spasmodic efforts which are felt in severe gripings, and which efforts, propagated downwards to the rectum, occasion there the frequent mucous stools and tenesmus.

Cure. The most eminent of our late practitioners, and of greatest experience in this disease, seem to be of opinion, that it is to be cured most effectually by purging, assiduously employed. The means may be various: but the most gentle laxatives are usually sufficient; and, as the medicine must be frequently repeated, these are the most safe, the more especially as an inflammatory state so frequently accompanies the disease. Whatever laxatives produce an evacuation of natural faeces, and a consequent remission of the symptoms, will be sufficient to effectuate the cure. But, if the gentle laxatives shall not produce the evacuation now mentioned,

somewhat more powerful must be employed; and nothing is more proper or convenient than tartar emetic, given in small doses, and at such intervals as may determine their operation to be chiefly by stool.

Vomiting has been held a principal remedy in this disease; and may be usefully employed in the beginning of the disease, with a view to both the state of the stomach and of the fever: but it is not necessary to repeat it often; and, unless the emetics employed operate also by stool, they are of little service. Ipecacuanha is by no means a specific; and it proves only useful when so managed as to operate chiefly by stool.

For relieving the constriction of the colon, and evacuating the retained faeces, glysters may sometimes be useful; but they are seldom so effectual as laxatives, given by the mouth; and acrid glysters, if they be not effectual in evacuating the colon, may prove hurtful by stimulating the rectum too much.

The frequent and severe griping attending this disease, leads almost necessarily to the use of opiates; and they are very effectual for the purpose of relieving from the gripes; but, by occasioning an interruption of the action of the small guts, they favour the constriction of the colon; and thereby aggravate the disease.

From our account of the nature of this disease, it will be sufficiently obvious, that the use of astringents in the beginning of it must be absolutely pernicious. Whether an acrid matter be the original cause of the dysentery may be uncertain; but, from the indigestion, and the stagnation of fluids, which attend the disease, we may suppose that some acrid matters are constantly present in the stomach and intestines, and therefore that demulcents may be always usefully employed. At the same time, from this consideration that mild oily matters thrown into the intestines in considerable quantity always prove laxative; therefore the oleaginous demulcents are the most useful.

As this disease is so often of an inflammatory or of a putrid nature, it is evident that the diet employed in it should be vegetable and aëcent. Milk in its entire state, is of doubtful quality in many cases; but some portion of the cream is often allowable, and whey is always proper. At the beginning of the disease, aborbents seem to be superfluous; and, by their astringent and septic powers, they may be hurtful.

When this disease is complicated with an intermittent, and is protracted from that circumstance chiefly, it is to be treated as an intermittent, by administering the Peruvian bark, which in the earlier periods of the disease is hardly to be admitted. See DYSENTERY.

CLASS II. NEUROSES;

AN INJURY OF THE SENSE AND MOTION, WITHOUT ANY LOCAL AFFECTION.

ORDER I. COMATA.

GENUS XXXV. APOPLEXY; the Sanguineous APOPLEXY.

Description. In this disease the patients fall suddenly down, and are deprived of all sense and voluntary motion, but without convulsions. A giddiness of the head, noise in the ears, coruscations before the eyes, and redness of the face, usually precede. The distinguishing symptom of the disease is a deep sleep, attended with violent snoring; if any thing is put into the mouth, it is returned through the nose; nor can any thing be swallowed without shutting the nostrils; and even when this is done, the person is in the utmost danger of suffocation. Sometimes apopleptic patients will open their eyes after having taken a large dose of an emetic; but if they shew no sign of sense, there is not the least hope of their recovery. Sometimes the apoplexy terminates in an hemiplegia; in which case it comes on with a distortion of the mouth towards the sound side, drawing of the tongue the same way, and hammering of the speech. Dissections sometimes shew a rupture of some vessels of the meninges, or of the brain itself; though sometimes, if we may believe Dr. Willis, no defect is to be observed either in the cerebrum or cerebellum.

Causes, &c. The general cause of the sanguineous apoplexy is a plethoric habit of body, with a determination to the head. The disease therefore may be brought on by whatever violently urges on the circulation of the blood; such as surfeits, intoxication, violent passions of the mind, immoderate exercise, &c. It takes place, however, for the most part, when the venous plethora hath subsisted for a considerable time in the system. For that reason it commonly does not attack people till past the age of 60; and that whether the patients are corpulent and have a short neck, or whether they are of a lean habit of body. Till people are past the age of childhood, apoplexy never happens.

Prognosis. This disease very often kills at its first attack; and few survive a repetition of the fit; so that those who make mention of people who have survived several attacks of the apoplexy, have probably mistaken the epilepsy for it. In no disease is the prognosis more fatal; since those who seem to be recovering from a fit, are frequently and suddenly carried off by its return, without either warning of its approach, or possibility of preventing it. The good signs are when the disease apparently wears off, and the patient evidently begins to recover; the bad ones are when all the symptoms continue and increase.

Cure. This is to be attempted, by large and repeated bleedings; emetics and stimulating glysters. The body is to be kept in a somewhat erect posture, and the head kept up.

M E D I C I N E.

APOPLEXY from Poisons.

The poisons which bring on an apoplexy, when taken internally, are those of the stimulant and sedative kind, as spirituous liquors, opium, and the more violent kinds of vegetable poisons. The vapours of mercury, or of lead, in great quantity, will sometimes produce a similar effect; though commonly they produce rather a paralysis, and operate slowly. The vapours of charcoal, or fixed air, in any form, breathed in great quantity, also produce an apoplexy, or a state very similar to it; and even cold itself produces a fatal sleep, though without the apoplectic snoring. To enumerate all the different symptoms which affect the unhappy persons who have swallowed opium, or any of the stronger vegetable poisons, is impossible, as they are scarce to be found the same in any two patients. The state induced by them seems to differ somewhat from that of a true apoplexy; as it is commonly attended with convulsions, but hath the particular distinguishing sign of apoplexy, namely, a very difficult breathing or snoring, more or less violent according to the quantity of poisonous matter swallowed.

Of the poisonous effects of fixed air, Dr. Percival gives the following account: "All those noxious vapours, whether arising from burning charcoal, the fermenting grape, the Grotto del Cani, (see GROTTA) or the cavern of Pyrmont, operate nearly in the same manner. When accumulated and confined, their effects are often instantaneous; they immediately destroy the action of the brain and nerves, and in a moment arrest the vital motions. When more diffused, their effects are slower, but still evidently mark out a direct affection of the nervous system.

"Those who are exposed to the vapours of the fermenting grape, are as instantly destroyed as they would be by the strongest electrical shock. A state of insensibility is the immediate effect upon those animals which are thrust into the Grotto del Cani, or the cavern of Pyrmont: the animal is deprived of motion, lies as if dead; and if not quickly returned into the fresh air, is irrecoverable. And if we attend to the histories of those who have suffered from the vapours of burning charcoal, we shall, in like manner, find, that the brain and moving powers are the parts primarily affected.

"A person was left reading in bed with a pan of charcoal in a corner of the room. On being visited early the next morning, he was found with his eyes shut, his book open and laid on one side, his candle extinguished, and, to appearance, like one in a deep sleep. Stimulants and cupping-glasses gave no relief; but he was soon recovered by the free access of fresh air.

"Were the following cautions generally attended to, they might, in some instances, be the happy means of preserving life: Never to be confined with burning charcoal in a small room, or where there is not a free draught of air by a chimney or some other way: never to venture into any place in which air has been long pent up, or which, from other circumstances, ought to be suspected; unless such suspected place be either previously well ventilated, or put to the test of the lighted candle; for it is a singular and well-known fact, that the life of flame is in some circumstances sooner affected, and more expeditiously extinguished by noxious vapours, than animal life.

"The most obvious, effectual, and expeditious means of relief to those who have unhappily suffered from this cause, are such as will dislodge and wash away the poison, restore the energy of the brain and nerves, and renew the vital motions. Let the patient, therefore, be immediately carried into the open air, and let the air be fanned backwards and forwards to assist its action: let cold water be thrown on the face; let the face, mouth, and nostrils, be repeatedly washed; and, as soon as practicable, get the patient to drink some cold water. But if the case is too far gone to be thus relieved, let a healthy person breathe into the mouth of the patient, and gently force air into the mouth, throat, and nostrils. Frictions, cupping, bleeding, and blisters, are likewise indicated: and if, after the instant danger is removed, a fever be excited, the method of cure must be adapted to the nature and prevailing symptoms of the fever."

With regard to the poison of opium, Dr. Mead recommends the following method of cure: Besides evacuations by vomiting, bleeding, and blistering, acid medicines and lixivial salts are proper: these contract the relaxed fibres, and, by their diuretic force, make a depletion of the vessels. Our author says, he hath given repeated doses of a mixture of salt of wormwood and juice of lemons, with extraordinary success.

APOPLEXY from Passions of the Mind.

Apoplexies from violent passions may be either sanguineous or ferous, though more commonly of the former than the latter species. The treatment is the same in either case. Or they may partake of the nature of catalepsy; in which case, the method of treatment is the same with that of the genuine catalepsy.

APOPLEXY from Suffocation.

This is the kind of apoplexy which takes place in those who are hanged or drowned. For the treatment of those persons, see the articles HANGING and DROWNING.

Besides the species abovementioned, the apoplexy is a symptom in many other distempers, such as fevers, both continued and intermitting, exanthemata hysteria, epilepsy, gout, worms, ischuria, and scurvy.

GENUS XXXVI. PARALYSIS, the PALSY.

Description. The palsy shews itself by a sudden loss of tone and vital power in a certain part of the body: In the slighter degrees of the disease, it only affects a particular muscle, as the sphincter of the anus or bladder, thus occasioning an involuntary discharge of excrement or of urine; of the muscles of the tongue, which occasions stammering, or loss of speech; of the muscles of the larynx, by which the patient becomes unable to swallow solids, and sometimes even liquids also. In the higher degrees of the disease, the paralytic affection is diffused over a whole limb, as the foot, leg, hand, or arm; and sometimes it affects a whole side of the body, in which case it is called *hemiplegia*; and sometimes, which is the most violent case, it affects all the parts below the waist, or even below the head, though this last is exceedingly rare. In these violent cases, the speech is either very much impeded, or totally lost: convulsions often take place on the sound side, with the cynic spasm or involuntary laughter, and other distortions of the face: sometimes the whole paralytic part of the body becomes livid, or even mortified, before the patient's death; and sometimes the paralytic parts gradually decay and shrivel up, so as to become much less than before.

Causes, &c. Palsies most commonly supervene the different species of coma, especially the apoplexy. They are also occasioned by any debilitating power applied to the body, especially by excesses in venery. Sometimes they are a kind of crisis to other distempers, as the colic of Poitou, and the apoplexy. The hemiplegia especially often follows the last-mentioned disease: Aged people, and those who are by any other means debilitated, are subject to palsy; which will sometimes also affect even infants, from the repulsion of exanthemata of various kinds. Palsies are also the infallible consequences of injuries of the large nerves.

Prognosis. Except in the slighter cases of palsies, we have little room to hope for a cure: however, death doth not immediately follow even the most severe paralytic affections. In an hemiplegia, it is not uncommon to see the patients live several years; and even in the paraplegia, if death does not ensue within two or three weeks, it may not take place for a considerable time. It is a promising sign when the patient feels a slight degree of painful itchininess in the affected parts; and if a fever should arise, it bids fair to cure the palsy. When the sense of feeling remains, there is much more room to hope for a cure than when it is gone, as well as the power of motion; but when we observe the flesh to waste, and the skin to appear withered and dry, we may look upon the disease to be incurable. Convulsions supervening on a palsy are a fatal sign.

Cure. Many remedies have been recommended in palsies: but it must be confessed, that, except in the slighter cases, medicines seldom prove effectual; and before any scheme of cure can be laid down, every circumstance relative to the patient's habit of body, and previous state of health, should be carefully weighed. If an hemiplegia or paraplegia should come on after an apoplexy, attended with those circumstances which physicians have supposed to denote a viscid state of the blood, a course of the attenuant gums, with fixed alkaline salts, and chalybeate waters, may do service; to which it will be proper to add frictions with the volatile liniment all down the spine; but in habits where the blood is rather inclined to the watery state, it will be necessary to give emetics from time to time; to apply blisters, and cut issues.

The natural hot-baths are often found useful in paralytic cases; and where the patients cannot avail themselves of these, an artificial bath may be tried, by dissolving salt of steel in water, and impregnating the water with fixed air. Frictions of the parts, and scouring them with nettles, have also been recommended, and may do service, as well as volatile and stimulating medicines taken inwardly.

ORDER II. ADYNAMIÆ.

Diminution of the Involuntary MOTIONS.

GENUS XXXVII. SYNCOPE, or FAINTING.

Description. A syncope begins with a remarkable anxiety about the heart; after which follows a sudden extinction, as it were, not only of the animal powers and actions, but also of the vital powers; so that the patients are deprived of pulse, sense, and motion, all at once. In those cases which physicians have distinguished by the name of *leipothymia*, the patient does not entirely lose his senses, but turns cold and pale; and the pulse continues to beat, though weakly; the heart also seems to tremble rather than beat, and the respiration is just perceptible. But in the true syncope or full asphyxia, not the smallest sign of life can be perceived; the face hath a death-like paleness, the extremities are cold, the eyes shut, or at least troubled; the mouth sometimes shut, and sometimes gaping wide open; the limbs flaccid, and the strength quite gone: as soon as they begin to recover, they fetch deep and heavy sighs.

Causes, &c. Fainting is occasioned most commonly by profuse evacuations, especially of blood; but it may happen also from violent passions of the mind, from surfeits, excessive pain, &c. People of delicate constitutions are very subject to it from slight causes; and sometimes it will arise from affections of the heart and large vessels, not easy to be understood. Fainting is also a symptom

M E D I C I N E.

symptom of many disorders, especially of that fatal one called a *polybus of the heart*, of the plague, and many putrid diseases.

Prognosis. When fainting happens in the beginning of any acute distemper, it is by no means a good omen; but when it takes place in the increase or at the height of the disease, the danger is somewhat less; but in general, when fainting comes on without any evident cause, it is to be dreaded. In violent hæmorrhages it is favourable; as the bleeding vessels have time to contract and recover themselves, and thus the patient may escape.

Cure. When persons of a full habit faint through excess of passion, they ought to be bled without delay, and should drink vinegar or lemon-juice diluted with water; and, after the bowels are emptied by a clyster, take a pægoric draught and go to bed.

The general effects of a sudden fright have been mentioned on a former occasion. When these are so violent as to require medical aid, our first endeavours must be to take off the spasmodic constriction, and restore freedom to the circulation; by bleeding, if the habit be at all inclined to fulness; and by giving a mixture, with equal parts of the vinum antimoniale and elixir pægoricum, in some agreeable vehicle, which will bring on sleep, and encourage perspiration. It was formerly mentioned, that convulsions, or even an epilepsy, may be brought on by frights; which should make people cautious of playing foolish tricks in this way.

In order to revive the patients, they ought to be laid along in a horizontal posture, in an airy place; the legs, thighs, and arms, are to be rubbed with hot flannels; very strong vinegar, or salt of hartshorn, or the spirit of this, or, of sal-ammoniac, are to be held to the nostrils, and rubbed into them, or being properly diluted, poured down the throat; cold water is to be sprinkled on the face and neck: and when by these means the patient shall be sufficiently revived, wine boiled up with some grateful aromatic, is to be given, in a proper quantity.

In the fainting consequent upon profuse uterine hæmorrhages, it will be a safer practice to abstain from all heating and stimulant things; as life, in these cases, is preserved by the coagulation of the blood in the extremities of the open vessels; which might be prevented by the pouring in hot wine, or volatile alkaline spirits.

GENUS XXXVIII. DYSPEPSIA, or Difficulty of Digestion.

Description. It is by no means easy to define exactly the distemper called *dyspepsia*, when considered as an original disease, seeing there are very few maladies which, some way or other, do not shew themselves by an affection of the stomach; and much more difficult still it must be to enumerate all its symptoms. The most remarkable, however, and the most common, are the following: Want of appetite; distension of the stomach when no food has been taken for some time before; slight dejection of spirits; a gradual decay of the muscular strength; languor and aversion to motion; the food, which is taken without appetite, is not well digested; the stomach and intestines are much distended with flatus, whence the patients are tormented with spasms, gripes, and sickness; frequently a limpid water, having an acid or putrid taste, is brought up; sometimes the food itself is thrown up by mouthfuls; and sometimes, though rarely, the same is swallowed again, after the manner of ruminating animals. While matters are in this situation, the heart sometimes palpitates, and the breath is quick, and drawn with difficulty; the head aches and is giddy; and sometimes both these symptoms are continual, and very violent, in so much that the patient is not only tormented with pain, but staggers as if he were drunk. By reason of the too great acescency or putrefaction of the aliment, a cardialgia, or heartburn, comes on, and in this situation a spontaneous diarrhœa sometimes carries off the disease; but in other cases there is an obstinate costiveness, attended with colic pains. Frequently the pulse is quick, sometimes slow, but always weak; the circulation is so languid that the blood can scarce reach the extreme vessels, or at least stagnates in them, so that the face becomes livid, swelled, and has an unusual appearance; and at the same time that the circulation and nervous power are in this languid state, the perspiration becomes less copious; the skin becomes dry and corrugated; the natural heat, especially of the extremities, is much diminished; the tongue is white; and an universal laxity takes place, in so much that the uvula and velum pendulum palati are sometimes enlarged to such a degree as to become extremely troublesome.

Causes, &c. The causes of dyspepsia may be any thing which debilitates the system in general, but in a particular manner affects the stomach. Such are, opium, taken in immoderate quantities, which hurts by its sedative and relaxing powers; spirituous liquors, drunk to excess; tobacco, tea, coffee, or any warm relaxing liquor, taken in too great quantity; acid, unripe fruits; vomits or purges too frequently taken; an indolent sedentary life, &c. &c. All these act chiefly upon people of a weak and delicate habit; for the robust and hardy seldom labour under a dyspepsia, or at most a very slight one.

Prognosis. When a dyspepsia first occurs, it is frequently removed without great difficulty; when it is symptomatic, we must endeavour to cure the primary disease; but when it frequently returns, with symptoms of great debility, hectic, or dropsy, we have great reason to dread the event.

Cure. A radical cure of dyspepsia is only to be expected from

tonic medicines, which can remove from the stomach and system that debility on which the disease depends. But, previous to their use, it will be necessary to evacuate the contents of the alimentary canal by vomits and purgatives. If there is a tendency to putrescency, antiseptics must then be exhibited; but more frequently there is a prevailing acidity which creates an intolerable heart-burn. To palliate this symptom, magnesia alba may be given; which is much preferable to the common testaceous powders, as being purgative when dissolved in an acid, while the others are rather astringent. In the third volume of the Medical Observations, we have an account of two cases of dyspepsia, attended with a very uncommon degree of cardialgia, in which magnesia was so successful, that we can scarce doubt of its efficacy in slighter degrees of the disorder. See the Article DIGESTION.

ORDER III. SPASMI: Irregular Motions of the Muscles, or Muscular Fibres.

GENUS XXXIX. CONVULSION.

Description. When convulsions attack only particular parts of the body, they are generally attended with some kind of paralysis at the same time, by which means the affected parts are alternately convulsed and relaxed, a permanent convulsion, or unnatural contraction of particular muscles, is called *spasm* or *cramp*. These partial convulsions may attack almost any part of the body; and are not unfrequently symptomatic, in fevers, the cholera morbus, &c. The involuntary startings of the tendons, the pricking of the bed-clothes, &c. in acute diseases, &c. are all of them convulsive disorders.

Causes. Convulsions, not only of particular parts, but also over the whole body, often take place from causes not very evident. Sometimes they seem to depend on a certain delicacy or irritability of the nervous system, which is framed with such exquisite sensibility as to be strongly affected by the slightest causes. Delicate women are often subject to hysterical convulsions, as also hypochondriac people. Convulsions, however, often take their rise from wounds, irritations of the stomach and intestines by worms, poisons, violent cathartics, emetics, &c. and very often they are symptomatic, as in dentition, the small-pox, and many kinds of fevers.

Prognosis. Except in some few cases, convulsive disorders are always to be dreaded; but less in young people, than in such as are advanced in life. Those which attack girls under the age of puberty will generally cease on the appearance of the menses; and boys have likewise a chance of being relieved as they advance in life: but in grown-up people, unless the cause is very evident, a cure is hardly to be expected.

Cure. See EPILEPSY.

GENUS XL. EPILEPSY, or FALLING SICKNESS.

Description. The epilepsy often attacks suddenly, and without giving any warning; but more frequently is preceded by a pain in the head, lassitude, some disturbance of the senses, inquiet sleep, unusual dread, dimness of sight, a noise in the ears, palpitation of the heart, coldness of the joints, and in some there is a sensation of formication or a cold air, &c. ascending from the lower extremities towards the head. In the fit, the persons fall suddenly to the ground (whence the name of the *falling sickness*) frequently with a violent cry. The thumbs are shut up close in the palms of the hands, and are with difficulty taken out; the eyes are distorted, so that nothing but the whites are to be seen; all sensation is suspended, in so much, that by no smell, noise, or otherwise, nor even by pinching the body, can they be brought to themselves; they froth at the mouth with a hissing kind of noise; the tongue is frequently lacerated by the teeth, and there is a violent convulsive motion of the arms and legs. Sometimes, however, the limbs, instead of being agitated by convulsive motions, are all stiff, and the parties are as immoveable as a statue. In children the penis is erected, and in young men there is an emission of the semen; and the urine is often thrown out to a considerable distance. At length there is a remission of the symptoms, and the patients recover after a longer or shorter interval; when they complain of a pain, torpor, and heaviness of the head, with a lassitude of all the joints.

Causes, &c. The dissection of epileptic subjects has shewn a variety of morbid appearances, which may be supposed to have contributed to the disease; such as, indurations in the brain, or meninges; caries of the internal surface of the cranium; projections of the bony substance of the same, pressing upon the brain; collections of the serum or purulent matter, and earthy concretions, within the skull; besides many others which are recorded by Bonetus, Morgagni, and Lieutaud. But often the causes are impossible to be discovered; for even in those who have died of the disease, the brain and all other parts of the nervous system have been apparently sound. The disease will attack strong as well as weak people; and in those who are subject to it, any considerable excess in drinking, a surfeit, violent passion, or venery, &c. will certainly bring on a fit. Some have epileptic paroxysms returning periodically, after considerable intervals.

Prognosis. If the epilepsy comes on before the time of puberty, there are some hopes of its going off at that time. But it is a bad sign when it attacks about the 21st year, and still worse if the fits grow more frequent; for then the animal functions are often destroyed, as well as those of the mind, and the patient becomes stupid and

M E D I C I N E.

and foolish. Sometimes it will terminate in melancholy or madness, and sometimes in a mortal apoplexy or palsy. It hath sometimes, however, been observed, that epilepsies have been removed by the appearance of cutaneous diseases, as the itch, small-pox, measles, &c. While the disease is recent, therefore, we are not to despair of a cure; but if it be of long standing, or hereditary, there is very little reason to expect that it can be removed.

Cure. In all convulsive disorders, excepting those which are cured by nature about the time of puberty, the cure by artificial means is very difficult. Numberless specifics have been recommended, but all of them have failed of answering the expectation. When the cause can be discovered, that must be removed. In other cases, the cold-bath, valerian-root, castor, musk, opium, and fetid gums. Peruvian-bark, with the whole tribe of nerval and antispasmodic medicines, have been recommended: but none of these, nor indeed any combination of them, have been found generally useful; though the slighter, or symptomatic cases may often be removed by them.

Of late the *calx*, improperly called the *flowers*, of zinc, have obtained such reputation in convulsive disorders as to be received into the Edinburgh dispensatory. They were proposed by Dr. Gaubius as an antispasmodic, in his *Adversaria*; and their efficacy hath since been confirmed by various observations. In an inaugural dissertation published by Dr. Hart at Leyden, the medical virtues of the flowers of zinc are considered. He observes, that they have long been used externally, chiefly for inflammations of the eyes from acrid lymph. Glauber first proposed the internal use of them; and Gaubius discovered them to be the remedy of the celebrated empiric Luddemannus under the title of *luna fixata*. After this he exhibited them with success in convulsive and spasmodic diseases. Our author supposes, that they act either as absorbents, or as possessing a specific virtue: but is a strong advocate for their efficacy, on whatever principles they may operate; and, in favour of his opinion, relates seven cases in which they proved successful. Dr. Gaubius affirms that he has used the flowers of zinc in cases of the chincough, hysterical hiccough, and spasmus cynicus; that they frequently did more than other medicines, but were by no means successful in every case. The other cures mentioned by Dr. Hart are similar to those above mentioned, and it does not appear that he ever saw a confirmed epilepsy cured by this medicine.

In the first volume of *Edin. Medical Commentaries*, p. 204, we have an account, by Mr. Benjamin Bell, of a man afflicted with a confirmed epilepsy, who was considerably relieved by the flowers of zinc. He was about 35 years of age, and had been subject to the disease for ten years.

Dr. Percival relates some cases of epilepsy which seem to have been cured by the flowers of zinc; and in other cases, where the disease was not entirely removed by it, the spasms were nevertheless much mitigated. The good effects of flowers of zinc as an antispasmodic are also attested by Dr. Haygarth of Chester, and Dr. White of York. The former gives a test of their goodness which may be of use to those who do not prepare them, namely, that the true flowers of zinc when strongly heated become yellow, but resume their white colour on being allowed to cool. The latter gives a case of hieranofos, or strange convulsions of almost all the muscles of the body, cured by zinc, after a number of other remedies had failed. The patient, however, had been formerly much relieved by Ward's antimonial pill.

GENUS XLI. ASTHMA.

The asthma is a chronic disease, which may continue to give very great distress, at intervals, for a considerable number of years. Sir John Floyer, when he wrote his celebrated Treatise, had laboured under repeated paroxysms for 30 years.

The common distinction is into *humid* and *dry*; the former is accompanied with an expectoration of mucus or purulent matter, but the latter is not so attended. In the genuine humoral asthma, the patients are obliged to lean forward; the inspiration is short and spasmodic; and the expiration very slow. Asthmatic persons have generally some warning of the attack, from a languor, loss of appetite, oppression and swelling of the stomach, from flatulence, which precede the fit; but it is usually in the middle of the night, that the violent difficulty of breathing comes on.

The duration of the paroxysm is uncertain, as it will sometimes terminate in three or four hours, while at other times it shall continue for as many days; nay, it has been known to last three weeks without intermission. While it subsists, the patient is in very great distress, not being able to lie in bed, nor scarcely to speak or expectorate, so great is the difficulty of breathing; and yet, notwithstanding all this apparent interruption to the free passage of the blood through the lungs, an inflammation here seldom or never supervenes a fit of the asthma. As the paroxysm wears off, and the breathing becomes free, there is more or less of an expectoration of mucus; and the urine, from being pale and limpid, becomes high coloured, and lets fall a copious sediment.

In order to obtain relief in the fit, we must sometimes bleed, unless extreme weakness or old-age should forbid, and repeat it according to the degrees of strength and fulness: a purging clyster, with a solution of assafoetida, must be immediately injected; and if the violence of the symptoms should not speedily abate, it will be

proper to blister the nape of the neck. A very strong infusion of roasted coffee has been found to give ease in an asthmatic paroxysm. Dr. Pringle says it is the best abater of the paroxysms of the periodic asthma that he has seen. The coffee ought to be of the best Moco, newly burnt, and made very strong immediately after grinding it. He commonly ordered an ounce for one dish; which is to be repeated fresh after the interval of a quarter, or half an hour; and which is to be taken without milk or sugar. This medicine in general is mentioned by Musgrave, in his *Treatise de Arthritide anomala*; but he first heard of it from a physician in Litchfield, who had been informed by the old people of that place, that Sir John Floyer, during the latter end of his life, kept free from, or at least lived easy under, his asthma, from the use of very strong coffee. This discovery, it seems, he made after the publication of his book upon that disease. Dr. Percival says that he has frequently directed coffee in the asthma, with great success.

In the intervals of the fits, persons subject to the asthma, especially the humid species, should take emetics from time to time. An infusion of tobacco is an emetic that has been found very serviceable in some asthmatic cases; and smoking or chewing the same has been known to prevent the frequency and severity of the paroxysms. They should also use the *lac ammoniaci*, with a due proportion of *oxymel scilliticum* and *vinum antimoniale*, with a view to promote expectoration; or the gum-ammoniac, and others of similar virtues, may be formed into pills, and combined with soap, as before mentioned for the dyspnoea pituitosa; or a mass may be composed of assafoetida and balsam of Tolu, with *syr. ex allio*; and these pills may be washed down by a medicated wine impregnated with squills, horseradish-root, and mustard-seed; or a strong bitter infusion, with a little antimonial wine.

The dry or *spasmodic asthma*, during the extreme violence of the fit, is best relieved by opiates; and sometimes very large doses are required. But, in order to obtain permanent relief, nothing is found to answer better than the *radix ipecacuanha*, in small doses. Three, five, eight, or ten grains, according to the strength and constitution of the patient, given every other day, have been productive of the happiest effects; acting sometimes as an evacuant, pumping up the viscid phlegm; at others, as an antispasmodic or sedative. Issues are generally recommended in both species, and will often be found useful. The frequent use of honey has also proved beneficial; see the Article HONEY.

Changes of weather are usually felt very sensibly by asthmatic people, who in general cannot live with tolerable ease in the atmosphere of large cities. A light diet of meats that are easy of digestion and not flatulent, is requisite for asthmatic people; and the exercise of riding is indispensably necessary. See the article ASTHMA.

GENUS XLII. COLICA. The COLIC.

Description. The colic is chiefly known by a violent pain in the abdomen, commonly about the umbilical region. The pain resembles various kinds of sensations, as of burning, twisting, boring, a ligature drawn very tight, &c. The belly is generally very costive, though sometimes there is a violent evacuation of bilious matter, upwards and downwards.

The pain comes on generally after a meal, and soon occasions nausea and vomiting. Sometimes the disease is attended with pyrexia, violent thirst, and a full pulse; the vomiting becomes more violent, and excrementitious matters are thrown up, with the most exquisite pain and tension of the abdomen; a hiccough comes on, which continues obstinately; till at last a cessation of pain and foetid breath indicate a mortification of the intestines, and approaching death. Sometimes the peristaltic motion of the intestines is so totally inverted, that all the contents of the intestines are evacuated by the mouth, and even clysters will be vomited; which constitutes that disease commonly called *iliac passion*.

Causes, &c. Colics may arise from any sudden check given to perspiration, as by violent cold applied to any part of the body, especially to the lower extremities and abdomen. Very frequently they are occasioned by austere, acid, or indigestible aliments taken into the stomach. By any of these, a violent colic, or indeed an iliac passion, may be occasioned; for this last, though commonly accounted a different species of the disease, differs from a colic in no other way than in being in every respect in a much higher degree. In those who have died of this disease, and been dissected, the gut hath sometimes been found twisted; but more commonly there hath been an *intromission* of the intestine, that is, one part of the gut seems to have entered within the other. In the Edinburgh Medical Essays, Vol. III. we have a dissertation on the use of the warm-bath in the bilious colic, in which the author derives the disorder from a spasmodic constriction of the intestine, occasioned by the acrimony of the bile. By this, he says, the intestine is not only contracted into an unusual narrowness, but coats of it have been found, upon dissection, so closely joined, that no passage could be made downwards more than if they had been strongly tied by a ligature.

If this happens in the human body, there is the greatest danger of a mortification, because the part which is constricted, and at any rate disposed to inflammation, hath that disposition very much increased by its confinement within the other, and by the pressure of the contents of the alimentary canal from the stomach downwards upon it. An iliac passion may also arise from the strangulation

M E D I C I N E.

lation of part of the intestine in a hernia; and even a very small portion of it thus strangulated may occasion a fatal disease. In the Medical Observations, Vol. IV. however, we have an account of an iliac passion arising from a very different cause, which could neither have been suspected nor cured by any other way than the operation of *gastrotony*, or opening the abdomen of the patient, in order to remove the cause of the disorder. The patient, a woman of about 28 years of age, after suffering extreme torture for six days. The body being opened, some quantity of a dirty-coloured fluid was found in the cavity of the abdomen. The jejunum and ileum were greatly distended with air. A portion of the omentum adhered to the mesentery, near that part where the ileum terminates in the caecum. From this adhesion, which was close to the spine, there ran a ligamentous cord or process, about two inches and a half long, unequally thick, in some places not thicker than a packthread: which by its other extremity adhered to the coats of the ileum, about two inches above the caecum. This cord formed a circle with the mesentery, large enough to admit a hen's egg to pass through it. The cord had formed a noose (in a manner difficult to be explained) which included a doubling of about two inches of the lower end of the ileum; and was drawn so tight, that it not only put a stop to the passage of every thing through the bowels, and brought on a gangrene of the strangulated part, but it had even cut through all the coats of the intestine on the opposite side of the mesentery, and made an aperture about an inch long. In the Memoirs of the Academy of Surgery are mentioned several similar cases.

Prognosis. The colic is never to be reckoned void of danger, as it may unexpectedly terminate in an inflammation and gangrene of the intestines. Those species of it which are attended with purging must be considered as much less dangerous than those in which the vomiting is very violent. The iliac passion, or that attended with the vomiting of faeces, is always to be accounted highly dangerous; but if the passage through the intestines is free, even though their peristaltic motion should be inverted, and clysters evacuated by the mouth, there is much more hope of a cure than when the belly is obstinately costive, and there is some fixed obstruction which seems to bid defiance to all remedies.

Cure. As the chief danger in colics arises from an inflammation and consequent mortification of the intestines, it is essentially necessary, in the first place, to diminish the tendency to a pyrexia, if there should happen to be any. This is accomplished by bleeding, emollient injections, warm-bathing, and cooling medicines taken inwardly. Dr. Porter strongly recommends the warm-bath in those colics attended with violent evacuations of bile. He supposes it to do service by relaxing the constriction of the intestines, and thus preventing or removing the intussusception. In the mean time opiates may be given to ease the pain, while every method is tried, by cathartics and clysters of various kinds, to procure a stool. In obstinate cases, where stimulating cathartics have proved ineffectual, the milder kinds, such as manna, senna, oleum ricini, &c. will succeed; but where every thing of this kind fails, recourse must be had to some of the more extraordinary methods. Some have recommended the swallowing of leaden bullets, on a supposition that by their weight they would force through the obstruction into the gut; but these seem much more likely to create than to remove an obstruction. It is impossible they can act by their gravity, because the intestines do not lie in a straight line from the pylorus to the anus; and though this were actually the case, we cannot suppose that the weight of a leaden bullet could prove very efficacious in removing either a spasmodic constriction, or an obstruction from any other cause. But when we consider, not only that the intestines consist of a great multitude of solids, but that their peristaltic motion (by which only the contents are forced through them) is inverted, the futility of this remedy must be evident. It might rather be supposed to aggravate the disease; as the lead, by its pressure, would tend to fix the intussusception more firmly, or push it still further on. The same thing may be said of quicksilver: not to mention the pernicious consequences to be apprehended from swallowing large quantities of this mineral, even if it should prove efficacious in relieving the patient for the present. Another method hath been proposed, in the Medical Essays, for relieving the miserable patients in this disorder, which at last can be attended with no bad consequences, and in many cases hath been known to do service. The patient is to be taken out of bed, and made to walk about the cold floor of a damp apartment. At the same time, porringers of cold water are to be dashed on his feet, legs, and thighs; and this must be continued for an hour or longer, if a stool is not procured before that time, though this will generally be the case much sooner. The exercise doth not at all impair the patient's strength, but rather adds to it; and some very remarkable instances are adduced in the sixth volume of the Medical Essays, where this proved effectual after all other medicines had failed. In one person the disease had come on with an habitual costiveness, and he had been for a week tormented with the most violent pain and vomiting, which could be stopped neither by anodynes nor any other medicines, the sharpest clysters being returned unaltered, and all kinds of purgatives thrown up soon after they were swallowed; but by the above-mentioned method, a stool was procured in 35 minutes, and the patient re-

covered. In some others, the costiveness had continued for a much longer time. Other remedies are, the blowing air into the intestines by means of a bellows, and the injecting clysters of the smoke of tobacco. But neither of these seem very capable of removing the disease. They can affect only parts below the obstruction; while to cure the disease, it is necessary that the obstructed parts themselves should be reached by the medicine, and therefore we have not many well attested instances of their success. The cold water gives a general and very considerable shock to the system, checks the perspiration, and thus drives the humours inward upon the intestines, by which they receive a much more effectual stimulus than can be supposed to arise from any kind of clyster. But when all methods have failed, the only chance the patient can have for life is by a manual operation.

In those colics which are attended with faintings, &c. from the beginning, and which generally attack hysterical women and other debilitated persons, all kinds of evacuations are pernicious; and the cure is to be attempted by anodynes and cordials, which will seldom fail of success. See the Article COLIC.

GENUS XLII. LUMBRICI INTESTINORUM; *Maw, or Belly Worms.*

Those infesting the human body are chiefly of three kinds: the *ascarides*, or round and short white worm; the *teres*, or round and long worm; and the *tania*, or tape-worm.

The *ascarides* have usually their seat in the rectum. The round worms are about a span long, round and smooth; they are seated for the most part in the upper small intestines; but sometimes they are lodged also in the stomach, and in any part of the intestines, even to the rectum. The tape-worms are from two to forty feet long, according to the testimony of Platerus; they generally possess the whole track of the intestines, but especially the ileum; they very much resemble a tape in their appearance, whence the name of *tape-worm*.

In the Medical transactions, Vol. II. Dr. Heberden gives a very accurate account of the symptoms produced by the *ascarides*, from an eminent physician who was troubled with them all his life. They brought on an uneasiness in the rectum, and an almost intolerable itching in the anus; which sensations most usually came on in the evening, and prevented sleep for several hours. They were attended with heat, sometimes so considerable as to produce a swelling in the rectum both internally and externally; and if these symptoms were not soon relieved, a tenesmus was brought on, with a mucous dejection. Sometimes there was a gripping pain in the lower part of the abdomen a little above the *os pubis*. If this pain was very severe, a bloody mucus followed, in which there were often found *ascarides* alive. They were also sometimes suspected of occasioning disturbed sleep, and some degree of head-ache.

On this case Dr. Heberden observes, that the general health of the patient did not seem to have suffered from the long continuance of the disease, nor the immediate conveniences of the disorder itself to have increased. "It is (says he) perhaps universally true, that this kind of worms, though as difficult to be cured as any, yet is the least dangerous of all. They have been known to accompany a person through the whole of a long life, without any reason to suspect that they had hastened its end. As in this case there was no remarkable sickness, indigestion, giddiness, pain of the stomach, nor itching of the nose.

The above mentioned patient used purging and irritating clysters with very little success. Limewater was also used as a clyster; which brought on a costiveness, but had no good effect. Six grains of salt of steel were dissolved in six ounces of water, and injected. This clyster in a few minutes occasioned an itching in the rectum, griped a little without purging, and excited a tenesmus. Some few *ascarides* were brought off with it; but all of them were alive. The uneasy situation in the rectum did not abate till some warm milk was thrown up. Whenever the tenesmus or mucous stools were thought worth the taking notice of, warm milk and oil generally gave immediate relief. Oil given as a clyster sometimes brought off these animalcules: the oil swam on the surface of the mucus, and the *ascarides* were alive and moving in the mucus itself, which probably hindered the oil from coming in contact with them and killing them.

The Doctor also observes, that mucus or slime is the proper nest of the *ascarides*, in which they live, and is perhaps the food by which they are nourished; and it is this mucus which preserves them unhurt, though surrounded with many other liquors, the immediate touch of which would be fatal. It is hard to satisfy ourselves by what instinct they find it out in the human body, and by what means they get at it; but it is observable in many other parts of nature, as well as here, that where there is a fit soil for the hatching and growth of animals and vegetables, nature has taken sufficient care that their seeds should find the way thither. Worms are said to have been found in the intestines of infants born dead. Purges, by lessening this slime, never fail to relieve the patient: and it is not unlikely, that the worms which are not forced away by this quickened motion of the intestines, may, for want of a proper quantity of it, languish, and at last die; for if the *ascarides* are taken out of their mucus, and exposed to the open air, they become motionless, and apparently die in a very short time. Dr. Heberden supposes that the kind of purge made use of is of little consequence

M E D I C I N E.

consequence in the cure of all other worms, as well as ascariides; the insects being always defended by the mucus from the immediate action of medicines; and that, therefore, those purges are the best which act briskly, and of which a repetition can be most easily borne. Purging waters are of this sort, and jalap especially for children; two or more grains of which, mixed with sugar, are most easily taken, and may be repeated daily.

From the case abovementioned, and from Dr. Heberden's observations, we may easily see why it is so difficult to destroy these insects; and why anthelmintics, greatly celebrated for some cures, are yet so far from being specifics in the disease. As the worms which reside in the cavities of the human body are never exposed to the air, by which all living creatures are invigorated, it is evident that, in themselves, they must be the most tender and easily destructible creatures imaginable, and much less will be requisite to kill them than any of our common insects. The most pernicious substances to any of the common insects are oil, caustic fixed alkali, lime, and lime-water. The oil operates upon them by shutting up the pores of their bodies; the lime-water, lime, and caustic alkali, by dissolving their very substance. In the case of intestinal worms, however, the oil can have very little effect upon them, as they are defended from it by the moisture and mucus of the intestines; the like happens with lime-water; and, therefore, it is necessary that the medicine should be of such a nature as to destroy both mucus and insects together; for which purpose the caustic fixed alkali is at once safe and efficacious; nor is it probable that any case of worms whatever could resist the proper use of this medicine. A very large dose of any salt, indeed, will also destroy the mucus, and kill the worms; but it is apt to inflame and excoriate the stomach and intestines, and thus to produce worse distempers than that which it was intended to cure.

The long round worms seem to be the most dangerous which infest the human body, as they often pierce through the stomach and intestines, and thus bring on a miserable death. The common symptoms of these are nausea, vomiting, looseness, fainting, slender intermitting pulse, itching of the nose, epileptic fits. By the consumption of the chyle, they produce hunger, paleness, weakness, costiveness, tumour of the abdomen, eructations, and rumbling of the intestines; but it is from the perforation of the intestines that the disease proves so frequently fatal. A child may be known to have worms, from the cold temperament, paleness of the countenance, livid eyelids, hollow eyes, itching of the nose, voracity, startings, and grinding of the teeth in sleep; and more especially by a very foetid breath. Very frequently, however, they are voided by the mouth and anus, in which case there is no room to doubt. In the Medical Commentaries, vol. II. we have an account of the intestines being perforated by a worm, and yet the patient recovered. The patient was a woman, troubled with an inflammation in the lower part of the abdomen. The pain was so violent, that for six days she could not sleep; the tumour then broke, discharged upwards of a pound of thin watery sanies, immediately after which the excrements followed. The next day she was extremely low; her pulse could scarcely be felt; the extremities were cold; and there was a considerable discharge from the wound, which had already begun to mortify. She got a decoction of the bark with wine, which alleviated the symptoms; but, in removing the mortified parts, a worm was found among them nine inches long, and as thick as an eagle's quill. By proper applications, the discharge of excrements ceased, and she recovered perfect health. She was sensible of no accident giving rise to the inflammation; so that, in all probability, it arose entirely from the worm itself. See the article ASCARIS.

The *tania*, or *tape-worm*, as it is called, is one of those most difficult to be cured. It is of two kinds, *tania solium*, and *tania lata*; for a description of which, see the article TÆNIA. The reason of its being so difficult to cure is that though portions of it are apt to break off and be discharged, it is endowed with a power of reproduction, so that the patient is little or nothing better. The symptoms occasioned by it are not different from those above described. A specific against the *tania lata* was so much celebrated in France, that the king thought proper to purchase it from the proprietor, Madame Nouffer.

This specific, however, is not to be considered as a new discovery; the efficacy of fern in cases of *tania* having been known long ago. Theophrastus prescribes its root, in doses of four drachms, given in water sweetened with honey, as useful in expelling flat worms. Dioscorides orders it in the same dose, and adds, that its effects are more certain when it is mixed with four oboli (40 grains) of scammony or black hellebore; he particularly requires that garlic should be taken beforehand. Pliny, Galen, Oribasius, and Aëtius, ascribe the same virtues to fern; and are followed in this by Avicenna, and the other Arabian physicians.

Simon Paulus, quoted by Ray and Geoffroy, considers it as the most efficacious of all poisons against the flat worm, and as being the basis of all the secret remedies extolled by the empirics in that disease. Andry (*Général. des Vers*, p. 246, 249) prefers distilled fern-water to the root in powder, or he employs it only in the form of an opiate, mixed with other substances.

These are not the only authors who have mentioned the *tania*; many others have described this worm, the symptoms it excites,

and the treatment proper to expel it. Almost all of them mention the fern-root, but at the same time they point out other remedies as possessing equal efficacy. Amongst these we find the bark of the root of the mulberry-tree, the juice of the *auricula muris*, the roots of *chamaelon niger*, ginger, zedoary; decoctions of mugwort, southernwood, wormwood, pennyroyal, origanum, hyssop, and in general of all bitter and aromatic plants, &c. Some of them direct the specific to be simply mixed, and taken in wine or honey and water; others join to it the use of some purgative remedy, which, they say, adds to its efficacy.

In Sweden, it has been a practice to drink several gallons of cold water, and then to take some drastic purge. Boerhaave says, that he himself saw a *tania*, measuring 600 ells, expelled from a Russian, by means of the *vitriolum martis*. All these methods, however, have too often proved ineffectual.

GENUS XLIV. DIARRHŒA, or LOOSENESS.

This is occasioned by the too great quantity of matter thrown into the alimentary canal; and what is discharged hath not the appearance of excrements, but is much whiter, and of a thinner consistence. Voracious people who do not sufficiently chew their food, gormandizers, and even those who stammer in their speech, are said to be liable to this disease. In slighter cases it is removed without any medicine, or by a dose of rhubarb; but where the matters have acquired a putrid taint, the disorder may be exceedingly protracted and become dangerous. In this case lenient antiseptic purgatives are to be made use of, after which the cure is to be completed by astringents.

The Bilious DIARRHŒA.

This distemper shews itself by copious stools of a very yellow colour, attended with gripes and heat of the bowels, thirst, bitterness, and dryness of the mouth, yellowness of the tongue, and frequently follows an intermitting or bilious fever. When the fever is gone, the diarrhœa is to be removed by acidulated and cooling drinks, with small doses of nitre.

The Mucous DIARRHŒA.

This kind of diarrhœa, besides the matters usually excreted, is attended with a copious defection of the mucus of the intestines with great pain; while the patient daily pines away, but without any fever. Persons of all ages are liable to it, and it comes on usually in the winter time; but is so obstinate, that it will sometimes continue for years. In obstinate loosenesses of this kind, vomits, frequently repeated, are of the greatest service. It is also very beneficial to keep the body warm, and rub the belly with stimulating ointments; at the same time that astringent clysters, rhubarb, and stomachic medicines, are to be exhibited. Starch clysters are very often efficacious. Some kinds of looseness are contagious; and Sir John Pringle mentions a soldier who laboured under an obstinate diarrhœa, and infected all those who used the same privy with himself. In the looseness which frequently followed a dysentery, the same author tells us, that he began the cure with giving a vomit of ipecacuana, after which he put the patients on a course of astringents. He used a mixture of three drachms of extract of logwood, dissolved in an ounce and a half of spirituous cinnamon-water, to which was added seven ounces of common water, and two drachms of japonic tincture. Of this the patient took two spoonfuls once in four or five hours, and sometimes also an opiate at bed-time. He recommends the same medicine in obstinate diarrhœas of all kinds. A decoction of *simarouba*-bark was also found effectual, when the dysenteric symptoms had gone off. Dr. Huck, who used this remedy in North America, also recommends it in diarrhœas. Two or three ounces of it are to be boiled in a pound and a half of water to a pound; and the whole quantity taken throughout the day. He began with the weakest decoction; and, when the stomach of the patient could easily bear it, he then ordered the strongest: but at the same time he acknowledges that, unless the sick found themselves sensibly better within three days from the time they began the medicine, they seldom afterwards received any benefit from it. But when all astringents have failed, Sir John Pringle informs us, he has known a cure effected by a milk and farinaceous diet; and he thinks in all cases the disorder would be much more easily removed if the patients could be prevailed on to abstain entirely from spirituous liquors and animal food. If the milk by itself should turn sour on the stomach, a third part of lime-water may be added. In one case he found a patient receive more benefit from good butter-milk than from sweet milk. The chief drinks are decoctions of barley, rice, calcined hartshorn, toast and water, or milk and water.

GENUS XLV. DIABETES, or too great a Quantity of URINE.

Description. The diabetes first shews itself by dryness of the mouth, and thirst, white frothy spittle, and the urine in somewhat larger quantity than usual. A heat begins to be perceived in the bowels, which at first is a little pungent, and gradually increases. The thirst continues to augment by degrees, and the patient gradually loses the power of retaining his urine for any length of time. It is remarkable, that though the patients drink much, the quantity of urine always exceeds what is drunk. When the urine is retained a little while, there is a swelling of the loins, ilia, and testes; the strength gradually decays; the skin is dry and shrivelled; œdematous swellings arise in various parts of the body, but after-

M E D I C I N E.

wards subside without relieving the disease in the least; and the patient is frequently carried off by convulsions.

Causes. These are exceedingly obscure and uncertain; spasms of the nervous system, debility, and every thing inducing it, but especially strong diuretics and immoderate venery, have been accused as bringing on the diabetes: it hath, however, occurred in persons where none of all these causes could be suspected; nor have the best physicians been able to determine it. Dissections have only shewn that the kidneys were in an enlarged and relaxed state: in one of Dr. Home's patients, who died, they smelled sour; which shewed, that the urine peculiar to diabetes came from the kidneys, and was sent directly from the intestines by a retrograde motion of the lymphatics, as some imagine.

Prognosis. The diabetes is rarely cured, unless when taken at the very beginning, which is seldom done; and in a confirmed diabetes, the prognosis must therefore be unfavourable.

Cure. The only hopes of a cure in this distemper are from astringent and strengthening medicines, such as the bark in substance, with small doses of rhubarb; decoction of the bark, with the acid elixir of vitriol; the cold infusion of the bark; Dover's powder; alum-water; lime-water; antimonials, combined with *tinctura Thebaica*: the body should be kept constantly open, either with rhubarb, or the infusion of fenna joined with rhubarb: the common drink should be rice-water, barley-water, lime-water, and milk; lime-water alone; sage, balm, or mint-tea; small beer, simple water, and water acidulated with the vitriolic acid. In seven months, these remedies, judiciously varied, may make some progress in removing the disease. In Dr. Home's patients, all these medicines, and many others, were tried without the least good effect; inasmuch that he uses this remarkable expression: "Thus these two patients have exhausted all that experience had ever recommended, and almost all that theory could suggest; yet, in both cases, the disease has resisted all the means of cure used." It is remarkable that, though septics were given to both, in such quantity as evidently to produce a putrefecency in the *prima via*, the urine remained unaltered, both in quantity and quality. See the article DIABETES.

GENUS XLVI. HYSTERIA, HYSTERICUS.

Description. The hysteria is a convulsive disease which comes on at uncertain intervals, sometimes longer and sometimes shorter, but at no stated time. The paroxysms commonly begin with a languor and debility of the whole body; yawning, stretching, and restlessness. A sense of coldness, also, in the extremities, almost always precedes, and, for the most part, remains during the whole time of the paroxysm. To this sometimes succeeds a sense of heat; and the two sensations alternate with each other in different parts of the body. The face is sometimes flushed and sometimes pale; and sometimes the paleness and flushing come alternately. There is a violent pain in the head; the eyes become dim, and pour out tears; there is a rumbling and inflation of the intestines; a sensation is felt like that of a globe ascending from the lower part of the abdomen or hypogastrium, which sometimes seems to roll along the whole alimentary canal. It ascends to the stomach, sometimes suddenly, sometimes slowly; and there produces a sense of inflation and weight, together with anxiety, nausea, and vomiting. At last it comes up to the throat, where it produces a sense of suffocation, and difficulty of breathing or swallowing. All this time there are the most violent pains, both in the external and internal parts of the abdomen; the muscles are convulsed: the navel is drawn inwards; and there are frequently such spasms of the intestines, that neither clysters can be injected, nor even flatus pass downwards. Sometimes the paroxysm remits after these symptoms have continued for a certain time; but more frequently the patients fall into fainting fits; sometimes they lie without motion, as if they were in a deep sleep; sometimes they beat their breasts violently and continually with their hands, and sometimes they are seized with general convulsions, and the disease puts on an appearance of an epilepsy. In some patients the extremities become cold and stiff, and the body has the appearance of one in a catalepsy. Sometimes a most violent beating pain takes place in some part of the head, as if a nail was driving into it, and all visible objects seem to turn round; grievous pains attack the loins, back, and bladder, and the patients make a surprising quantity of urine, as limpid as water: which last is one of the surest signs of the disease. The mind is very much affected as well as the body. Sometimes the patients are tormented with vain fears; sometimes they will laugh, at other times cry immoderately; and sometimes their temper becomes so peevish and fretful, that they cannot enjoy a moment's quiet.

Causes, &c. The general cause of hysteria is thought, by the best physicians, to consist in a too great mobility and irritability of the nervous system, and of consequence may be brought on by whatever debilitates and renders the body irritable. Hence the disease most frequently attacks females of a weak and lax habit of body; though there are some instances of men also attacked by it. The disease generally comes on between the time of puberty and the age of 35, and makes its attacks during the time of menstruation more frequently than at any other. It also more usually seizes barren women and young widows than such as are bearing children.

Prognosis. Though the appearance of this disease is so very terrible, it seldom proves mortal, unless by wrong treatment: but

notwithstanding this, it is extremely difficult of cure, and rarely admits of any thing else than being palliated; for though it should seem to be conquered by medicine for a time, it very quickly returns, and that from the slightest causes.

Cure. The most powerful remedy hitherto discovered in hysterical cases is opium, or the solution of it, called *laudanum*. By this commonly the most violent paroxysms are stopped, though it is not sufficient to accomplish a radical cure. In Home's Clinical Experiments, we find an instance of a cure performed by venesection, though this remedy hath been generally condemned in hysterical cases. *Asafetida* seems to stand next in virtue to opium; though with some it disagrees, and occasions pains in the stomach, and vomiting. *Aether* will also frequently remove an hysterical fit; but its effects are of short duration: and if it do not effect a cure soon after its exhibition, no service is to be expected, either by perseverance in the use of it, or by increasing the dose, and with some constitutions it disagrees to such a degree as to occasion convulsions. If the patient is seized with a violent fit, so that she can swallow nothing, which is frequently the case, it will be proper to apply some strong volatile alkali to her nose; or, if that be not at hand, the vapour of burning feathers is sometimes very efficacious. A plaster of galbanum and *asafetida* will also prove serviceable: but it must be remembered, that none of these things will prevent the return of the disease; and, therefore, a radical cure is to be attempted by exercise, the Peruvian-bark, chalybeates, mineral waters, and other tonics.

GENUS XLVII. HYDROPHOBIA; the Dread of WATER.

Description. This disease commonly does not make its attack till a considerable time after the bite. In some few instances it hath commenced in seven or eight days from the accident; but generally the patient continues in health for 20, 30, or 40 days, or even much longer. The bite hath been healed long before that time, frequently with the greatest ease; though sometimes it resists all kinds of healing applications, and forms a running ulcer, which discharges a quantity of matter for many days. The patient becomes melancholy, loves solitude, and hath a sickness at stomach. Sometimes the peculiar symptom of the disease, the dread of water, comes on all at once. Sometimes the disease begins like a common fore-throat; and the soreness daily increasing, the hydrophobic symptoms shew themselves like a convulsive spasm of the muscles of the fauces. Dr. James, in his Treatise on Canine Madness, mentions a boy, sent out to fill up two bottles with water, who was so terrified by the noise of the liquid running into them, that he fled into the house, crying out that he was bewitched. He mentions also the case of a farmer, who, going to draw some ale from the cask, was terrified to such a degree at its running into the vessel, that he ran out in great haste, with the spigot in his hand. But in whatever manner this symptom comes on, it is certain that the most painful sensations accompany every attempt to swallow liquids: nay, the bare sight of water, of a looking-glass, or any thing clear or pellucid, will give the utmost uneasiness, or even throw them into convulsions.

With regard to the affection of the mind itself in this disease, it does not appear that the patients are deprived of reason. Some have, merely by the dint of resolution, conquered the dread of water, though they never could conquer the convulsive motions which the contact of liquids occasioned: while this resolution hath been of no avail; for the convulsions and other symptoms increasing, have almost always destroyed the unhappy patients.

In this disease there seems to be an extreme sensibility and irritability of the nervous system. The eyes cannot bear the light, or the sight of any thing white; the least touch or motion offends them, and they want to be kept as quiet, and in as dark a place, as possible. In all there is a great flow of viscid saliva into the mouth, which is exceedingly troublesome to the patients, as it has the same effect upon their fauces that other liquids have. This, therefore, they perpetually blow off with violence, which, in a patient of Dr. Fothergill's, occasioned a noise not unlike the hollow barking of a dog, and which, he conjectures, might have given rise to the common notion, that hydrophobous patients bark like dogs. They have an insatiable thirst; but are unable to get down any drink, except with the utmost difficulty; though sometimes they can swallow bread soaked in liquids, slices of oranges, or other fruits. There is a pain under the *scrobiculus cordis*, and the patients mournfully point to that place as the seat of the disease. Dr. Vaughan is of opinion, that it is this pain, rather than any difficulty in swallowing, which distresses the patient on every attempt to drink. The voice is commonly plaintive and mournful; but Dr. Vaughan tells us there is a mixture of fierceness and timidity in the countenance, which he cannot describe, but by which he could know an hydrophobous person without asking any questions.

In this distemper, indeed, the symptoms are so various that they cannot be enumerated; for we seldom read two cases of hydrophobia which do not differ very remarkably in this respect. Some seem to have at times a furious delirium, and an inclination to spit at or bite the bystanders; while others shew no such inclination, but will even suffer people to wipe the inside of their mouths with the corner of a handkerchief, in order to clear away the viscid saliva, which is ready to suffocate them. In some male patients there is an involuntary erection of the penis, and emission of the semen;

M E D I C I N E.

and the urine is forced away by the frequent return of the spasms. In a letter from Dr. Wolf, of Warsaw, to Henry Baker, F.R.S. dated Warsaw, Sept. 26th, 1767, we have the following melancholy account of the cases of five persons who died of the hydrophobia: "None of them quite lost their right senses; but they were all talking without intermission, praying, lamenting, despairing, cursing, fighting, spitting a frothy saliva, screeching, sometimes belching, retching, but rarely vomiting. Every member is convulsed by fits, but most violently from the navel up to the breast and oesophagus. The fit comes on every quarter of an hour; the fauces are not red, nor the tongue dry. The pulse is not at all feverish, and when the fit is nearly over like a sound pulse. The face grows pale, then brown, and during the fit almost black; the lips livid: the head is drowsy, and the ears tingling; the urine limpid. At last they grow weary: the fits are less violent, and cease towards the end; the pulse becomes weak, intermittent, and not very quick; they sweat, and at last the whole body becomes cold. They compose themselves quietly as if to get sleep, and so they expire.

Causes, &c. In no disease whatever are we more at a loss to discover the causes than in the hydrophobia. In dogs, foxes, and wolves, it seems to come on spontaneously; though this is contested by some authors. It is said, that the causes commonly assigned, viz. heat, feeding upon putrid flesh, want of water, &c. are not sufficient for producing the distemper. It does not appear that madness is more frequent among dogs in the warm than in the cold climates; nay, in the island of Antigua, where the climate is very hot, and the water very scarce, the dogs are said not to be subject to this distemper.

With regard to the immediate cause among mankind, there is not the least doubt that the hydrophobia is occasioned by the saliva of the mad animal being mixed with the blood. It doth not appear that this can operate through the cuticula; but, when that is rubbed off, the smallest quantity is sufficient to communicate the disease, and a slight scratch with the teeth of a mad animal hath been found as pernicious as a large wound. It is certain also, that the infection hath been communicated by the bites of dogs, cats, wolves, foxes, weasels, and swine, when not in a state of madness.

When we attempt to investigate the nature of the cause of the hydrophobia by dissections, our enquiries are commonly disappointed. In two bodies opened by Dr. Vaughan, there was not the least morbid appearance; in the very fauces, where we might have expected that the disease would have shewn itself most evidently, there was not the least appearance even of inflammation. The stomach, intestines, diaphragm, oesophagus, &c. were all in a natural state: neither do we find in authors of credit any certain accounts of morbid appearances in the bodies of hydrophobic persons after death.

Prognosis. When a person is bit, the prognosis with regard to the ensuing hydrophobia is very uncertain. All those who are bit do not fall into the disease; nay, Dr. Vaughan relates, that out of 30 bit by a mad dog, only one was seized with the hydrophobia. During the interval betwixt the bite and the time the disease comes on, there are no symptoms by which we can judge whether it will appear or not. When once it hath made its appearance, the prognosis is exceedingly fatal.

Prevention and Cure. It hath been generally allowed by practitioners, that though the hydrophobia may be prevented, yet it can seldom or never be cured after it has made its appearance. A great number of different methods of prevention have been attempted. Bathing in cold water, especially in the sea, and drinking sea-water for a certain time, have been prescribed, and by some accounted a certain preventative. When this was known to fail, a long course of antiphlogistic regimen, violent submersion in water, even to danger of drowning, and keeping the wounded place open with cauteries, were recommended. To this extreme severity Dr. Mead objected; and in his Treatise on this subject endeavours to shew that in all ages the greatest success hath been reaped from diuretics, for which reason he proposes the following powder: "Take ash-coloured ground-liverwort, half an ounce; black pepper, two drachms: reduce them separately to powder, then mix them together." But this medicine, which was inserted in former editions of the London Dispensatory, under the name of *Pulvis Antilyssus*, has long lost its credit.

There is a famous East-India medicine composed of 24 grains of native and as much facitious cannabar, made into a powder with 16 grains of musk. This is called the *Tonquin* medicine, and must be taken in a tea-cup full of arrack or brandy; and is said to secure the patient for 30 days, at the expiration of which it is to be repeated; but if he has any symptoms of the disease, it must be repeated in three hours, which is said to be sufficient for a cure. The first dose is to be taken as soon after the bite as possible.

Another celebrated remedy is Palmarius's powder, composed of the leaves of rue, vervain, sage, polypody, wormwood, mint, mugwort, balm, betony, St. John's-wort, and lesser centaury. These herbs must be gathered in their prime, dried separately in the shade, and then powdered. The dose is a drachm, or a drachm and a half, taken every day.

A remedy which might promise to be a more efficacious than any of these hitherto mentioned is mercury. This hath been recom-

mended in frictions, and to be taken inwardly in the form of calomel and turbith mineral, in order if possible to raise a slight salivation; on which the efficacy was thought to depend. Besides this, venesection, opium, the bark, camphor, have been tried in very large quantities; the warm-bath; and, in short, every thing which human invention could suggest.

The last celebrated antidote against the poison of a mad dog hath been known for some years by the name of the *Ormskirk medicine*. The true composition of this is kept a secret by the proprietors: however, it hath been analysed, and the following composition published by Dr. Heysham, as perfectly similar to it in all respects.

"Take half an ounce of chalk, three drachms of Armenian bole, ten grains of alum, one drachm of elecampane in powder; mix them all together, and add six drops of oil of anise."

They must certainly be very credulous who can put confidence in such an insignificant medicine, as a preservative against the hydrophobia: however, there is a possibility that there may be some unknown ingredient in the genuine powder; for it is difficult to analyse powders after the ingredients are thoroughly mixed together. The efficacy of the medicine therefore must depend on the virtues of that unknown ingredient, if any such there be.

Many instances might be adduced of the inefficacy of this pretended specific: the danger of acquiescing in which, will, it is hoped, create a due degree of caution in those to whom they who are so unfortunate as to be bit by a mad animal may commit themselves. Of the great variety of remedies which have had their day of reputation, there is not one which has not possessed the credit, some time or other, of preventing the noxious effects arising from the bite of a mad dog. A more adequate experience has with all of them discovered the deception. It was above observed, that the hydrophobia is by no means the infallible consequence of being bit by a mad animal: and that of between 20 and 30 persons who were bit by the dog which gave the fatal wound to one of Dr. Vaughan's patients, not one felt the least ill effect but himself. "In the above number (says the Doctor) were some who took the Ormskirk medicine; others went to the salt-water; and part of them used no remedy, who yet fared equally well with the most attentive to their injury. The same thing has often happened before; and much merit, I doubt not, has been attributed to the medicine taken, from that celebrated one of *Sir George Cobb*, down to the infallible one which my good *Lady Bountiful's* receipt book furnishes."

From all that has been said, the reader will judge how far the hydrophobia is capable of being subdued by any of the medicinal powers which have yet been tried. Some eminent physicians assert that it is totally incurable; and allege that the instances recorded by different authors of its cure have not been the genuine kind, but that which comes on spontaneously, and which is by no means so dangerous. Indeed, two of Dr. Wolf's patients recovered, where the disease seems to have been perfectly genuine: but in these the poison seemed to vent itself partly on some other place besides the nervous system. In one the blood was evidently infected, as it had an abominable fætor; and the other had a violent pain and swelling in the belly. In all the others it seemed to have attacked only the nervous system: which perhaps hath not the same ability to throw off any offending matter that the vascular system hath.

Dr. Wolf himself adopts this hypothesis, that perhaps the serum may become frothy; but in blood drawn from a vein not the least fault appears either in the serum or crassamentum. He affirms, however, that the duodenum appears to be one of the parts first and principally affected; and as it is not inflamed, it would seem that the affection it sustains must arise from the vitiated state of its juices.

Be this as it will, however, in the hydrophobia, the stomach seems totally, or in a great measure, to lose the power which at other times it possesses. Two grains of *cuprum ammoniacale* were repeatedly given to a child of eight years of age without effect; but this dose would occasion violent vomiting in a strong healthy man. Something or other therefore must have prevented this substance from acting on the nervous coat of the stomach; and this, we can only suppose to have been the exceedingly disordered state of the gastric juice, which occasioned such violent irritation through the whole body that the weaker stimulus of the medicine was entirely lost. It would seem proper therefore to consider the stomach in hydrophobic cases as really containing a poisonous matter, which could not be expelled by vomiting, because it is renewed as fast as evacuated. The indication therefore must be, to change its nature by such medicines as are certainly more powerful than the poison; and this indication will naturally lead us to think of large doses of alkaline salts. These, it is certain, will destroy any animal substance with which they come in contact, and render even the poison of serpents inactive. By exhibiting a few doses of them, we should be certain to change the state of the stomachic juices; and thus might free the patient from those intolerable spasms which always occasion death in such a short time. Dr. Wolf seems inclined to think that volatile alkalis were of service; but the above hypothesis would incline us to use rather the fixed kind.

At

M E D I C I N E.

At any time it seems vain for physicians to trust much to the power of opium, mercury, musk, or cinnabar, either singly, or combined in any possible way. The bark hath also failed, and the most celebrated specifics have been found ineffectual. Alkalis are the next most powerful remedies which the *materia medica* affords, and they cannot be more unsuccessful than the others have generally been.

Where corrosive mercury hath been swallowed, alkaline salt is recommended to destroy the poison which nature cannot expel by vomiting; and why should not something be attempted to destroy the poison which the stomach seems to secrete in the hydrophobia, and which nature attempts to expel, though in vain, by violent efforts to vomit?

But whatever plan may be pursued in the hopes of curing this dreadful malady, after any of the symptoms have made their appearance, we ought, in every instance of the accident that gives rise to it, to direct our immediate care to prevention, as being perhaps the only real ground of hope: and the most certain and efficacious way of preventing the ill consequences, is instantly (if it may be done) to cut out the piece in the place that happens to be bitten. Dr. James, indeed, says, that he would have little opinion of cutting or cauterising, if ten minutes were suffered to elapse from the receiving of the bite before the operation was performed. But in an inaugural dissertation since published at Edinburgh, by Dr. Parry, the author is of opinion that excision will be of use a considerable time after the bite is received. He adopts this opinion from what happens in the small-pox, where the blood doth not seem to receive the infection till some days after the inoculation hath been performed. A second inflammation, he tells us, then takes place, and the infection is conveyed into the blood. In like manner, when the hydrophobic infection is about to be conveyed into the blood, according to him, the wound, or its cicatrix, begins again to be inflamed; and it is this second inflammation which does all the mischief. Excision, or the cautery, will therefore be effectual any time betwixt the bite and the second inflammation of the wound. Without implicitly trusting to this doctrine, however, or considering it as in any degree ascertained in what manner the poison diffuses itself, by what marks its progress may be known, or how soon the system may be irremediably tainted with its malignity; it is undoubtedly safest not to lose unnecessarily a moment's time in applying the knife. This, or a dilation of the wound, if it be small, Dr. Vaughan considers as the only prophylactics that can be depended upon. In the latter case, he directs to fill the wound with gunpowder, and set fire to it, which would produce a laceration of the part, and possibly the action of ignited powder upon the poison may have its use.

On these cases Dr. Wolf makes the following observations: "Thus we see that the bark, the mercury, the acids, the musk, the feeding on the most famous herbs, the sweating, the *cura antiphlogistica*, are no specifics."

ORDER IV. VESANIE; Disorders of the Judgment.

GENUS XLVIII. MELANCHOLIA, MELANCHOLIC Madness.

The treatment of the melancholic madness being nearly similar to that of the maniac, we shall refer our readers to the following Genus.

GENUS XLIX. MANIA, RAVING or FURIOUS Madness.

Although these distempers may be considered as distinct genera, yet they are so nearly allied, and so readily change into each other, that it sufficiently justifies the treating of them both at once.

The distinguishing characteristic of madness, according to Dr. Battie, is a *false perception*; and under this general character may be comprehended all kinds of what is called *madness*, from the most silly stupidity and idiotism to the most furious lunacy. Frequently the different kinds of madness are changed into each other by the casual excitement of some passion: thus, an idiot may become furiously mad, by being put in a violent passion; though this does not so often happen as the change of melancholy into the raving madness, and *vice versa*.

It is a very surprising circumstance, that mad people are not only less liable to be seized with infectious disorders than those who are in perfect health, but even when labouring under other diseases, if the patients chance to be seized with madness, they are sometimes freed from their former complaints. Of this kind Dr. Mead relates two very remarkable instances.

On the other hand, it has been known, that an intermittent fever, supervening madness of long standing, has proved a cure for the madness; the senses having returned when the fever terminated. Dr. Monro saw two instances of this himself, and mentions it as an observation of his predecessor in the care of Bethlem hospital.

Another remarkable circumstance is, that immoderate joy, long continued, as effectually disorders the mind as anxiety and grief. For it was observable in the famous South-Sea year, when so many immense fortunes were suddenly gained, and as suddenly lost, that more people had their heads turned from the prodigious flow of unexpected riches than from the entire loss of their whole substance.

Mad people, especially of the melancholic kind, sometimes obstinately persevere in doing things which must excite great pain; whence it should seem as if their minds were troubled with some distracting notions which make them patiently bear the present distress lest more severe tortures should be inflicted; or possibly they

may think that, by thus tormenting the body, they render themselves more acceptable to the Divine Being, and expiate the heinous sins of which they may imagine themselves to have been guilty.

Cure, &c. All the species and degrees of madness which are hereditary, or that grow up with people from their early youth, are out of the power of physic; and so, for the most part, are all maniacal cases of more than one year's standing, let them arise from what source soever. Very often, mere waste, or the dregs of some particular disease, such as the ague, small-pox, or a nervous fever, shall occasion different degrees of foolishness, or madness. In these cases, the cure must not be attempted by evacuations; but, on the contrary, by nourishing diet, clear air, moderate exercise, and the use of wine: whereas, in almost all the other maniacal cases, which arise from different sources, and which come on in consequence of imtemperate living, violent passions, or intense thinking, it is generally held that evacuations of every kind are necessary, unless the constitution of the patient be such as absolutely forbids them.

Blood is most conveniently drawn either from the arm or jugulars; and if the weakness be such as renders it improper to take away much blood, we may apply cupping-glasses to the occiput.

Vomiting, in weakly people, must be excited by the vinum ipecacuanhæ; but, in the more robust, by emetic tartar, or antimonial wine: the most efficacious cathartics are the infusion or tincture of black hellebore, or infusion of fenna, quickened with tincture of jalap; but if there be a suppression of the menses, or hæmorrhoidal discharge, then aloetic purges will be more proper. In general, mad people require very large doses, both of the emetics and cathartics, before any considerable operation ensues.

Dr. Monro assures us, that the evacuation of vomiting is infinitely preferable to any other: the prodigious quantity of phlegm with which the patients in this disease abound, he says, is not to be got the better of but by repeated vomits; and he observes that the purges have not their right effect, or do not operate to so good purpose, until the phlegm is broken and attenuated by frequent emetics. He mentions the case of a gentleman who had laboured under a melancholy for three years, from which he was relieved entirely by the use of vomits, and a proper regimen. Increasing the discharge by urine is also of the greatest moment, especially when any degree of fever is present. The cutaneous discharges are also to be promoted, for which purpose the hot-bath is of the highest service in maniacal cases. Hoffman asserts that he has seen numerous instances, both of inveterate melancholy and raging madness, happily cured by means of warm-bathing, bleeding and nitrous medicines having been premised. Camphor has also been highly commended; but, if we believe Dr. Locker, of Vienna, not very deservedly.

Both reason and experience shew the necessity of confining such as are deprived of their senses; and no small share of the management consists in hindering them to hurt themselves or do mischief to other persons. It has sometimes been usual to chain and to beat them; but this is both cruel and absurd; since the contrivance called the *strait waistcoat* answers every purpose of restraining the patients, without hurting them.

It is of great use in practice, to bear in mind that all mad people are cowardly, and can be awed even by the menacing look of a very expressive countenance; and when those who have charge of them once impress them with the notion of fear, they easily submit to any thing that is required. The physician, however, should never deceive them in any thing, but more especially with regard to their distemper: for as they are generally conscious of it themselves, they acquire a kind of reverence for those who know it; and by letting them see that he is thoroughly acquainted with their complaint, he may very often gain such an ascendant over them that they will readily follow his direction.

It is a more difficult matter to manage those whose madness is accompanied either with excessive joy or with great dejection and despondency, than those who are agitated with rage: and all that can be done is to endeavour to excite contrary ideas, by repressing the immoderate fits of laughter in one kind by chiding or threatening (taking care, however, not absolutely to terrify them, which can never be done without danger, that has often added to the misery of the unhappy sufferer); and dispelling the gloomy thoughts in the other, by introducing pleasing concerts of music, or any other species of entertainment which the patients have been known to delight in while they had the use of their reason.

Though blistering the head has generally been directed, Dr. Mead says he has oftener found it to do harm than service: but he recommends issues in the back; and advises to keep the head always close shaved, and to wash it from time to time with warm vinegar. Opium is usually forbidden in maniacal cases, as supposing that it always increases the disturbance; but there are instances where large doses of this medicine have been found to prove a cure, and perhaps if it were tried oftener we should find powerful effects from it: there certainly cannot much harm ensue from a few doses, which may be immediately disused if they should be found to exasperate the disease.

The diet of maniacal patients ought to be perfectly light and thin: their meals should be moderate: but they should never be suffered to live too low, especially while they are under a course of physic: they should be obliged to observe great regularity in their hours: even their amusements should be such as are best suited to their

M E D I C I N E.

their disposition; and after the disease appears to be subdued, chalybeate waters and the cold-bath will be highly proper, to strengthen their whole frame, and secure them against a relapse.

CLASS III. CACHEXIAE.

A depraved Habit of the Whole or greatest Part of the Body.
ORDER I. MARCORES; *a Wasting of the whole Body.*

GENUS L. TABES, or Wasting of the Body.

This disorder is occasioned by the absorption of pus from some ulcer, external or internal, which produces a hectic fever. The primary indication, therefore, must be to heal the ulcer, and thus take away the cause of the disease. If the ulcer cannot be healed, the patient will certainly die in an emaciated state. But, for the proper treatment of the tabes proceeding from this cause, see the articles ULCER, and SYPHILIS, &c.

GENUS LI. ATROPHY, or NERVOUS CONSUMPTION.

Description. This is a wasting of the body, without any remarkable fever, cough, or difficulty of breathing; but attended with want of appetite, and a bad digestion; whence the whole body grows languid, and wastes by degrees. Dr. Cullen, however, asserts, that some degree of fever, or at least of increased quickness of the pulse, always attends this disease.

Causes. Sometimes this distemper will come on without any evident cause. Sometimes it will arise from passions of the mind; from an abuse of spirituous liquors; from excessive evacuations, especially of the semen; in which case the distemper hath got the name of *tabes dorsalis*. It will arise from mere old age, or from famine.

Prognosis. This distemper, from whatever cause it may arise, is very difficult to cure, and often terminates in a fatal dropsy.

Cure. Stomachic and nervous medicines are only to be depended upon in this case. The Peruvian bark, elixir of vitriol, and chalybeates, are excellent; and the diet should be as light and nutritive as possible. In that species of the distemper occasioned by venereal excesses, it is so essentially necessary to abstain from them, that, without it, the best remedies will prove useless. But this is so seldom complied with, that the tabes dorsalis almost always proves mortal.

ORDER II. INTUMESCENTIAE; *External Tumours.*

GENUS LII. POLYSARCA, or CORPULENCY.

In a natural and healthy state, the fat, or animal oil, is not allowed to diffuse itself throughout the cellular interstices at large; but is confined to the places where such an oily fluid is necessary, by a particular apparatus of distinct vesicles: but in many constitutions the oily part of the blood appears to exceed the requisite proportion, and easily separates from the other constituent parts; and then it is apt to accumulate in such quantities that we may suppose it to burst those vesicles which were originally destined to hinder it from spreading too far.

The increase of the omentum particularly, and the accumulation of fat about the kidneys and mesentery, swell the abdomen, and obstruct the motions of the diaphragm; whence one reason of the difficulty of breathing which is peculiar to corpulent people; while the heart, and the large vessels connected therewith, are in like manner so encumbered, that neither the systolic nor subsystolic motion can be performed with sufficient freedom; whence weakness and slowness of the pulse: but when the whole habit is in a manner overwhelmed with an oily fluid, the enlargement of the cellular interstices will necessarily interrupt the general distribution and circulation throughout the nervous and vascular systems; impeding the action of the muscular fibres, and producing insensibility, somnolency, and death.

These cases are the more deplorable, as there is but little prospect of a cure; for the animal oil is of too gross a nature to be easily taken up by absorption: and we know that when fluids are accumulated in the cellular system, there are only two ways in which they can be carried off or escape; namely, by the absorbents, which take their rise from the cellular interstices, and through the pores of the skin by transudation.

Another misfortune is that the disease steals on so imperceptibly, that it becomes inveterate by the time that people begin to think of pursuing the proper means of relief.

Soap has been proposed as a remedy to melt down and facilitate the absorption of the fat in corpulent people; and Dr. Fleming, some years ago, published a little treatise, wherein he recommends this medicine, and relates the case of a gentleman who is said to have received considerable benefit from it. But perhaps the soap-lees would be more powerful, and might be more easily taken, sheathed, as hereafter directed, when recommended as a dissolvent of the stone.

Lieutaud advises to use *acetum scilliticum* in small doses, with frequent purging and brisk exercise: but it will seldom happen that the patients will be found sufficiently steady to persist in any of these courses, it being the nature of the disorder to render them irresolute and inattentive to their condition: therefore the principal use of rules must be with a view to prevention; and persons who are disposed to corpulency should take care in time to prevent it from becoming an absolute disease, by using a great deal of exercise, not indulging in sleep, and abridging their meals, especially that of supper. Salted meats are less fattening than such as are fresh; and drinking freely of coffee is recommended to corpulent people.

No. 103.

But Dr. Fothergill observes that a strict adherence to vegetable diet reduces exuberant fat more certainly than any other means that he knows of; and gives two cases wherein this regimen succeeded remarkably well. The famous Dr. Cheyne thus brought himself down, from a most unwieldy bulk, to a reasonable weight; as he himself informs us. See the articles CORPULENCY and ABSTINENCE.

GENUS LIII. PNEUMATOSIS, EMPHYSEMA, *Windy Swelling.*

The emphysema sometimes comes on spontaneously; but more frequently is occasioned by wounds of the lungs, which, giving vent to the air, that fluid insinuates itself into the cellular texture, and often blows it up to a surprising degree. It must be observed, however, that it is only in cases of laceration of the lungs where this disease can take place; for, in a simple wound, the effusion of blood always prevents the air from getting out. The cure is to be accomplished by the scarifications and compresses, and, in some cases, only by the paracentesis of the thorax.

GENUS LIV. TYMPANITES, the TYMPANY.

This is an inflation of the abdomen, and is of two kinds: 1. That in which the flatus is contained in the intestines, in which the patient has frequent explosions of wind, with a swelling of the belly frequently unequal. 2. When the flatus is contained in the cavity of the abdomen; in which case the swelling is more equal, and the belly sounds when struck, without any considerable emission of flatus. In both cases the rest of the body falls away.

Causes, &c. The tympany sometimes takes place in those who have been long troubled with flatulencies in the stomach and intestines. It happens frequently to women after abortion; to both sexes after the suppression of the hemorrhoides; and sometimes from tedious febrile disorders injudiciously treated.

Prognosis. This disease is generally very obstinate, and, for the most part, proves fatal, by degenerating into an ascites. Sometimes, if the patient be healthy and strong, the disease may terminate favourably, and that the more readily if it has followed some other disorder. A hectic consumption, dry cough, and emaciated countenance in a tympany, with a swelling of the feet, denote approaching death in a very short time.

Cure. The cure of the tympany is to be attempted by carminative, resolvent, and stomachic medicines, gentle laxatives, and at last tonics, especially chalybeates.

GENUS LV. PHYSOMETRA, or WINDY SWELLING of the Uterus.

The treatment of this is not different from that of the tympany.

GENUS LVI. ANASARCA, or WATERY SWELLING over the whole Body.

In this disease the feet first begin to swell, especially in the evening, after exercise, and when the patient has stood or sat long; which swelling rises frequently to the thighs. By lying in bed, the swelling becomes less, or even almost disappears. In the progress of the disease, the swelling often rises to the hips, loins, and belly, and at last covers the whole body. This disease, besides the other symptoms hereafter mentioned under ASCITES, is attended with a remarkable difficulty of breathing. For the cure, see ASCITES. Only it may be here noticed, that, in anasarca, it is usual to scarify the feet and legs: by this means the water is often discharged: but the operator must be cautious not to make the incision too deep; they ought barely to penetrate through the skin; and especial care must be taken, by spirituous fomentations and proper digestives, to prevent a gangrene. Dr. Fothergill observes, that the safest and most efficacious way of making these drains is by the instrument used for cupping, called a *scarificator*; and he always orders it to be so applied as to make the little wounds transversely; as they not only discharge better, but are also longer in healing, than when made longitudinally.

GENUS LVII. ASCITES, or DROPSY of the Abdomen.

Description. This disease assumes three different forms: 1. When the water immediately washes the intestines. 2. When it is interposed between the abdominal muscles and the peritonæum; or, 3. It may be contained in sacs and hollow glands, in which case it is called the *encysted dropsy*. Some physicians, of great reputation, have asserted that the water was often placed within the duplicature of the peritonæum: but this is alleged, by Dr. Milman, to be a mistake, as that membrane is looked upon by the best anatomists to be single; and he thinks, that the abovementioned physicians have been led into the mistake from observing the water collected in the cellular substance of the peritonæum.

In the beginning of an ascites the patient becomes languid, breathless, and hath an aversion to motion: his belly swells; and when struck, the sound of fluctuating water is perceptible: there is a difficulty of breathing when the belly is pressed: there is an almost continual thirst, which, in the progress of the disease, becomes very urgent; the urine is thick, in small quantity, and red: the pulse is small and frequent; and, as the belly swells, the other parts waste away: a fever at last arises, which, constantly increasing, at last carries off the patient. These symptoms are most urgent where the waters are in immediate contact with the intestines; in the other kinds, the rest of the body is less wasted; nor is there so great thirst, or difficulty of breathing.

Causes, &c. The immediate cause of the dropsy is a greater effusion of serum by the exhalant arteries than the absorbents can take up. This may be occasioned either by too great a quantity of

M E D I C I N E.

liquid thrown out by the former, or by an inability of the latter to perform their office. This commonly happens in people whose bodies are of a weak and lax texture, and hence women are more subject to this malady than men; chlorotic girls especially are very apt to become dropsical.

Sometimes, however, this disease is occasioned by a debility of the vital powers, by great evacuations of blood, or by acute diseases accidentally protected beyond their usual period; and although this cause seems very different from a laxity of fibres, yet the dropsy seems to be produced in a similar manner by both. For the vital powers being debilitated by either of these causes, naturally brings on a certain debility and laxity of the solids; and, on the other hand, a debility of the solids always brings on a debility of the vital powers: and from this debility of the vital powers, in both cases, it often happens that those humours which ought to be expelled from the body are not, but accumulate by degrees in its cavities: There is, however, this difference between the two kinds of dropsy arising from these two different causes: That in the one which arises from laxity the solid parts are more injured than in that which arises from a debility of the vital powers. In the former, therefore, the water seems to flow out from every quarter, and the body swells all over. But when the disease is occasioned by a debility of the vital powers, though the solids are less damaged, yet the power of the heat being much diminished, and the humours scarce propelled through the extreme vessels, the thin liquids by which, in a healthy state, the body is daily recruited, are carried by their own weight either into the cavities or into the cellular texture. Hence those aqueous effusions which follow great evacuations of blood, or violent loosenesses, begin in the more depending parts of the body, gradually ascending, till they arrive at the cavity of the abdomen, or even the thorax.

But another and much more sufficient cause for the production of dropsy is an obstruction of the circulation; and this may take place from polypi in the heart or large vessels, and hard swellings in the abdomen. Instances have been observed of a dropsy arising from scirrhus tumours in the omentum, and many more from a scirrhus liver or spleen, and from an infarction and obstruction of the mesenteric glands, by which means the lymph coming from the extremities is prevented from arriving at the heart.

Lastly, whatever, either within or without the vessels, contracts or shuts up their cavities, produces a more copious and easy transmission of the thin humours through the exhalant arteries, at the same time that it prevents their return by the absorbent veins. This hath been established by experiment. For Lower having perforated the right side of the thorax in a dog, tied the *vena cava* and sewed up the wound. The animal languished for a few hours, and then died. On dissection, a great quantity of serum was found in the abdomen, as if he had long laboured under an ascites. In like manner, having tied the jugular veins of another dog, a surprising swelling took place in those parts above the ligatures, and in two days the creature died. On dissection, all the muscles and glands were vastly distended, and quite pellucid, with limpid serum. From these experiments, and some cases of disease mentioned by different authors, it appears, that when the veins are obstructed so that they cannot receive the arterial blood, the serum is separated as by a filtre into the more open cavities and laxer parts of the body, while the thicker part stagnates, and is collected in the proper blood-vessels.

The too great tenuity of the humours is very frequently accused as the cause of dropsy; and many authors have asserted, that dropsy might arise merely from a superabundance of water in the blood. For this some experiments of Halesius are quoted, from which they would infer that when a great quantity of aqueous fluid is introduced into the blood, the superfluous fluid ought by no means to pass through the extremities of the sanguiferous arteries into the veins in the common course of circulation, but by being effused into the cavities should produce a dropsy. But this can only happen when the vital powers are very much diminished; for, in a natural state, the superfluous quantity is immediately thrown out by the skin or kidneys; and agreeably to this we have an experiment of Schultzeius, who induced a dropsy in a dog by causing him to drink a great quantity of water; but he had first bled him almost *ad deliquium*, so that the vital powers were in a manner oppressed by the deluge of water. In this manner do those become hydropic who are seized with the disease on drinking large quantities of water, either when wearied with labour, or weakened by some kinds of diseases. Dr. Fothergill relates an instance of a person who being advised to drink plentifully of barley-water, in order to remove a fever, rashly drank 12 pounds of that liquor every day for a month, and thus fell into an almost incurable distemper. But if this quantity had been taken only during the prevalence of the fever, he would, in all probability, have suffered no inconvenience.

The remote causes of dropsy are many and various. Whatever relaxes the solids in such a manner as to give an occasion of accumulation to the ferous fluids, disposes to the dropsy. A lazy indolent life, rainy wet weather, swampy or low soils, and every thing which conduces to vitiate the viscera, or insensibly to produce obstructions in them, paves the way for a dropsy. Hence those are ready to fall into the disease who use hard and viscid aliments, such as poor people in some countries who are fed with unwholesome

aliments; and the same thing happens to those who drink immoderately of spirituous liquors.

Prognosis. When the dropsy arises from a scirrhus of the liver or spleen, or any of the other viscera, the prognosis must always be fatal, as also when it arises from disorders of the lungs. Neither is the case more favourable to those in whom the small vessels are ruptured, and pour out their liquids into the cavity of the abdomen. Those certainly die who have polypi in the vessels, or tumours compressing the veins and vessels of the abdomen. A dropsy arising from obstructions in the mesenteric glands is likewise difficult to cure, whether such obstruction arise from a bad habit of body, or from any other cause; but if we can by any means remove the disease of the glands, the dropsy easily ceases. But in those who fall into dropsy without any disease preceding, it is not quite so dangerous; and even though a disease hath preceded, if the patient's strength is not greatly weakened, if the respiration is free, and the person is not affected with any particular pain, we may entertain great hopes of a cure. But where a great loss of blood is followed by a fever, and that by a dropsy, the patients almost always die, and that in a short time; but they are very frequently cured who fall into this disease without any preceding hæmorrhage.

Cure. In the cure of this disease authors chiefly mention two indications: 1. To expel the superfluous quantity of water; and, 2. To prevent its being again collected. But therefore we proceed to speak of the remedies, it is necessary to take notice, that by the animal economy, if a great evacuation of a fluid takes place in any part of the body, all the other fluids in the body are directed towards that part, and those which lie as it were lurking in different parts will be immediately absorbed, and thrown out by the same passage. Hence the humours which in hydropic persons are extravasated into the different cavities of the body will be thrown into the intestines, and evacuated by purgatives; or by diuretics will be thrown into the kidneys, and evacuated by urine. It is not, however, only necessary to excite these evacuations in order to remove this malady, but they must be assiduously promoted and kept up till the abundant humour is totally expelled. For this reason Sydenham has advised purgatives to be administered every day, unless, either through the too great weakness of the body, or the violent operation of the purgative, it shall be necessary to interpose a day or two now and then; because if any considerable intervals are allowed to take place between the exhibition of the purgatives, an opportunity is given to the waters of collecting again. In this method, however, there is the following inconvenience, that when the waters are totally evacuated, the strength is at the same time so much exhausted, that the distemper commonly returns in a very short time. Hence almost our only hopes of curing a dropsy, consist in gently evacuating the waters by means of diuretics. But the efficacy of these is generally very doubtful. Dr. Friend hath long ago observed, that this part of medicine is of all others the most lame and imperfect; but a certain French physician, named Bacher, lately found a method of making the diuretics much more successful. His reputation becomes at last so great, that the French king thought proper to purchase his secret for a great sum of money. The basis of his medicine was hellebore-root, the malignant qualities of which he pretended to correct.

But though Bacher was firmly of opinion that his pills cured the dropsy by reason of the correction: yet it is certain, that, in the hands of other practitioners, his pills have failed. It is also certain that different medicines will prove equally efficacious in dropsical cases, provided a regimen is made use of.

For a great number of ages it hath been recommended to dropsical patients to abstain as much as possible from drink, and thus to the torments of their disease was added that of an intolerable thirst; and how great this torment was, we may understand from an example of a friend of king Antigonus, who, having been closely watched both by order of the physicians and also of the king, was so unable to bear the raging thirst occasioned by his disease that he swallowed his own excrements and urine, and thus speedily put an end to his life. Dr. Milman shews at great length the pernicious tendency of this practice. He maintains that it is quite contrary to the sentiments of Hippocrates and the best ancient physicians. He asserts, that unless plenty of diluting drink be given, the best diuretics can have no effect. He condemns also in the strongest terms the practice of giving dropsical patients only dry, hard, and indigestible aliments. These would oppress the stomach even of the most healthy, and how much more must they do so to those who are already debilitated by labouring under a tedious disorder? By what means also are these aliments to be dissolved in the stomach, when drink is withheld? In this disease the saliva is viscid, and in small quantity; from whence it may be reasonably conjectured, that the rest of the fluids are of the same nature, and the gastric juices likewise depraved. Thus the aliments lie long in the stomach; and if the viscera were formerly free of obstructions, they are now generated; the strength fails; perspiration and other excretions are obstructed; the viscid and pituitous humours produced by these kinds of food float about the præcordia, and increase the disease, while the surface of the body becomes quite dry. Nay, so much does this kind of diet conspire with the disease, that 1000 pounds of fluid will sometimes be imbibed in a few days by hydropic

M E D I C I N E.

pic persons who take no drink. Even in health, if the body from any cause becomes dry, or deprived of a considerable part of its juices, as by hunger, labour, &c. it will imbibe a considerable quantity of moisture from the air; so that we must impute the above-mentioned extraordinary inhalation, in part at least, to the denial of drink, and to the nature of the aliment given to the sick. The following is the method, related by Dr. Milman, of his practice in the Middlesex hospital.

If the patient is not very much debilitated, he is sometimes treated with the purging waters, and a dose of jalap and calomel alternately. On the intermediate days he gets a saline mixture, with 40 or 60 drops of *acetum scititicum* every sixth hour; drinking with the purgatives oat-gruel and some thin broths. That he might the better ascertain what share the liquids given along with the medicines had in producing a copious flow of urine, he sometimes gave the medicines in the beginning of the distemper without allowing the drink: but though the swellings were usually diminished a little by the purgatives, the urine still continued scanty, and the patients were greatly weakened. Fearing, therefore, lest, by following this course, the strength of the sick might be too much reduced, he then began his course of diuretic medicines, giving large quantities of barley-water with a little *sal diureticus*; by which means, sometimes in the short space of 48 hours after the course was begun, the urine flowed out in a very large quantity: but as saline drinks are very disagreeable to the taste, a drink was composed purposely for hydropic persons, of half an ounce of cream of tartar dissolved in two pounds of barley-water, made agreeably sweet with syrup, adding one or two ounces of French brandy.

To this composition Dr. Milman was induced by the great praises given to cream of tartar by some physicians in hydropic cases. In the *Acta Bononiensia*, 15 cases of hydropic patients are narrated who were cured only by taking half an ounce of cream of tartar daily. But it is remarkable, that by these very patients the cream of tartar was taken for 20, 30, nay 40 days, often without any perceptible effect; yet when dissolved in a large quantity of water, it shewed its salutary effects frequently within as many hours, by producing a plentiful flow of urine. This liquor is now the common drink of hydropic patients in the hospital above-mentioned, of which they drink at pleasure along with their medicines.

Among purgative medicines Dr. Milman recommends the *radix seneka*; but says, when the decoction of it is too strong, he always found it excite vomiting, and thus greatly to distress the patients: but when only half an ounce or six drachms of the root are used to a pound of decoction, instead of a whole ounce, he found it an excellent remedy.

The water having been drawn off, we are to put the patient on a course of strengtheners; such as the cortex and filings of iron, with some of the warm aromatics, and a due proportion of rhubarb infused in wine. Enjoin brisk exercise and frictions on the belly, with such a course of diet as shall be light and nourishing.

When the patient can by no other means be relieved, the operation of paracentesis must be had recourse to.

ORDER III. IMPETIGINES; *Cachexies deforming the Skin and external Parts of the Body.*

GENUS LVIII. SCROFULA, or KING'S-EVIL.

Description. This disease shews itself by hard, scirrhus, and often indolent tumours, which arise by degrees in the glands of the neck, under the chin, arm-pits, and different parts of the body; but most commonly in the neck, and behind the ears. In process of time, the cellular substance, ligaments of the joints, and even the bones themselves, are affected. In scrofula the swellings are much more moveable than those of the scirrhus kind; they are generally softer, and seldom attended with much pain; they are tedious in coming to suppuration; are apt to disappear suddenly, and again to rise in some other part of the body. We may likewise mention, as characteristic circumstances of this disease, a remarkable softness of the skin, a kind of fulness of the face, generally with large eyes, and a very delicate complexion.

Causes. A variety of causes have been mentioned as tending to produce scrofula, viz. a crude indigestible food; bad water, living in damp low situations; its being an hereditary disease, and in some countries endemic, &c. But whatever may in different circumstances be the exciting or predisposing causes of the scrofula, the disease itself either depends upon, or is at least much connected with, a debility of the constitution in general, and probably of the lymphatic system in particular, the complaint always shewing itself by some affections of the latter: and that debility has at least a considerable influence on its production, is probable, not only from the manifest nature of some of the causes said to be productive of scrofula, but likewise from such remedies as are found most serviceable in the cure, which are all of a tonic invigorating nature.

Prognosis. The scrofula is a distemper which often eludes the most powerful medicines, and therefore physicians cannot, with any certainty, promise a cure. It is seldom, however, that it proves mortal in a short time, unless it attacks the internal parts, such as the lungs, where it frequently produces tubercles that bring on a fatal consumption. When it attacks the joints, it frequently produces ulcers, which continue for a long time, and gradually waste the patient; while, in the mean time, the bones become foul and

corroded, and death ensues after a long scene of misery. The prognosis in this respect must be regulated entirely by the nature of the symptoms.

Cure. It was long supposed, that scrofula depended upon an acid acrimony of the fluids: and this, it is probable, gave rise to the use of burnt sponge, different kinds of soap, and other alkaline substances, as the best remedies for acidity. But although a soreness of the stomach and *prima via* does, no doubt, frequently occur in these complaints, yet it seems to be entirely the consequence of the general relaxation which in scrofula so universally prevails, and which does not render it in the least necessary to suppose a general acceffion of the fluids to take place; as the one very frequently, it is well known, even in other complaints, occurs without the least suspicion of any acid acrimony existing. This is also rendered very probable from the indolent nature of scrofulous tumours, which have been known to subsist for years, without giving any uneasiness; which could not have been the case if an acid, or any other acrimony, had prevailed in them.

Gentle mercurials are sometimes of use as resolvents in scrofulous swellings; but nothing has such considerable influence as a frequent and copious use of Peruvian-bark. Cold-bathing too, especially in the sea, together with frequent moderate exercise, is often of singular service here; as is likewise change of air, especially to a warm climate.

In the scrofulous inflammation of the eyes, or ophthalmia strumosa, the bark has also been given with extraordinary advantage: and we meet with an instance of its having cured the gutta serena in the face; a complaint which is so often difficult to remove, and is extremely disagreeable to the fair sex. From the various cases related of tumified glands, it appears that when the habit is relaxed and the circulation weak, either from constitution or accident, the bark is a most efficacious medicine, and that it acts as a resolvent and discutient. It will not, however, succeed in all cases; but there are few in which a trial can be attended with much detriment. Dr. Fothergill observes that he has never known it avail much where the bones are affected, nor where the scrofulous tumour is so situated as to be accompanied with much pain, as in the joints, or under the membranous coverings of the muscles; for when the disease attacks those parts, the periosteum seldom escapes without some injury, by which the bone will of course be likewise affected. Here the bark is of no effect; instead of lessening, it rather increases the fever that accompanies those circumstances; and, if it does not really aggravate the complaint, it seems at least to accelerate the progress of the disease.

Various are the modes in which the bark is administered; but Dr. Fothergill makes use of a decoction, with the addition of some aromatic ingredients and a small quantity of liquorice-root, as a form in which a sufficient quantity may be given without exciting disgust. The powder soon becomes disagreeable to very young patients; and the extract seems not so much to be depended upon as may have been imagined. In making the extract, it is exposed to so much heat as must have some effect upon its virtues, perhaps to their detriment. In administering it, likewise, if great care be not taken to mix it intimately with a proper vehicle, or some very soluble substance, in weak bowels it very often purges, and thereby not only disappoints the physician, but injures the patient. A small quantity of the *cortex Winteranus* added, gives the medicine a grateful warmth; and a little liquorice, a few raisins, gum-arabic or the like, added to the decoction before it is taken from the fire, by making the liquor viscid, enables it to suspend more of the fine particles of the bark; by which process the medicine is not only improved in efficacy, but at the same time rendered less disagreeable.

In indolent swellings of the glands from viscid humours, seawater also has been strongly recommended by Dr. Ruffel.

Dr. Fothergill also acquaints us, that the cicuta is not without a considerable share of efficacy in removing scrofulous disorders. He mentions the case of a gentlewoman, about 28 years of age, afflicted from her infancy with scrofulous complaints, severe ophthalmies, glandular swellings, &c. cured by the *extractum cicuta* taken constantly for the space of a year. He observes, however, that when given to children, even in very small doses, it is apt to produce spasmodic affections; for which reason he rarely exhibits it to them when very young, or even to adults of very irritable habits.

Our author gives several other instances of the success of cicuta in scrofulous cases, and even in one which seemed to be not far removed from a confirmed phthisis; but owns that it seldom had such good effects afterwards; yet he is of opinion that where there are symptoms of tubercles forming, a strumous habit, and a tendency to phthisis, the cicuta will often be serviceable. It is anodyne, corrects acrimony, and promotes the formation of good matter.

With regard to the quality of the medicine; our author observes, the extract prepared from hemloc before the plant arrives at maturity, is much inferior to that which is made when the hemloc has acquired its full vigour and is rather on the verge of decline; just when the flowers fade, the rudiments of the seeds become observable, and the habit of the plant inclines to yellow, seems the proper time to collect the hemloc. It has then had the full benefit of the summer-heat, and the plants that grow in exposed places will generally be found more vigorous than those that grow

M E D I C I N E.

grow in the shade. The less heat it undergoes during the preparation the better: therefore, if a considerable quantity of the dry powder of the plant, gathered at a proper season, is added, the less boiling will be necessary, and the medicine will be the more efficacious. But, let the extract be prepared in what manner soever it may, provided it is made from the genuine plant at a proper season, and is not destroyed by boiling, the chief difference observable in using it is that a larger quantity of one kind is required to produce a certain effect than of another. Twenty grains of one sort of extract have been found equal, in point of efficacy, to thirty, nay, near forty, of another; yet both of them made from the genuine plant, and, most probably, prepared with equal fidelity. To prevent the inconveniences arising from this uncertainty, it seems always expedient to begin with small doses, and proceed, step by step, till the extract produces certain effects, which seldom fail to arise from a full dose. These effects are different in different constitutions: but, for the most part, a giddiness affecting the head, and motions of the eyes, as if something pushed them outwards, are first felt; a slight sickness, and trembling agitation of the body; a laxative stool or two. One, or all of these symptoms are the marks of a full dose, let the quantity in weight be what it will. Here we must stop till none of these effects are felt; and, in three or four days, advance a few grains more. From general experience, all who have used this medicine to any good purpose, agree, that the cicuta seldom procures any benefit, though given for a long time, unless in as large a dose as the patient can bear, without suffering any of the inconveniences abovementioned.

Patients commonly bear a greater quantity of the extract at night than at noon, and at noon than in the morning. Two ounces may be divided into thirty pills, not gilt. Adults begin with two in the morning, two at noon, and three or four at night, with directions to increase each dose, by the addition of a pill to each, as they can bear it.

GENUS LIX. SYPHILIS, the LUES VENEREA, or French Pox.

Astruc, who wrote the history of the lues venerea, is fully convinced that it is a new disease, which never appeared in Europe till some time between the years 1494 and 1496, having been imported from America by the companions of Christopher Columbus; though this opinion is not without its opponents.

The venereal infection, however, cannot, like the contagious miasmata of the small-pox, and some other diseases, be carried through the air, and thus spread from place to place: for, unless it is transmitted from the parents to the children, there is no other way of contracting the disease but by actually touching some person who is affected. Thus, when a nurse happens to labour under the disease, the infant that she suckles will receive the infection; as, on the other hand, when the child is infected, the nurse is liable to receive it: and there have even been instances known of lying-in women being infected very violently, from having employed a person to draw their breasts who happened to have venereal ulcers in the throat. It may be caught by touching venereal sores, if the cuticle be abraded or torn; and in this way accoucheurs and midwives have sometimes been infected severely. Dr. Macbride says, the most inveterate pox he ever saw was caught by a midwife, who happened to have a whitlow on one of her fingers, when she delivered a woman ill of the lues venerea. But by far the most ready way of contracting this disease is by coition; the genital parts being much more bibulous than the rest of the body. When the disorder is communicated, the places where the morbid matter enters are generally those where it first makes its appearance; and as coition is the most usual way of contracting it, so the first symptoms usually appear on or near the pudenda.

The patient's own account will, for the most part, help us to distinguish the disease; but there are sometimes cases wherein we cannot avail ourselves of this information, and where, instead of confessing, the parties shall conceal all circumstances; while, on the other hand, there are now and then people to be met with, who persuade themselves that symptoms are venereal, which, in reality, are owing to some other cause: and, therefore, it is of the utmost importance to inform ourselves thoroughly of the nature of those symptoms and appearances which may be considered as pathognomic signs of lues venerea. In the first place, when we find that the local symptoms, such as chancres, buboes, phymosis, and the like, do not give way to the usual methods; or, when these complaints, after having been cured, break out again without a fresh infection; we may justly suspect that the virus has entered the whole mass of lymph; and if, at the same time, ulcers break out in the throat, and the face is deformed by callous tubercles covered with a brown or yellow scab, we may be assured that the case is now become a confirmed lues, which will require a mercurial course.

Venereal ulcers affecting the mouth are distinguishable from those which are scorbutic, in the following manner: 1. Venereal ulcers first affect the tonsils, fauces, and uvula; then the gums, but these very rarely: on the contrary, scorbutic ulcers affect the gums first of all; then the fauces, tonsils, and uvula. 2. Venereal ulcers frequently spread to the nose; scorbutic ones never. 3. Venereal ulcers are callous in the edges; scorbutic ones are not so. 4. Venereal ulcers are circumscribed, and, for the most part, are circular,

at least they are confined to certain places; scorbutic ones are of a more irregular form, spread wider, and frequently affect the whole mouth. 5. Venereal ulcers are for the most part hollow, and generally covered at the bottom with a white or yellow slough; but scorbutic ones are more apt to grow up into loose fungi. 6. Venereal ulcers are red in their circumference, but scorbutic ones are always livid. 7. Venereal ulcers frequently rot the subjacent bones, the scorbutic ones seldom or never; 8. and lastly, venereal ulcers are mostly combined with other symptoms which are known to be venereal; scorbutic ones with the distinguishing signs of scurvy, such as strait breathing, listlessness, swelling of the legs, rotten gums, &c.

Another sure sign of the confirmed lues are certain deep-seated nocturnal pains, particularly of the shins, arms, and head. As for any superficial wandering pains, that have no fixed seat, and which affect the membranes of the muscles and ligaments of the joints, they, for the most part, will be found to belong to the gout or rheumatism, and can never be considered as venereal, unless accompanied with some other evident signs: but with regard to the pains that are deeply seated, and always fixed to the same place, and which affect the middle and more solid part of the ulna, tibia, and bones of the cranium, and rage chiefly and with greatest violence in the fore-part of the night, so that the patient can get no rest till morning approaches, these may serve to convince us that the disease has spread itself throughout the whole habit, whether they be accompanied with other symptoms of the lues or not. *Gummata* in the fleshy parts, *nodes* in the periosteum, *ganglia* upon the tendons, *tophi* upon the ligaments, *exostoses* upon the bones, and *fici* at the verge of the anus, are all of them signs of the confirmed lues: these are hard indolent swellings; but as they sometimes arise independent of any venereal infection, and perhaps may proceed from a scrofulous taint, unless they are accompanied, or have been preceded, by some of the more certain and evident symptoms of the lues, we must be cautious about pronouncing them venereal. When these swellings are not owing to the syphilitic virus, they are very seldom painful, or tend to inflame and suppurate; whereas those that are venereal usually do, and if they lie upon a bone, generally bring on a caries.

These, then, are the principal and most evident signs of the confirmed lues. There are others which are more equivocal, and which, unless we can fairly trace them back to some that are more certain, cannot be held as signs of the venereal disease: such are, 1. Obstinate inflammations of the eyes, frequently returning with great heat, itching and ulceration of the eyelids. 2. A ringing and hissing noise in the ears, with ulcers or caries in the bones of the meatus auditorius. 3. Obstinate head-aches. 4. Obstinate cutaneous eruptions, of the itchy or leprous appearance, not yielding to the milder methods of treatment. 5. Swellings of the bones; and, 6. Wandering and obstinate pains. None of these symptoms, however, can be known to be venereal, except they happen to coincide with some one or other of the more certain signs. Upon the whole, we are first to distinguish and consider the several symptoms apart; and then, by comparing them with each other, a clear judgment may be formed upon the general review.

Prognosis. Being thoroughly convinced that the case is venereal, we are to consider, first of all, whether it be of a longer or shorter date; for the more recent it is, it will, *ceteris paribus*, be less difficult to remove. But there are other circumstances which will assist us in forming a prognostic as to the event. As,

1. The age of the patient. The disorder is more dangerous to infants and old people than to such as are in the flower and vigour of life, in whom some part of the virus may be expelled by exercise, or may be subdued, in some degree, by the strength of the constitution.

2. The sex. Though women are for the most part weaker than men, and, therefore, should seem less able to resist the force of any disease; yet experience shews, that this is easier borne by them than by men: which seems owing to the menstrual and other uterine discharges, by which, perhaps, a good share of the virus may be carried off immediately from the parts where it was first applied; for, it is observable, that whenever these discharges are obstructed, or cease by the ordinary course of nature, all the symptoms of this disease grow worse.

3. The habit of body. Persons who have acrid juices will be liable to suffer more from the venereal poison than such as have their blood in a milder state; hence, when people of a scorbutic or scrofulous habit contract venereal disorders, the symptoms are always remarkably violent, and difficult to cure: and, for the same reasons, the confirmed lues is much more to be dreaded in a person already inclined to an asthma, phthisis, dropsy, gout, or any other chronic distemper, than in one of a sound and healthy constitution: for, as the original disease is increased by the accession of the venereal poison, so the lues is aggravated by being joined to an old disorder. The more numerous the symptoms, and the more they affect the bones, the more difficult the cure; but if the acrimony should seize on the nobler internal parts, such as the brain, the lungs, or the liver, then the disease becomes incurable, and the patient will either go off suddenly in an apoplectic fit, or sink under a consumption.

Cure. Some practitioners have affirmed, that the disease may be totally extirpated without the use of mercury: but, excepting in

MEDICINE.

slight cases, it appears from the most accurate observations that this grand specific is indispensable; whether it be introduced through the pores of the skin, in the form of ointments, plasters, washes, &c. or given by the mouth, disguised in the different shapes of pills, troches, powders, or solutions.

Formerly it was held as a rule, that a salivation ought to be raised, and a great discharge excited. But this is now found to be unnecessary; for, as mercury acts by some specific power in subduing and correcting the venereal virus, all that is required is to throw in a sufficient quantity of the medicine for this purpose; and if it can be diverted from the salivary glands, so much the better, since the inconveniences attending a spitting are such as we should always wish to avoid.

Mercury, when combined with any saline substance, has its activity prodigiously increased; hence the great variety of chymical preparations, which have been contrived to unite it with different acids.

Corrosive sublimate is one of the most active of all the mercurial preparations, inasmuch as to become a poison even in very small doses. It therefore cannot be given in substance; but must be dissolved, in order to render it capable of a more minute division. We may see, by looking into Wiseman, that this is an old medicine, though seldom given by regular practitioners. How it came to be introduced into so remote a part of the world as Siberia, is not easily found out; but Dr. Clerc, author of the *Histoire Naturelle de l'Homme Malade*, assures us, that the sublimate solution has been of use there time out of mind. It appears to have been totally forgotten in other places, until of late years, when the Baron Van Swieten brought it into vogue; so that now, if we credit Dr. Locker, they use no other mercurial preparation at Vienna. The number of patients cured by this remedy alone in the hospital of St. Mark, which was under the care of that gentleman, from 1754 to 1761 inclusive, being 4880.

The way to prepare the solution is, to dissolve as much sublimate in any kind of ardent spirit (at Vienna they use only corn-brandy) as will give half a grain to an ounce of solution. The dose to a grown person is one spoonful mixed with a pint of any light ptisan or barley water, and this to be taken morning and evening: the patients should keep mostly in a warm chamber, and lie in bed to sweat after taking the medicine: their diet should be light: and they ought to drink plentifully throughout the day, of whey, ptisan, or barley water. If the solution does not keep the belly open, a mild purge must be given from time to time; for Locker observes, that those whom it purges two or three times a day, get well sooner than those whom it does not purge: he also says, that it very seldom affects the mouth, but that it promotes the urinary and cutaneous discharges. This course is not only to be continued till all the symptoms disappear, but for some weeks longer. The shortest time in which Locker used to let the patients out, was six weeks; and they were continued on a course of decoction of the woods for some weeks after they left off the solution.

This method has been introduced both in Britain and Ireland, though by no means to the exclusion of others; but it appears, that the solution does not turn out so infallible a remedy, either in these kingdoms, or in France, as they say it has done in Germany. It was seldom ever found to perform a radical cure, and the frequent use of it proved in many cases highly prejudicial. It has therefore been succeeded in practice by a remedy first recommended by Dr. Plenck, and since improved by Dr. Saunders; consisting of mercury united with mucilage of gum arabic, which is said to render its exhibition perfectly mild and safe. For particulars, we refer to Dr. Saunders's treatise. If it is determined to have recourse to the mercurial frictions, the patient must be prepared by going into the warm bath some days successively; having been previously bled if of a plethoric habit, and taking a dose or two of some proper cathartic. The patient being fitted with the necessary apparatus of flannels, is then to enter on the course. If the person be of a robust habit, and in the prime of life, we may begin with two drachms of the *unguentum caruleum fortius*, (Ph. Lond) which is to be rubbed in about the ankles by an assistant whose hands are covered with bladders: then having intermitted a day, we may expend two drachms more of the ointment, and rest for two days; after which, if no soreness of the mouth comes on, use only one drachm; and at every subsequent friction ascend till the ointment shall reach the trunk of the body; after which the rubbings are to be begun at the wrists, and from thence gradually extended to the shoulders. In order to prevent the mercury from laying too much hold of the mouth, it must be diverted to the skin, by keeping the patient in a constant perspiration from the warmth of the room, and by drinking plentifully of barley water, whey, or ptisan; but if, nevertheless, the mercury should tend to raise a spitting, then, from time to time, we are either to give some gentle cathartic, or order the patient into a vapour-bath: and thus we are to go on, rubbing in a drachm of the ointment every second, third, or fourth night, according as it may be found to operate; and on the intermediate days, either purging or bathing, unless we should choose to let the salivation come on; which, however, it is much better to avoid, as we shall thus be able to throw in a larger quantity of mercury.

It is impossible to ascertain the quantity of mercury that is

No. 104.

necessary to be rubbed in, as this will vary according to circumstances; but we are always to continue the frictions for a fortnight at least, after all symptoms of the disease shall have totally disappeared; and when we have done with the mercury, warm bathing, and sudorific decoctions of the woods, are to be continued for some time longer. Some venereal cases are so very obstinate as not to yield to mercury; and some of the particular symptoms will remain even after repeated courses, particularly the nodes and swellings of the periosteum. These are sometimes cured by a decoction of the roots of mezeiron, an ounce being boiled in a gallon of water down to two quarts; a pint of this decoction is to be consumed in the course of a day. Such other symptoms as are found to resist mercury, may perhaps be conquered by a long continuance of the decoction of sarsaparilla, aided by the warmth of a southern climate.

This is a general sketch of the methods of treatment for the confirmed lues; but for a complete history of the disease, and for ample directions in every situation, we refer to Astruc; and his abridger Dr. Chapman. We have to add, however, that a method of curing this disease by fumigation has been lately recommended in France: but it seems not to meet with great encouragement. The most recent proposal for the cure of the venereal disease is that of Mr. Clare, and consists in rubbing a small quantity of mercury on the inside of the cheek; by which means we not only avoid the inconveniences of unction, but also the purgative effects that are often produced by this medicine when taken into the stomach.

GENUS LX. SCORBUTUS, the SCURVY.

Description. The first indication of the scorbutic diathesis, is generally a change of colour in the face, from the natural and healthy look to a pale and bloated complexion, with a listlessness, and aversion to every sort of exercise; the gums soon after become itchy, swell, and are apt to bleed on the lightest touch; the breath grows offensive; and the gums swelling daily more and more, turn livid, and at length become extremely fungous and putrid, as being continually in contact with the external air; which in every case favours the putrefaction of substances disposed to run into that state, and is indeed absolutely requisite for the production of actual rottenness. But what is very remarkable in this disease, notwithstanding the various and immense load of distress under which the patients labour, there is no sickness at the stomach, the appetite keeps up, and the senses remain entire almost to the very last; when lying at rest, they make no complaints, and feel little distress or pain; but the moment they attempt to rise, or stir themselves, then the breathing becomes difficult, with a kind of straitness or catching, and great oppression, and sometimes they have been known to fall into a syncope. This catching of breath upon motion, with the loss of strength, dejection of spirit, and rotten gums, are held as the essential or distinguishing symptoms of the disease. The skin is generally dry, except in the very last stage, when the patients become exceedingly subject to faintings, and then it grows clammy and moist; in some it has an asnerine appearance; but much oftener it is smooth and shining; and, when examined, is found spread over with spots not rising above the surface, of a reddish, bluish, livid, or purple colour, with a sort of yellow rim round them. At first these spots are for the most part small, but in time they increase to large blotches. The legs and thighs are the places where they are mostly seen; more rarely on the head and face. Many have a swelling of the legs, which is harder, and retains the impression of the finger longer than the common dropical or truly cedematous swellings. The slightest wounds and bruises, in scorbutic habits, degenerate into foul and untoward ulcers. And the appearance of these ulcers is so singular and uniform, that they are easily distinguished from all others. Scorbutic ulcers afford no good digestion, but a thin and fetid ichor mixed with blood, which at length has the appearance of a coagulated gore lying caked on the surface of the fore, not to be separated or wiped off without some difficulty. The flesh underneath these sloughs feels to the probe soft and spongy, and is very purid. Neither detergents, or escharotics, are here of any service; for though such sloughs be with great pains taken away, they are found again at the next dressing, where the same sanguinous putrid appearance always presents itself. Their edges are generally of a livid colour, and puffed up with excrecences of proud flesh arising from below the skin. As the violence of the disease increases, the ulcers shoot out a soft bloody fungus, which often rises in a night's time to a monstrous size; and although destroyed by cauteries, actual or potential, or cut away with the knife, is found at next dressing as large as ever. It is a good while, however, before these ulcers, bad as they are, come to affect the bones with rottenness. These appearances will always serve to assure us that an ulcer is scorbutic; and should put us on our guard with respect to the giving mercurials, which are the most pernicious things that can be administered in these cases.

The pulse is variable; but most commonly slower and more feeble than in the time of perfect health. A stiffness in the tendons and weakness in the joints of the knees, appear early in the disease; but as it grows more inveterate, the patients generally lose the use of their limbs altogether; having a contraction of the flexor-tendons in the ham, with a swelling and pain in the joint of the knee.

MEDICINE.

Some have their legs monstrously swelled, and covered over with livid spots or ecchymoses; others have had tumours there; some, though without swelling, have the calves of the legs and the flesh of the thighs quite indurated. As persons far gone in the scurvy are apt to faint, and even expire, on being moved and brought out into the fresh air, the utmost care and circumspection are requisite when it is necessary to stir or remove them.

Scorbutic patients are at all times, but more especially as the disease advances, extremely subject to profuse bleedings from different parts of the body; as from the nose, gums, intestines, lungs, &c: and from their ulcers, which generally bleed plentifully if the fungus be cut away. It is not easy to conceive a more dismal and diversified scene of misery than what is beheld in the third and last stage of this distemper; it being then that the anomalous and more extraordinary symptoms appear, such as the bursting out of old wounds, and the dissolution of old fractures that have been long united.

Causes. The term *scurvy* hath been indiscriminately applied, even by physicians, to almost all the different kinds of cutaneous foulness; owing to some writers of the last century, who comprehended such a variety of symptoms under this denomination, that there are few chronic distempers which may not be so called, according to their scheme; but the disease here meant is the true putrid scurvy, so often fatal to seamen, and to people pent up in garrisons without sufficient supplies of sound animal food, and fresh vegetables: or which is sometimes known to be endemic in certain countries, where the nature of the soil, the general state of the atmosphere, and the common course of diet, all combine in producing that singular species of corruption in the mass of blood, which constitutes this disease; for the appearances, on dissecting scorbutic subjects, sufficiently shew that the scurvy may, with great propriety, be termed a disease of the blood.

Dr. Lind has, in a postscript to the third edition of his treatise on the scurvy, given the result of his observations drawn from the dissection of a considerable number of victims to this fatal malady, from which it appears that the true scorbutic state, in an advanced stage of the distemper, consists in numerous effusions of blood into the cellular interstices of most parts of the body, superficial as well as internal; particularly the gums, and the legs; the texture of the former, being almost entirely cellular, (and these cells naturally occupied by pure blood) and the generally dependent state of the latter, rendering these parts, of all others in the whole body, the most apt to receive, and retain the stagnant blood, when its crisis comes to be destroyed, and it loses that glutinous quality which, during health, hinders it from escaping through the pores in the coats of the blood-vessels.

A dropical indispotion, especially in the legs and breast, was frequently, but not always, observed in the subjects that were opened, and the pericardium was sometimes found distended with water; the water, thus collected, was often so sharp as to shrivel the hands of the dissector; and in some instances, where the skin happened to be broken, it irritated and festered the wound.

The fleshy fibres were found so extremely lax and tender, and the bellies of the muscles in the legs and thighs so stuffed with the effused stagnating blood, that it was always difficult, and sometimes impossible, to raise or separate one muscle from another. He says, that the quantity of this effused blood was amazing; in some bodies it seemed that almost a fourth part of the whole mass had escaped from the vessels; and it often lay in large concretions on the pericardium, and in some few instances under this membrane, immediately on the bone. And yet, notwithstanding this dissolved and depraved state of the external fleshy parts, the brain always appeared perfectly sound, and the viscera of the abdomen, as well as those in the thorax, were, in general, found quite uncorrupted. There were spots indeed, from extravasated blood, observed on the mesentery, intestines, stomach, and omentum; but these spots were firm, and free from any mortified taint; and, more than once, an effusion of blood, as large as a hand's breadth, has been seen on the surface of the stomach; and what was remarkable, that very subject was not known while living to have made any complaint of sickness, pain, or any other disorder, in either stomach, or bowels. These circumstances, and appearances, with many other that are not here enumerated, all prove to a demonstration the putrescent state of the blood; and yet Dr. Lind takes no small pains to combat the idea of the scurvy's proceeding from animal putrefaction; a notion, which, according to him, "may, and hath misled physicians to propose and administer remedies for it altogether ineffectual."

He also, in the preface to his third edition, talks of the mischief done by an attachment to delusive theories; says, "it is not probable that a remedy for the scurvy will ever be discovered from a pre-conceived hypothesis, or by speculative men in the closet, who have never seen the disease, or who have seen at most only a few cases of it," and adds, "that though a few partial facts and observations may, for a little, flatter with hopes of greater success, yet more enlarged experience must ever evince the fallacy of all positive assertions in the healing art."

And hence we may understand how it may possibly happen that when persons are greatly weakened by some preceding disorder, and at the same time debarred the use of proper bodily exercise,

scorbutic diathesis should take place, even though they enjoy the advantages of pure air and wholesome diet. But these are solitary cases, and very rarely seen; for whenever the scurvy seizes numbers, it will be found to depend on a combination of the major part, or perhaps all, of the following circumstances.

1. A moist atmosphere, and more especially if cold be joined to this moisture.
2. Too long cessation from bodily exercise, whether it be from constraint, or a lazy slothful disposition.
3. Dejection of mind.
4. Neglect of cleanliness, and want of sufficient cloathing.
5. Want of wholesome drink, either of pure water, or fermented liquors.
- And 6. above all, the being obliged to live continually on salted meats, perhaps not well cured, without a due proportion of the milder farinaceous or mucilaginous vegetables, sufficient to correct the pernicious tendency of the salt, by supplying the bland oil and saccharine matter requisite for the purposes of nutrition.

Prevention and Cure. The scurvy may be prevented, by obviating and correcting those circumstances in respect of the non-naturals which were mentioned as contributing to the disease, and laid down as causes. It is therefore a duty highly incumbent on officers commanding at sea, or in garrisons, to use every possible precaution; and, in the first place, to correct the coldness and moisture of the atmosphere, by sufficient fires; in the next, to see that their men be lodged in dry, clean, and well ventilated births, or apartments; thirdly, to promote cheerfulness, and enjoin frequent exercise, which alone is of infinite use in preventing the scurvy; fourthly, to take care that the cloathing be proper, and cleanliness of person strictly observed; fifthly, to supply them with wholesome drink, either with pure water, or sound fermented liquors; and if spirits be allowed, to have them properly diluted with water, and sweetened with molasses or coarse sugar; and lastly, to order the salted meats to be sparingly used, or sometimes entirely abstained from; and, in their place, let the people live on different compositions of the dried vegetables, fresh meat and recent vegetables being introduced as often as they can possibly be procured.

A close attention to these matters will, in general, prevent the scurvy from making its appearance at all, and will always hinder it from spreading its influence far. But when these precautions have been neglected, or the circumstances such that they cannot be put in practice, and the disease hath actually taken place, our whole endeavour must be to restore the blood to its original state of soundness: and happily, such is the nature of this disease (which confirms the hypothesis that it is seated in the gross fluids, and particularly the blood), that if a sufficiency of new matter, of the truly mild nutritious sort, can be thrown into the circulation while the fleshy fibres retain any tolerable degree of firmness, the patient will recover; and that in a surprisingly short space of time, provided a pure air, comfortable lodgings, sufficient cloathing, cleanliness, and exercise, lend their necessary aid.

This being the case, the plan of treatment is to be conducted almost entirely in the dietetic way; as the change in the mass of blood, which is necessary to produce, must be brought about by things that can be received into the stomach by pints, or pounds, and not by those which are administered in drops or grains, drachms or ounces. For here, as the subtle fluids are not sensibly affected, and there is no disorder of the nervous system, we have no need of those active drugs, which are indispensably necessary in febrile or nervous diseases; the scorbutic diathesis being quite opposite to that which tends to produce a fever, or any species of spasmodic disorder; nay, Dr. Lind says, he has repeatedly found, that even the infection of an hospital fever is long resisted by a scorbutic habit.

It will now naturally occur to the reader, what those alimentary substances must be which bid the fairest to restore the blood to its healthy state; and he needs scarcely to be told, that they are of those kinds which the stomach can bear with pleasure though taken in large quantities, which abound in jelly or mucilage, and which allow these nutritious parts to be easily developed; for though the viscera in scorbutic patients may be all perfectly sound, yet we cannot expect, that either the digestive fluids, or organs, should possess the same degrees of power, which enable them, during health, to convert the crude dry farinacea, and the hard salted flesh of animals, into nourishment. We must therefore search for the *antiscorbutic* virtue in the tender sweet flesh of graminivorous animals; in new milks, and in the mucilaginous juices of recent vegetables; whether they be fruits, leaves or roots. And provided they be fresh, and succulent, and of such mildness as will permit them to be abundantly taken, it is of little importance whether they be sweet or sour, accecent or alkalescent; for such is the power of the alimentary fermentation, that by the time the chyle is ready to enter the lacteals, their native qualities are obliterated; and the oily saccharine matter which lay hid in the mucilage entirely extricated.

The four juices of lemons, oranges, and times, have been generally held as antiscorbutics in an eminent degree, and their power ascribed to their acid; from an idea that acids of all kinds are the only correctors of putrefaction. But the general current of practical observations shews, and our experiments confirm it, that the virtue of these juices (and, we presume, of every other that has been

MEDICINE.

been known to cure the scurvy) depends on their *aerial principle*, and consequently resides in the mucilage, whether it be sweet or sour; accordingly, while perfectly recent and in the mucilaginous state, and especially if mixed with wine and sugar, the juices of any of these fruits will be found a most grateful and powerful antiscorbutic.

But if the belly should not be loosened by the use of the fresh vegetables, nor the skin become soft and moist, then they must be assailed by stewed prunes, or a decoction of tamarinds with cream of tartar, in order to abate the costiveness; and by drinking a light decoction of the woods, and warm-bathing, in order to relax the pores of the skin; for nothing contributes more to the recovery of scorbutic patients than moderate sweating. We are always to be careful that scorbutic persons, after a long abstinence from greens and fruits, be not permitted to eat voraciously at first, lest they fall into a fatal dysentery.

All this, however, that has been laid down as necessary towards the cure, supposes the patients to be in situations where they can be plentifully furnished with all the requisites; but unhappily these things are not to be procured at sea, and often deficient in garrisons: therefore, in order that a remedy for the scurvy might never be wanting, Dr. Macbride, in the year 1762, first conceived the notion, that *infusion of malt*, commonly called *wort*, might be substituted for the common antiscorbutics, and it was accordingly tried.

More than three years elapsed, before any account arrived of the experiments having been made: at length, ten narratives of cases were received, wherein the wort had been tried, with very remarkable success; and this being judged a matter of much importance to the seafaring part of mankind, these were immediately communicated to the public in a pamphlet with the title of *An historical account of a new method of treating the scurvy at sea*.

This was in 1767; but since that time a considerable number of letters and medical journals, sufficient to make up a large volume, have been printed, particularly by the surgeons of his Majesty's ships that have been employed of late years for making discoveries in the southern hemisphere. Certain it is, that in many instances it has succeeded beyond expectation.

During Captain Cook's last voyage, the most remarkable in respect of the healthiness of the crew, that ever was performed, the wort is acknowledged to have been of singular use.

In a letter which this very celebrated and successful circumnavigator wrote to Sir John Pringle, he gives an account of the methods pursued for preserving the health of his people; and which were productive of such happy effects, that he performed "a voyage of three years, and 18 days, through all the climates from 52 deg. north to 71 deg. south, with a loss of one man only by disease, and who died of a complicated and lingering illness, without any mixture of scurvy. Two others were unfortunately drowned, and one killed by a fall; so that out of the whole number (118) with which he set out from England, he lost only four.

He says that much was owing to the extraordinary attention of the admiralty, in causing such articles to be put on board as either by experience or conjecture were judged to tend most to preserve the health of seamen; and with respect to the wort, he expresseth himself as follows.

"We had on board a large quantity of *malt*, of which was made *sweet wort*, and given not only to those men who had manifest symptoms of the scurvy, but to such also as were, from circumstances, judged to be most liable to that disorder) from one or two to three pints in the day to each man, or in such proportion as the surgeon thought necessary, which sometimes amounted to three quarts in the 24 hours: this is without doubt one of the best antiscorbutic sea-medicines yet found out; and, if given in time, will, with proper attention to other things, I am persuaded, prevent the scurvy from making any great progress for a considerable time: but I am not altogether of opinion that it will cure it, in an advanced state, at sea."

On this last point, however, the Captain and his Surgeon differ; for this gentleman positively asserts, and his journal (in Dr. Macbride's possession) confirms it, that the infusion of malt did effect a cure in a confirmed case, and at sea.

The malt, being thoroughly dried, and packed up in small casks, is carried to sea, where it will keep sound, in every variety of climate, for at least two years: when wanted for use it is to be ground in a hand-mill, and the infusion prepared from day to day by pouring three measures of boiling water on one of the ground malt; the mixture being well mashed, is left to infuse for 10 or 12 hours, and the clear infusion then strained off. The patients are to drink it in such quantities as may be deemed necessary, from one to three quarts in the course of 24 hours: a panada is also necessary to be made of it, by adding biscuit, and currants or raisins; and this palatable mess is used by way of solid food. This course of diet, like that of the recent vegetables, generally keeps the bowels sufficiently open; but in cases where costiveness nevertheless prevails, gentle laxatives must be interposed from time to time, together with diaphoretics, and the topical assistants, fomentations and gargles, as in the common way of management.

Captain Cook was also provided with a large stock of *sour*

kraut, (cabbage leaves cut small, fermented and stopped in the second stage of fermentation.) A pound of this was served to each man twice a-week, while they were at sea. He had also a liberal supply of *portable soup*; of which the men had generally an ounce three days in the week, boiled up with their pease; and sometimes it was served to them oftener: and when they could get fresh greens, it was boiled up with them, and made such an agreeable mess, that it was the means of making the people eat a greater quantity of greens than they would otherwise have done. And what was still of further advantage, they were furnished with sugar, in lieu of butter or oil, which is seldom of the sweetest sort; so that the crew were undoubtedly great gainers by the exchange.

In addition to all these advantages of being so well provided with every necessary, either in the way of diet or medicine, Captain Cook was remarkably attentive to all the circumstances respecting cleanliness, exercise, sufficient cloathing, provision of pure water, and purification of the air, in the cloister parts of the ship.

Newly brewed *Spruce-beer* (made from a decoction of the tops of the spruce fir, and molasses, is an excellent antiscorbutic; acts in the same way that the wort does, and will be found of equal efficacy, therefore may be substituted. But in situations where neither the one nor the other can be had, a most salutary mess may be prepared from oatmeal, by infusing it in water, in a wooden vessel, till it ferments, and begins to turn sourish; which generally happens, in moderately warm weather, in the space of two days. The liquor is then strained off from the grounds, and boiled down to the consistence of a jelly, which is to be eat with wine and sugar, or with butter and sugar.

GENUS LXI. ICTERUS, the JAUNDICE.

Description. The jaundice first shews itself by a listlessness and want of appetite, the patient becomes dull, oppressed, and generally collicive. These symptoms have continued but a very short time, when a yellow colour begins to diffuse itself over the *tunica albuginea*, or white part of the eye, and the nails of the fingers; the urine becomes high coloured, with the yellowish sediment capable of tinging linen; the stools are whitish or grey. In some there is a most violent pain in the epigastric region, which is considerably increased after meals. Sometimes the patient hath a continual propensity to sleep; but in others there is too great watchfulness and sometimes the pain is so great, that though the patient be sleepy he cannot compose himself to rest. The pains come by fits; and all the women who have had the jaundice and borne children, agree, that they are more violent than labour-pains. As the disease increases, the yellow colour becomes more and more deep; an itching is felt all over the skin; and even the internal membranes of the viscera, the bones, and the brain itself, become tinged, as hath been shewn from dissections, where the bones have been found tinged sometimes for years after the jaundice hath been cured.

In like manner all the secretions are affected with the yellow colour of the bile, which in this disease is diffused throughout the whole mass of fluids. The saliva becomes yellow and bitter: the urine excessively high coloured in such a manner as to appear almost black; nay, the blood itself is sometimes said to appear of a yellow colour when drawn from a vein; yet Dr. Heberden says that he never saw the milk altered in its colour, even in cases of very deep jaundice. In process of time the blood begins to acquire a tendency to dissolution and putrefaction; which is known by the patient's colour changing from a deep yellow to a black or dark yellow. Haemorrhages ensue from various parts of the body, and the patients frequently die of an apoplexy; though in some the disease degenerates into an incurable dropsy; and there have not been wanting instances of some who have died of the dropsy after the jaundice itself had been totally removed.

Causes. As the jaundice consists in a diffusion of the bile throughout the whole system, it thence follows, that whatever may favour this diffusion is also to be reckoned among the causes of jaundice. Many disputes have arisen concerning the manner in which the bile is resorbed into the blood; but it is now generally agreed that it is taken up by the lymphatics of the gall-bladder and biliary ducts. Hence, a jaundice may arise from any thing obstructing the passage of the bile into the duodenum, or from any thing which alters the state of the lymphatics in such a manner as to make them capable of absorbing the bile in its natural state. Hence the jaundice may arise from schirrh of the liver or other viscera pressing upon the biliary ducts, and obstructing the passage of the bile; from status distending the duodenum; and shutting up the entrance of the ductus communis choledochus into it; from the same orifice being plugged up by viscid bile, or other fordes; but by far the most frequent cause of jaundice is the formation of calculi. These are found of almost all sizes, from that of a small pea to that of a walnut, or bigger; are of different colours; and sometimes appear as if formed in the inward part by crystallization, but of lamellæ on the outer part; though sometimes the outward part is covered with rough and shining crystals, while the inward part is lamellated. These enter into the biliary ducts, and obstruct them, causing a jaundice, with violent pain for some time; and which can be cured by no means till the stone is either passed entirely through the ductus communis, or returned into the gall.

MEDICINE.

gall-bladder. Sometimes, in the opinion of many celebrated physicians, the jaundice is occasioned by spasmodic contractions of the biliary ducts; but this is denied by others, and it is not yet ascertained whether these ducts are capable of being affected by spasm or not, as the existence of muscular fibres in them hath not with certainty been discovered. It cannot, however, be denied that violent fits of passion have often produced jaundice, sometimes temporary, but frequently permanent. This hath been by some deemed a sufficient proof of the spasmodic contraction of the ducts; but their opponents suppose, that the agitation occasioned by the passion might push forward some biliary concretion into a narrow part of the duct, by which means a jaundice would certainly be produced, till the concretion was either driven backward or forward into the duodenum altogether.

In a very relaxed state of the body there is also an absorption of the bile, as in the yellow fever; and indeed in all putrid disorders there is a kind of yellowish taint over the skin, though much less than in the true jaundice. The reason of this is, that in these disorders there is usually an increased secretion of bile, commonly of a thinner consistence than in a healthy state, while the orifices of the lymphatics are probably enlarged, and thus ready to absorb a fluid somewhat thicker than what they ought to take up in a healthy state; but these disorders are of short duration in comparison with the real jaundice, which sometimes lasts for many years.

Prognosis. As jaundice may arise from many different causes, some of which cannot be discovered during the patient's life, the prognosis must on this account be very uncertain. The only cases which admit of a cure are those depending upon biliary concretions, or obstructions of the biliary ducts by viscid bile; for the stones are seldom of such a size but that the ducts will let them pass through, though frequently not without extreme pain. Indeed this pain, though so violent, and almost intolerable to the sick person, affords the best prognosis; as the physician may readily assure his patient, that there is a great hope of his being relieved from it. The coming on of a gentle diarrhoea attended with bilious stools, together with the cessation of pain, are signs of the disease being cured. We are not, however, always to conclude, because the disease is not attended with acute pain, that it is therefore incurable; for frequently the passage of a stone through the biliary ducts is accompanied only with a sensation of slight uneasiness.

Cure. When the jaundice arises from indurated swellings or schirrhi of the viscera, it is absolutely incurable; nevertheless, as these cannot always be discovered, the physician must proceed in every case of jaundice as if it arose from calculi. The indications here are, 1. To dissolve the concretions; and, 2. To prevent their formation a second time. But unhappily the medical art hath not yet afforded a solvent for biliary concretions. They cannot even be dissolved when taken out of the body either by acids or alkalies, or any thing besides a mixture of oil of turpentine and spirit of wine, and these substances are by far too irritating to be given in sufficient quantity to affect a concretion in the biliary ducts. Boerhaave observes, that diseases of the liver are much worse to cure than those in any other part of the body; because of the difficulty there is in getting at the part affected, and the tedious and roundabout passage the blood hath to it. The only method of cure now attempted in the jaundice is, to expel the calculus into the intestines; for which vomits and exercise are the principal medicines. The former are justly reckoned the most efficacious medicines, as they powerfully shake all the abdominal and thoracic viscera; and thus tend to dislodge any obstructing matter that may be contained in them. But if there be a tendency to inflammation, vomits must not be exhibited till bleeding has been premised. We must also proceed with caution if the pain is very sharp; for in all cases where the disease is attended with violent pain, it will be necessary to allay it by opiates before the exhibition of an emetic. There is also danger, that, by a continued use of vomits, a stone which is too large to pass, may be so impacted in the ducts, that it cannot even be returned into the gall-bladder, which would otherwise have happened. In all cases therefore, if no relief follows the exhibition of the second or third dose, it will be prudent to forbear their farther use for some time.

Of all kinds of exercise, that of riding on horseback, is most to be depended upon in this disease. It operates in the same manner with vomits, namely, by the shake it gives to the viscera; and therefore the cautions necessary to be observed in the use of vomits are also necessary to be observed in the use of riding. Cathartics also may be of service, by cleansing the *prima via*, and soliciting a discharge of a bile into the intestines; but they must not be of too drastic a nature, or they may produce incurable obstructions, by bringing forward stones that are too large to pass. Anodynes, the warm bath, and saponaceous medicines, are serviceable by their relaxing quality. Soap hath been supposed to do service as a solvent; but this is now found to be a mistake, and it acts in no other way than as a relaxant.

But when all means of relief fail, as in cases of schirrhus, we can then only attempt to palliate the symptoms, and preserve the patient's life as long as possible. This is best accomplished by diuretics; for thus a great quantity of bilious matter is evacuated, and the system is freed from the bad consequences which ensue on its stagnation in the habit. But even this is by no means equal

to the common evacuation by stool; nor can all the attempts to supply the want of bile in the intestines, by bitters and other stomachics, restore the patient to his wonted appetite and vigour. If the pain be very violent, we must on all occasions have recourse to opiates, or if the blood hath acquired a tendency to dissolution, it must be counteracted by proper antiseptics.

If the disease goes off, its return must be prevented by a course of tonic medicines, particularly the Peruvian bark and antiseptics.

In the East-Indies, mercury hath been lately recommended as exceedingly efficacious in disorders of the liver, especially those which follow intermitting and remitting fevers. Dr. Monro, in his Observations on the means of preserving the health of soldiers, acquaints us, that he has seen some icteric cases which, he thought, received benefit from taking a few grains of *mercurius dulcis* at night, and a purge next morning; and this repeated two or three times a week.

CLASS IV. LOCALES.

An Affection of some Part, but not of the whole Body.

ORDER I. DYSÆSTHESIÆ.

The Senses depraved or destroyed from a Disease of the external Organs.

GENUS LXII. CALIGO, the CATARACT.

A *cataract* is an obstruction of the pupil, by the interposition of some opaque substance which either diminishes or totally extinguishes the sight. It is generally an opacity in the crystalline humour. In a recent or beginning *cataract*, the same medicines are to be used as in the *gutta serena*; and they will sometimes succeed. But when this does not happen, and the *cataract* becomes firm, it must be couched, or rather extracted; Dr. Buchan says he has resolved a recent *cataract* by giving the patient some purges with calomel, keeping a poultice of fresh hemlock constantly upon the eye, and a perpetual blister on the neck.

GENUS LXIII. AMAUROSIS, the GUTTA SERENA.

A *gutta serena* is an abolition of the sight without any apparent cause or fault in the eyes. When it is owing to a decay or wasting of the optic nerve, it does not admit of a cure; but when it proceeds from a compression of the nerves by redundant humours, these may in some measure be drained off, and the patient relieved. For this purpose, the body must be kept open with the laxative mercurial pills. If the patient be young, and of sanguine habit, he may be bled. Cupping with scarifications on the back part of the head will likewise be of use. A running at the nose may be promoted by volatile salts, stimulating powders, &c. But the most likely means of relieving the patient, are issues or blisters kept open for a long time on the back part of the head, behind the ears, or on the neck; which have been known to restore sight even after it had been for a considerable time lost. Should these fail, recourse must be had to a mercurial salivation; or, what will perhaps answer the purpose better, 12 grains of the corrosive sublimate of mercury may be dissolved in an English pint and a half of brandy, and a table-spoonful of it taken twice a-day, drinking half a pint of the decoction of sarsaparilla after it. Of late electricity hath been much celebrated as efficacious, when no other thing could do service.

GENUS LXIV. PARACUSIS, or Deprivation of HEARING.

The functions of the ear may be injured by wounds, ulcers, or any thing that hurts its fabric. The hearing may likewise be hurt by excessive noise; violent colds in the head; fevers; hard wax, or other substances sticking in the cavity of the ear; too great a degree of moisture or dryness of the ear. Deafness is very often the effect of old age, and is incident to most people in the decline of life. Sometimes it is owing to an original fault in the structure or formation of the ear itself. When this is the case it admits of no cure; and the unhappy person not only continues deaf, but generally likewise dumb for life.

When deafness is the effect of wounds, or ulcers of the ears, or of old age, it is not easily removed. When it proceeds from cold of the head, the patient must be careful to keep his head warm, especially in the night; he should likewise take some gentle purges, and keep his feet warm, and bathe them frequently in luke-warm water at bed-time. When deafness is the effect of a fever, it generally goes off after the patient recovers. If it proceeds from dry wax sticking in the ears, it may be softened by dropping oil into them; afterwards they must be syringed with warm milk and water.

If deafness proceeds from dryness of the ears, which may be known by looking into them, half an ounce of the oil of sweet almonds, and the same quantity of liquid opodeldoc, or tincture of *asafoetida*, may be mixed together, and a few drops of it put into the ear every night at bed-time, stopping them afterwards with a little wool, or cotton. Some, instead of oil, put a small slice of the fat of bacon into each ear, which is said to answer the purpose very well. When the ears abound with moisture, it may be drained off by an issue or seton, which should be made as near the affected part as possible.

Neither the eyes nor ears ought to be tampered with; they are tender organs, and require a very delicate touch. For this reason, what we would chiefly recommend in deafness, is to keep the head warm. From whatever cause the disorder proceeds, this is always proper; and more benefit has often been derived from it alone,

MEDICINE.

in the most obstinate cases of deafness, than from any medicines whatever.

GENUS LXV. ANOSMIA, or Defect of SMELLING.

Causes. The sense of smelling may be diminished or destroyed by diseases; as, the moisture, dryness, inflammation, or suppuration of that membrane which lines the insides of the nose, commonly called the *olfactory membrane*; the compression of the nerves which supply this membrane, or some fault in the brain itself at their origin. A defect, or too great a degree of solidity of the small spongy bones of the upper jaw, the caverns of the forehead, &c. may likewise impair the sense of smelling. It may also be injured by a collection of fetid matter in those caverns, which keeps constantly exhaling from them. Few things are more hurtful to the sense of smelling than taking great quantities of snuff.

Cure. When the nose abounds with moisture, after gentle evacuations, such things as tend to take off irritation and coagulate the thin sharp serum may be applied; as the oil of anise mixed with fine flour, camphire dissolved in oil of almonds, &c. The vapours of amber, frankincense, gum-mastic, and benjamin, may likewise be received into the nose and mouth. For moistening the mucus when it is too dry, some recommend snuff made of the leaves of marjoram, mixed with the oil of amber, marjoram, and aniseed; or a sternutatory of calcined white vitriol, 12 grains of which may be mixed with two ounces of marjoram-water and filtered. The steam or vapour of vinegar upon hot iron received up the nostrils is likewise of use for softening the mucus, opening obstructions, &c.

If there be reason to suspect that the nerves which supply the organs of smelling are inert or want stimulating; volatile salts strong snuffs, and other things which occasion sneezing, may be applied to the nose. The forehead may likewise be anointed with balsam of Peru, to which may be added a little of the oil of amber.

GENUS LXVI. AGEUSTIA, or Defect of TASTING.

Cause. The taste may be diminished by crusts, filth, mucus, aphæ, pellicles, warts, &c. covering the tongue: it may be depraved by a fault of the saliva, which being discharged into the mouth, gives the same sensation as if the food which the person takes had really a bad taste; or it may be entirely destroyed by injuries done to the nerves of the tongue and palate. Few things prove more hurtful either to the sense of tasting or smelling than obdurate colds, especially those which affect the head.

Cure. When the taste is diminished by filth, mucus, &c. the tongue ought to be scraped, and frequently washed with a mixture of water, vinegar, and honey, or some other detergent. When the saliva is vitiated, which seldom happens unless in fevers or other diseases, the curing of the disorder is the cure of this symptom. To relieve it however, in the mean time, the following things may be of use: if there be a bitter taste, it may be taken away by vomits, purges, and other things which evacuate bile: what is called a *stidorous taste*, arising from putrid humours, is corrected by the juice of citrons, oranges, and other acids: a salt taste is cured by plentiful dilution with watery liquors: an acid taste is destroyed by absorbents and alkaline salts, as powder of oyster-shells, salt of wormwood, &c.

When the sensibility of the nerves which supply the organs of taste is diminished, the chewing horse-radish, or other stimulating substances, will help to recover it.

ORDER II. APOCENOSES.

Flux of Blood or some other Humour more copious than usual.

GENUS LXVII. PROFUSIO, or FLUX of BLOOD.

For the treatment of this genus, see MENORRHAGIA, HÆMOPHTYSIS, &c.

GENUS LXVIII. EPIDROSIS, or Excessive SWEATING.

This is generally symptomatic; and occurs in almost all fevers, but especially in the latter stages of the hectic. Sometimes it is a primary disease, arising merely from weakness, and then easily admits of a cure by the use of the Peruvian bark, the cold bath, and other tonics.

GENUS LXIX. ENURESIS, an Involuntary FLUX of URINE.

This is a distemper which frequently affects children, otherwise healthy, when asleep; and is extremely disagreeable. Often it is merely the effect of laziness, and may be driven off by proper correction; but sometimes it proceeds from an atony or weakness of the sphincter of the bladder. Many ridiculous cures have been prescribed for it, among the rest field-mice dried and powdered. Tonics are frequently of use; but sometimes the distemper proves obstinate, in spite of every thing we can use. In the Medical Observations we find blisters greatly recommended in this disease, when applied to the region of the os sacrum. There are many cases in which the power of blisters in removing this distemper seems to exceed that of every other medicine whatever.

GENUS LXX. GONORRHOEA, or CLAP.

The gonorrhœa is a flux of viscid matter of various colours, from the urethra in men, and the vagina in women. It commonly proceeds from coition with a person infected with the venereal disease, and is the first symptom by which that disease usually shews itself.

Description. The first symptoms of the disease in man, are commonly a sensation at the end of the penis not unlike a flea-

bite, together with a fulness of the lips of the urethra, and some degree of tension in the penis, the urinary canal feeling as if tightened, and the urine flowing in a small and unequal stream: a little whitish mucus is to be seen about the orifice of the urethra, and oozing from it when slightly pressed, especially if the pressure is made on the spot where the soreness is most felt. The discharge soon increases in quantity, and varies in its colour according to the degree of inflammation. The patient feels a sensation of heat and pain in evacuating his urine, particularly at certain spots of the urethra, and above all towards its orifice; and the involuntary erections to which he is subject from the stimulus, particularly when warm in bed, occasion a distortion or curvature of the penis, attended with exquisite pain. When the inflammation is violent, the glands appear tumid and transparent, the tension extends through the whole of the penis, the perinæum is affected with swelling and redness, and even the loins, buttocks, and anus, sympathize and afford a very uneasy sensation. Sometimes the prepuce inflames about the end of the penis, and cannot be drawn back, occasioning what is called a *phymosis*; at others, as in the *paraphymosis*, it remains in an inflamed state below the glans, so that it cannot be drawn forwards; and if the stricture and inflammation are violent, may terminate in gangrene. Now and then, especially when there is a phymosis, we may perceive a hard chord extending along the back of the penis. This is an inflamed lymphatic, and may be considered as a prelude to a bubo.

In mild cases, the seat of the disease is in the urethra, not far from its orifice; but it frequently happens that the virus insinuates itself much higher up, so as to affect Cowper's glands, the prostate, and parts very near to the neck of the bladder.

In the generality of cases, the inflammation goes on increasing for several days, commonly for a week or a fortnight when medicines are taken; after which, the symptoms begin to abate; and the running, when left to itself, gradually lessens in quantity, and becomes whiter and thicker, till at length it totally stops. The colour of the mucus, however, is by no means a certain guide in these cases: for in many patients it is of a yellowish, and sometimes of a greenish hue to the very last; but in general it becomes more consistent towards the close of the disease.

In women, the parts of generation being fewer and more simple, the disease is less complicated than in men. Sometimes the vagina only is affected; and when this happens, the symptoms are very trifling; but in general it comes on with an itching and sensation of heat as in the other sex; and is attended with inflammation of the nymphæ, inside of the *labiæ*, *clitoris*, *caruncula myrtiformes*, the orifice and sometimes the whole of the *meatus urinarius*. Very often the deep-seated glands of the vagina are affected, and it is sometimes difficult to distinguish the discharge of a gonorrhœa from that of the fluor albus.

Causes, &c. Many ingenious arguments have of late been advanced to prove, that the gonorrhœa and the lues venerea are different affections, originating from two distinct species of virus; and this controversy still, perhaps, remains to be decided by future facts. Certain it is, that in 19 of 20 cases of gonorrhœa, no symptom whatever of syphilis appears; and that the disease readily admits of cure without having recourse to those remedies which are universally requisite for combating the contagion of syphilis. It is by no means wonderful, that in some cases both contagions, supposing them different, should be communicated at the same time. But as undeniable proof that the contagion in both cases is precisely the same, it has been alleged by some, that the matter of a chancre introduced into the urethra will generate a gonorrhœa, and that the discharge from a gonorrhœa will produce chancre, bubo, and every other symptom of syphilis. On the other hand, however, it is contended, that when experiments of this nature are conducted with the greatest accuracy, the matter of syphilis uniformly produces syphilis, and that of gonorrhœa, gonorrhœa only. Without pretending to decide on which of these experiments the greatest dependence is to be put, we may only observe, that while an almost inconceivably small portion of syphilitic matter applied to the glans penis, from connection with an infected female, infallibly produces syphilis if it be not speedily removed, the matter of gonorrhœa, in every instance of that disease, is applied to the whole surface of the glans penis for many days together without producing almost any bad effect whatever. From this, therefore, there is ground for inferring, either that it is not capable of being absorbed, or that if absorbed it is innocent.

But while there have been disputes with regard to the peculiar nature of the matter in gonorrhœa, there have also been controversies with respect to the source from whence it is derived. While some suppose it to be principally purulent matter arising from ulcerations, others assert that no such ulceration is ever produced in the urethra by gonorrhœa. They contend that the increased secretion in these cases is exactly similar to what happens in the catarrh. But the comparison will by no means hold good in every particular: in the latter the whole membrane of the nose is equally irritated; whereas in the gonorrhœa, only particular parts of the urethra seem to be affected. The disease, in the generality of cases, seldom extends more than an inch and a half

MEDICINE.

along that canal, and in many is confined (at least in the beginning) to a small spot about an inch from the extremity of the glans. The discharge is produced from that part of the urethra where the pain is felt; and the patient, when he voids his urine, feels no smarting till it reaches the inflamed spot: but as the disorder increases, the inflammation affects a greater number of points, just in the same manner as chancres affect different parts of the glans. It might be supposed that dissection would at once clear up this matter, and put an end to the dispute; but this is far from being the case. Dr. Simmons has seen several urethras opened in persons who had a gonorrhœa at the time of their death: in three of them the surface of the urethra, as in the cases related by Morgagni, appeared for some way down of a slight red colour, and in all of them was covered with mucus; but without any appearance of ulceration, except in two dissections at Paris, in which most of the gentlemen present were convinced that they saw evident marks of it: but Dr. Simmons says, that the appearances were to him not sufficiently satisfactory to enable him to decide with certainty on the subject. On the other hand, when we consider that the discharge in a gonorrhœa is sometimes tinged with blood, and that when this happens a little blood-vessel is no doubt ruptured, we can have no reason to doubt that an ulceration may, and sometimes does, happen in these cases; especially as we often observe an excoriation near the orifice of the urethra. It is certain, that wherever there is considerable inflammation, there will be danger of ulceration. Besides, from a neglected, or badly-treated gonorrhœa, we often see fistulas in *perinœo*, and other ulcers of the urethra, penetrating through its substance, and affording a passage to the urine. And there can be no doubt that slight ulcerations of this canan often occur, and are afterwards perfectly obliterated, in a similar manner to what happens in the papillæ of the tongue, the tonsils, &c. Such an obliteration will the more readily take place in a part like the urethra, defended with mucus, and not exposed to the air, which is known to have no little effect in hardening a cicatrix.

But whether ulcers take place or not, whether the virus of gonorrhœa be precisely of the same kind with that which gives syphilis, or of a different kind, there is reason from the phenomena of the disease to conclude, that the matter first acts by mixing with the mucus at the extremity of the urethra; and that from thence it is propagated upwards, particularly where the excretories of mucus are most numerous; and that on the parts to which it is applied, it operates as a peculiar irritating cause. The consequences of this irritation will be inflammation and an increased secretion of mucus; and so far the complaint will be local. In ninety-nine cases of an hundred a local affection of this kind constitutes the whole of the disease; and of this inflammation, ulcerations within the urethra, strictures, and other local affections, may be the consequence. But whether a disease of the habit ever takes place, unless when the contagion of syphilis is communicated with that of gonorrhœa, still remains to be determined by future observations and experiments.

Nothing can be more variable than the period at which the disease makes its appearance after infection. Perhaps, at a medium, we may place it between the 4th and 14th day; but in some cases it happens within 24 hours; and in others, not before the end of five or even six weeks: neither of these extremes, however, are common.

With the view of preventing gonorrhœa, some have advised, that the alkali either in its mild or caustic state, properly diluted with water, should be injected into the urethra; and there can be no doubt, that by this means the contagious matter, when it hath entered the urethra, may be removed. A removal may also be effected by the injection of a weak solution of corrosive sublimate, which seems to act not by dissolving the mucus but by producing an augmented secretion. That in some cases the disorder admits of a natural cure, there can be no doubt; the increased secretion of mucus carrying off the virus faster than it is formed, till at length the infection is wholly removed: But it is equally certain, that in every case, by the application of suitable remedies to the inflamed part, we may shorten the duration of the complaint, and abridge the sufferings of the patient, with the same certainty and safety as we are enabled to remove the effects of an ophthalmia or any other local inflammation, by proper topical applications.

Cure. From the foregoing description of the progress of the disease, it will easily be perceived that the chief curative indications are to subdue inflammation, and remove the virus that occasions it.

General remedies, such as occasional blood-letting, a cooling diet, the liberal use of diluting liquors, and mild purges, are by all allowed to be useful and even necessary.

The utility, and even the necessity of a cooling regimen are sufficiently obvious; wines and spirituous liquors, spices, a fish-diet, much animal food, and salted and high seasoned dishes of every sort, will constantly add to the complaint. The patient should eat meat only once a-day, and that sparingly. He should abstain from hot suppers. Milk, mild vegetables, and fruit should constitute the principal part of his diet while the inflammatory

symptoms continue. Every thing that tends to excite the venereal imagination should be studiously avoided; for whatever promotes erections of the penis will increase the inflammation, and of course add fuel to the disease. For the same reasons much walking or riding on horseback will be hurtful, from the irritation kept up in the perinæum by such means. Violent exercise of any kind, or any thing that is liable to increase the heat and momentum of the blood, will of course be improper.

The drinking freely of mild, cooling, mucilaginous liquors, such as linseed-tea, orgeat, whey, milk and water, almond emulsion, and the like, will be extremely useful, by diluting the urine, and preventing its salts from stimulating the urethra. When the heat and pain in making water are very considerable, mucilaginous substances are found to have the best effect, particularly the gum tragacanth. It is a common practice to give equal doses of this gum, or gum-arabic, and nitre, and to dissolve nitre in the patient's drink, with a view to lessen the inflammation. But in these cases nitre is always improper; it is known to be a powerful diuretic, its chief action being upon the urinary passages; so that the stimulus it occasions will only serve to increase the evil it is intended to alleviate. Cream of tartar, on account of its diuretic quality, will be equally improper. Our view here is not to promote a preternatural flow of urine; for the virus, being insoluble in water, cannot be washed away by such means: but our object ought to be, to render the urine that is secreted as mild and as little stimulating as possible.

Mild purges, which constitute another material part of the general remedies, are no doubt extremely useful when exhibited with prudence; but it is well known that the abuse of purgative medicines in this disease has been productive of numerous evils. Formerly it was a pretty general practice to give a large dose of calomel at bed-time, three or four times a week; and to work it off the next morning, with a strong dose of the *pilula coccie*, or some other drastic purge. This method was persevered in for several weeks; and as the constant effect of a violent drastic purge is to promote absorption from every cavity, the venereal virus was frequently carried into the system, and produced a confirmed lues; or, if the patient escaped this evil, he at least found himself troubled with an obstinate gleet, and, perhaps, his constitution materially injured: the effect of such a method being (especially in irritable habits) to weaken the stomach and bowels, and lay the foundation of hypochondriacal complaints. Violent purging likewise often occasions strangury, hernia humoralis, and other troublesome symptoms. Now that we are well acquainted with the doctrine of absorption, this absurd practice is very deservedly fallen into disrepute; for surely no man, who is conversant with anatomy, will, at this time of day, attempt to discharge the virus of a gonorrhœa by stool, when he knows that it must first be taken up by the lymphatics, and carried into the circulation; and yet, strange as it may seem, such is our attachment to old customs, that we still every now and then meet with cases in which this pernicious method has been adopted.

The topical remedies that are used consist chiefly of different sorts of injections, the ingredients of which are extremely various; but their modes of operation may in general be referred to their mucilaginous and sedative, or to their detergent, stimulating, and astringent qualities. In the hands of skilful practitioners, great advantages may doubtless be derived from the use of these remedies, but, on the other hand, the improper and unseasonable administration of them may prove a source of irreparable mischief to the patient.

We know that mucilaginous and oily injections will tend to allay the local inflammation; and that a sedative injection, such as a solution of opium, will lessen the irritability of the parts, and of course produce a similar effect; the utility of such applications is therefore sufficiently obvious.

A detergent injection, or one that will act upon the mucus of the urethra, increase the discharge of it, wash it away, and with it the venereal virus that is blended with it, can only be used as a prophylactic before the symptoms of infection have made their appearance. A solution of caustic, properly diluted, will answer this purpose. But great circumspection is necessary in the use of this kind of injection. If it be too weak, it can be of no efficacy; and if it be too strong, it may prove dangerous to the patient. A suppression of urine hath been brought on by the improper use of an injection of this kind. When the symptoms of inflammation have once made their appearance, the stimulus of such an injection must be extremely hazardous. Excoriation of the urethra has but too often been produced by remedies of this sort in the hands of adventurous and unskilful practitioners.

While the inflammation of the urethra continues, every thing that stimulates it must be hurtful. If the injection excites a painful sensation in the urethra, as is but too often the case, it will be liable to produce swelled testicles, difficulty in making water, excoriation, and other effects of increased inflammation: if by its astringency, the running is checked before the virus that excited the discharge is properly subdued, the patient will be exposed to all the dangers of a confirmed lues; and perhaps, to a variety of local complaints, such as obstructions in the urethra,

MEDICINE.

and abscesses in *perinaeo*, which are well known to be sometimes owing to applications of this sort improperly managed.

When the inflammation has subsided, gently stimulating and astringent injections may be used with safety, and with considerable advantage: for as the inflammation is at first excited by the stimulus of the venereal virus, so when the former begins to lessen we may be assured that the activity of the latter has abated in proportion; and, in general, when the inflammatory symptoms are entirely removed, it will be found that the mucus is no longer of an infectious nature, but is merely the effect of an increased secretion, and of relaxation. Mild astringents will therefore serve to brace and strengthen the vessels secreting mucus, and in this way will lessen the discharge, and greatly promote the cure. It is certain, that in the greater number of cases, a gonorrhœa, which if treated by internal remedies alone would continue for five or six weeks, or longer, may, when judiciously treated with injections, be cured in a fortnight, and very often in less time. The great aim, therefore, of the practitioner ought to be at first to make use of such injections only as will tend to lubricate the surface of the urethra, and to counteract and destroy the stimulus of the virus: as the inflammation abates, he may add some gently astringent preparation to a mucilaginous and sedative injection; taking care that its astringency be suited to the state of the disease, and to the irritability of the patient. Amongst a great variety of substances, mercury in different forms is one of those that is the most frequently employed in injections. All these mercurial injections have more or less of astringency; and, according to Dr. Simmons, it is solely to this property that we are to ascribe their effects; for the idea of their correcting the venereal virus was originally introduced, and has been continued upon mistaken principles.

Calomel, mixed with the mucus discharged in a gonorrhœa, has no more power in destroying the infectious properties of that mucus than cerusse or any other preparation would have. A diluted solution of sublimate injected into the urethra will, like a solution of verdigrise, or blue vitriol, or any other styptic, constringe the mouths of the lacunæ; but this is all that it will do, for it will never lessen the infectious nature of the virus. The same thing may be observed of crude mercury extinguished by means of mucilage, or of mercurial unktion, blended with the yolk of an egg, and which, when thrown up into the urethra, will act nearly in the same manner as balsam of copaiva, or any other stimulating injection. For the truth is, that mercury has no power over the venereal virus, until it has been introduced into the body, undergone certain changes, with which we are, and probably shall for ever remain, unacquainted. The local application of mercury can therefore have no other effects than what it derives from its stimulating and astringent properties: for the mercury not being absorbed in the urethra, of course cannot be carried into the system; and even if it could, the quantity that would be introduced in this way would be too minute to be of any efficacy. The stimulus of calomel, however, has often been found of considerable efficacy; and in women, when the vagina only was affected, after washing the parts well, the cure has been accomplished by rubbing them repeatedly with mercurial ointment.

As the gonorrhœa is often a local affection, it may be imagined, perhaps, that the internal use of mercury is unnecessary towards the cure. Very often indeed this complaint may be removed without having recourse to mercurials. Sometimes patients have been met with whose general health has been greatly impaired by a long continued use of mercury in such cases, while the original disease, the gonorrhœa, was rendered much worse by it. In some it degenerated into a gleet, that was cured with extreme difficulty, in others it brought on a variety of distressing symptoms. In cases of gonorrhœa, therefore, whenever mercury is administered, it ought not to be with a view to expedite the cure, but merely to obviate the dangers of absorption. When the infection is apparently slight, and the inflammation and the symptoms trifling, we may proceed without the assistance of mercury, especially if the patient is of a weak, relaxed, and irritable habit, likely to be injured by mercurial medicines. On the other hand, whenever the discharge is violent, the inflammation considerable, or the seat of the disease high upon the urethra, it is advisable to give mercurials in small doses, and in such forms as seem the best adapted to the constitution of the patient.

The following is the method of treatment recommended by Dr. Buchanan.

"To effect a cure astringent injections will generally be found necessary. These may be in various ways prepared; but I think those made with the white vitriol are both most safe and efficacious. They can be made stronger or weaker as circumstances may require; but it is best to begin with the most gentle, and increase their power, if necessary. I generally order a drachm of white vitriol to be dissolved in eight or nine ounces of common or rose water, and an ordinary syringe full of it to be thrown up three or four times a day. If this quantity does not perform a cure, it may be repeated, and the dose increased.

Although it is now very common to cure the gonorrhœa by astringent injections, there are still many practitioners, who do

not approve this mode of practice. I can, however, from much experience, assert, that it is both the most easy, elegant and efficacious method of cure; and that any bad consequences arising from it must be owing to the ignorance or misconduct of the practitioner himself; and not the remedy. Many, for example, use strong preparations of lead, all of which are dangerous when applied to the internal surface of the body; others use escharotics; which inflame and injure the parts. I have known a gonorrhœa actually cured by an injection made of green-tea, and would always recommend gentle methods where they will succeed.

When the pain and inflammation are seated high towards the neck of the bladder, it will be proper frequently to throw up an emollient clyster, which besides the benefit of procuring stools, will serve as a fomentation to the inflamed parts.

Soft poultices, when they can conveniently be applied to the parts are of great service. They may be made of the flour of linseed, or of wheat bread and milk, softened with fresh butter or sweet oil. When poultices cannot be conveniently used, cloths wrung out of warm water or bladders filled with warm milk and water, may be applied. I have often known the most excruciating pains during the inflammatory state of the gonorrhœa, relieved by one or other of these applications.

Few things tend more to keep off the inflammation in the spermatic vessels, than a proper truss for the scrotum. It ought to be so contrived as to support the testicles, and should be worn from the first appearance of disease till it has ceased some weeks.

The above treatment will sometimes remove the gonorrhœa so quickly, that the person will be in doubt whether he really laboured under that disease. This, however is too favourable a turn to be often expected. It more frequently happens, that we are able only to procure abatement or remission of the inflammatory symptoms, so far as to make it safe, to have recourse to the great antidote mercury.

Many people on the first appearance of a gonorrhœa fly to the use of mercury. This is a bad plan. Mercury is often not at all necessary in a gonorrhœa, and when taken too early, it does mischief. It may be necessary to complete the cure, but can never be proper at the commencement of it.

"When bleeding, purging, fomentations and the other things recommended, have eased the pain, softened the pulse, relieved the heat of the urine, and rendered the involuntary erections less frequent, the patient may begin to use mercury in any form that is least disagreeable to him." This plan of Dr. Buchan is now universally followed by the first practitioners.

The mercurial pill of the London Dispensatory, on account of the turpentine that enters into its composition, will sometimes pass through the body undissolved, and of course can then be of no use; but when the mercury is extinguished by means of honey, and made into pills, in the manner directed in the last edition of the Edinburgh pharmacopœia, it becomes as mild and perhaps as efficacious a preparation as any. Its efficacy will depend on its not irritating the bowels, and so passing off by stools; care must likewise be taken to prevent its affecting the mouth. Of the chymical preparations of mercury the mildest and least irritating is calomel. It may be given from gr. i. $\frac{1}{2}$. to gr. iii. at bed-time, occasionally interposing a mild purgative to prevent it from salivating; but in general the mercurial pill just mentioned is to be preferred.

When there is no chancre or bubo, no appearance, in short, that the infection is likely to be carried into the system, it would be improper to administer corrosive sublimate, the mercurius calcinatus, or any other of the more acrid preparations of mercury.

When there is no reason to suspect a venereal taint, astringent injections will be of the greatest service. It will be necessary, at the same time, to attend to the health of the patient, by giving the bark, chalybeate waters, cold bathing, and such other remedies as will tend to strengthen the system. When there is no tendency to inflammation, the balsam of copaiva, may be prescribed with advantage in large doses. Dr. Simmons says he once saw a complaint of this sort removed by applying a blister to the perinaem after it had resisted a variety of other remedies. In the Medical Observations also we have an account of the gleet and incontinence of urine removed at once by a blister to the os sacrum. In general, however, the other methods abovementioned will be sufficient to remove it, though sometimes it will continue for a long time in spite of all our endeavours to check it. Other kinds of gonorrhœa, in which the semen itself is ejected, especially during sleep, may be cured by tonics, and a mild cooling regimen.

ORDER III. EPISCHESES.

Suppression of Evacuations.

GENUS LXXI. OBSTIPATIO; COSTIVENESS.

Costiveness is sometimes occasioned by debility in dyspeptic persons, sometimes it is the effect of rigidity, and sometimes it is symptomatic of the colic. It may proceed from an excessive heat of the liver; drinking rough red wines, or other astringent liquors; too much exercise, especially on horseback: it may likewise proceed from a long use of cold insipid food, which does not sufficiently stimulate the intestines. Sometimes it is owing to the bile not descending to the intestines, as in the jaundice; and at other times, it proceeds from diseases of the intestines themselves, as a palsy, spasm, tumours, a cold dry state of the intestines, &c.

Excessive

MEDICINE.

Excessive coſtiveness is apt to occasion pains of the head, vomiting, colics, and other complaints of the bowels. It is peculiarly hurtful to hypochondriac and hyſteric perſons, as it generates wind and other grievous ſymptoms.

Perſons who are generally coſtive ſhould live upon a moiſtening and laxative diet; as roaſted or boiled apples, pears, ſewed prunes, raiſins gruels with currants, butter, honey, ſugar, and ſuch like. Broths with ſpinage, leeks, and other ſoft pot-herbs, are likewiſe proper. Rye-bread, or that which is made of a mixture of wheat and rye together, ought to be eat.

Coſtiveness is increaſed by keeping the body too warm, and by every thing that promotes the perſpiration; as wearing flannel, lying too long a-bed, &c.

The drink ſhould be of an opening quality. All ardent ſpirits, auſtere and aſtringent wines, as port, claret, &c. ought to be avoided. Malt-liquor that is fine and of a moderate ſtrength, is very proper. Butter-milk, whey, and other watery liquors, are likewiſe proper, and may be drank in turns, as the patient's inclination directs.

Thoſe who are troubled with coſtiveness ought, if poſſible, to remedy it by diet, as the conſtant uſe of medicines for that purpoſe is attended with many inconveniences, and often with bad conſequences. In time the cuſtom becomes neceſſary, and generally ends in a total relaxation of the bowels, indigeſtion, loſs of appetite, waſting of the ſtrength, and death.

The learned Dr. Arbuthnot adviſes thoſe who are troubled with coſtiveness to uſe animal-oils, as freſh butter, cream, marrow, fat broths, eſpecially thoſe made of the internal parts of animals, as the liver, heart, midriff, &c. He likewiſe recommends the expreſſed oils of mild vegetables, as olives, almonds, piſſaches, and the fruits themſelves; all oily and mild fruits, as figs; decoctions of mealy vegetables; theſe lubricate the inteſtines: ſome ſaponaceous ſubſtances which ſtimulate gently, as honey, hydromel, or boiled honey and water, unrefined ſugar, &c.

The doctor obſerves, that ſuch lenitive ſubſtances are proper for perſons of dry artabularian conſtitutions, who are ſubject to attrition of the belly and the piles, and will operate when ſtronger medicinal ſubſtances are ſometimes ineffectual; but that ſuch lenitive diet hurts thoſe whoſe bowels are weak and lax. He likewiſe obſerves, that all watery ſubſtances are lenitive; and that even common water, whey, ſour milk, and butter-milk, have that effect. That new milk, eſpecially aſſes milk, ſtimulates ſtill more when it ſours on the ſtomach; and that whey, turned ſour, will purge ſtrongly. That moſt garden-fruits are likewiſe laxative; and that ſome of them, as grapes, will throw ſuch as take them immoderately, into a cholera morbus, or incurable diarrhœa.

When the body cannot be kept open without medicine, gentle doſes of rhubarb may be taken twice or thrice a week. This is not near ſo injurious to the ſtomach as aloes, jalap, or the other draſtic purgatives, ſo much in uſe. Infuſions of ſenna and manna may likewiſe be taken, or half an ounce of ſoluble tartar diſſolved in water-gruel. About the ſize of a nutmeg of lenitive eleſtuary taken twice or thrice a day, generally answers the purpoſe very well.

GENUS LXXII. ISCHURIA; or SUPPRESSION of Urine.

This diſtemper is diſtinguiſhed into various ſpecies, according as the ſeat of it in the kidneys, the ureters, the bladder, or the urethra; and hence theſe ſpecies are named *renalis*, *ureterica*, *veſicalis*, and *urethralis*.

1. *Iſchuria renalis*, or a ſuppreſſion of urine from an affection of the kidneys, happens but rarely: however Dr. Home in his Clinical Experiment deſcribes the effects of it on a patient who was under his treatment, but died after all the probable means were uſed for his relief.

2. The *iſchuria ureterica* is alſo a rare diſeaſe, unleſs the obſtruction proceeds from a ſtone or a clot of blood ſtopping up the paſſage. Gravel or ſtones indeed, are very frequently formed in the kidneys; and, by falling into the ureters, occaſion an iſchuria, with violent pain, and ſymptoms more or leſs urgent in proportion to the ſize and ſhape of the ſtones. Sometimes it is attended with coldneſs of the extremities, nauſea and vomiting, and ſpaſtic conſtrictions of the præcordia, a difficulty of making water, conſtipation of the belly, difficulty of breathing, ſupor of the thigh, retraction of the teſticle to the *os pubis*, inquietude, loſs of ſtrength, ſyncope, and convulſion fits. When the violent pain has continued for ſeveral days and nights without intermiſſion, and has brought the patient exceeding low, and the ſuppreſſion of urine is complete, with coldneſs of the extremities and convulſions of the tendons, death is at hand. Nor is it a good ſign when the ſtone continues long in the ureter; for then the appetite decays, a nauſea and retching to vomit ſupervene, and the patient is conſumed with a hectic heat. Sometimes the pain is attended with an inflammation of the ſtomach and inteſtines; and ſometimes the diſeaſe ends in a dropſy of the breaſt, or lethargy, which ſoon carry off the patient.

The indications of cure are, to exclude the ſtone as eaſily as poſſible, and prevent the breeding of others. If the patient is of a ſanguineous temperament, Sydenham recommends to take away ten ounces of blood from the affected ſide; and then to give the patient a gallon of poſſet-drink in which two ounces of marſh-

mallow roots have been boiled, injecting at the ſame time an emollient clyſter. After the poſſet-drink has been vomited up, and the clyſter returned, give a pretty large doſe of an opiate. But if the patient is old or weak, or ſubject to the vapours, bleeding may be omitted, eſpecially if his urine at the beginning of the fit is coffee coloured and mixed with gravel; but as to other things, the cure is the ſame. Huxham greatly recommends an emollient bath prepared of a decoction of marſh-mallow root, linſeed, ſternugreek ſeed, and flowers of chamomile, to which may be added a few white-poppy ſeeds. By the uſe of this bath he ſays he has ſeen the moſt cruel fit of the gravel ſuddenly ended, when neither copious bleeding nor opiates had the leaſt effect. Mild diuretics are alſo of ſervice. Hoſſman recommends dulcified ſpirit of nitre as proper to relax the ſpaſtic ſtriſture. It is to be taken with ſuitable diſtilled waters, and ſyrup of poppies; or in broth, with a few ſpoonfuls of oil of ſweet almonds. Turpentine glyſters are alſo accounted very ſerviceable; and may be prepared of ten ounces of decoction of chamomile, with half an ounce of turpentine diſſolved in the yolk of an egg, with as much honey. The *ſal diureticum*, or *terra ſoliata tartari*, is much eſteemed by ſome, when taken along with an opiate. But when the ſtone is too big to paſs, Arbuthnot recommends a cool and diluent diet to hinder the further growth of it. Whey, linſeed, decoction of marſh-mallows, and gently reſolving diuretics, are alſo proper. To put a ſtop to the vomiting, *baſſamum traumaticum* may be uſed with ſucceſs when almoſt every other means have failed.

3. The *iſchuria veſicalis* may ariſe from a ſtone in the bladder; and this indeed is the moſt common cauſe of it; but there are certain caſes in which, though the uſual quantity of urine, or perhaps more, is paſſed, the patient dies from the retention of a ſtill greater quantity in the bladder. Of this Dr. Home gives the following inſtance.

A body being opened, it appeared that the tumour which was ſo diſtinctly felt in the left ſide of the abdomen, was owing to a diſtenſion of the bladder with urine. Its fundus reached to about the diviſion of the aorta into the ilia; it entirely filled the pelvis, and contained between five and ſix pounds of urine of a pale colour. On examining the external ſurface, its neck, and the beginning of the urethra, were found to be ſurrounded with a ſcirrhoty, which impeded the evacuation of the urine. The bladder itſelf was much thickened, but not more in one part than another. The ureters entered naturally; but were much thickened in their upper half near the kidney. The kidneys were ſomewhat enlarged; particularly the left, which had ſeveral watery veſicles on its external ſurface. The diſeaſe was miſtaken for an aſcites; and the catheter was not tried; but in another caſe the uſe of this inſtrument was apparently of more ſervice than any internal medicines.

GENUS LXXIII. DISURIA, or DIFFICULTY of MAKING WATER.

A difficulty of making water may ariſe from many different cauſes; as from ſome acrid matter in the blood; cantharides, for inſtance: and hence a ſtrangury very often ſucceeds the application of bliſters. In many caſes it ariſes from a compreſſion of ſome of the neighbouring parts; of the uterus, for inſtance, in a ſtate of pregnancy. Or it may ariſe from a ſpaſmodic affection of the bladder, or rather its ſphincter; or from an inflammation of theſe parts, or others near them. Hence the diſeaſe is diſtinguiſhed into ſo many ſpecies, the cure of which depends upon the remedies indicated by their different cauſes. But the moſt common as well as the moſt dangerous ſpecies is that ariſing from a calculous concretion, or

STONE in the BLADDER.

The ſigns of a ſtone in the bladder are, pain, eſpecially about the ſphincter; and bloody urine, in conſequence of riding or being jolted in a carriage; a ſenſe of weight in the *perinaum*; an itchineſs of the *glans penis*; ſlimy ſediment in the urine; and frequent ſtoppages in making water; a *teneſmus* alſo comes on while the urine is diſcharged: but the moſt certain ſign is, when the ſtone is felt by the finger introduced into the anus, or by the catheter.

Cauſes, &c. It is not eaſy to ſay what the particular cauſes are that occaſion the earthy particles of the fluids to run together, and from thoſe calculous concretions which are found in different parts of the body, and eſpecially in the organs for ſtraining off and diſcharging the urine.

The gout and ſtone are generally ſuppoſed to have ſome affinity, becauſe gouty people are for the moſt part afflicted with the gravel. But, perhaps, this is chiefly owing to their long confinement, and to the lying on the back, which people who labour under the gout are often obliged to ſubmit to; ſince the want of exerciſe, and this poſture, will naturally favour the ſtagnation of groſs matters in the kidneys: beſides, there are many inſtances of people ſeverely afflicted with the ſtone for the greateſt part of a long life, who have never had the leaſt attack of the gout.

Whatever may be the particular cauſe of the diſpoſition to *lithiaſis*, the kidneys appear to be the moſt likely places for the earthy particles to concrete or run together, becauſe of the great quantity of blood which paſſes through the renal arteries, and which

MEDICINE.

which comes immediately from the heart, fraught with various newly-received matters, that have not undergone much of the action of the vessels, and therefore cannot as yet be supposed to be thoroughly assimilated.

Anatomists who have carefully examined the kidneys in the human subject, particularly M. Bertin, informs us, that there are two sets of *tubuli uriniferi*; the one continued directly from the extremities of the renal artery, and the other springing from that vesicular texture which is conspicuous in the kidney.

It is in this vesicular part of the kidney that we presume the earthy particles first stagnate and coalesce: for it is hardly to be supposed, that such solid matters could be allowed to stop in the extremities of the renal arteries, since the blood, and the urine separated from it, must flow through these vessels with great degrees of force and velocity; but in the intermediate vesiculae the earthy particles may lie, and there attracting each other, soon come to acquire sensible degrees of magnitude, and thus become sand or gravel. As long as this sand or gravel formed in the vesicular part of the kidney lies quiet, there will be no pain or uneasiness, until the concretions become large enough to press either on the adjoining *tubuli*, or on the blood-vessels; then a sense of weight, and a kind of obtuse pain in the loins, will be felt. But when the small pieces of earthy matter shall be dislodged and washed off by the force of the circulating fluids, or loosened by some spasmodic actions of the motory fibres in these parts, they will in their passage create pain, raise different degrees of inflammation, or perhaps lacerate some blood-vessels, and cause bloody urine. When these little earthy concretions happen to be detained in the pelvis of the kidney, or any other place where a flow of urine continually passes, they soon increase in size, and become calculi, from the constant accession of earthy particles, which are attracted by the original bit of sand, which thus becomes the nucleus of a stone.

It is an opinion which Hippocrates first advanced, and which has been almost universally adopted by his followers, and hath remained till lately uncontroverted, that the stone and gravel are generated by the use of hard water. And from this quality, which the waters of certain springs possess of depositing a large earthy sediment, either in the aqueducts through which they are conveyed, or in the vessels in which they are boiled or preserved, it was obvious to infer, that in passing through the kidneys, and especially whilst retained in the bladder, they would let fall their grosser particles, which by the continued apposition of fresh matter, connected by the animal gluten, and compacted by the muscular action of that organ, would in time form a calculus, sufficiently large to produce a train of the most excruciating symptoms. And this reasoning *a priori* has been supposed to be confirmed by facts and experience, for not to mention the authority of Hippocrates, Dr. Lister has observed, that the inhabitants of Paris are peculiarly subject to the stone in the bladder. Nicholas de Blegny has related the history of one who was dissected at Paris, in whom the pylorus, a great part of the duodenum, and the stomach itself, were found incrustated with a stony matter, to the thickness of a finger's breadth. And it is well known, that the water of the river Seine, with which that city is supplied, is so impregnated with calcareous matter, as to incrustate, and in a short time to choke up the pipes through which it runs. But on the other hand it is objected, that the human calculus is of animal origin, and by chymical analysis appears to bear very little analogy to the stony concretions of water.

Dr. Percival informs us that a gentleman of Manchester, who had been long subject to nephritic complaints, and often voided small stones, was advised to refrain from his own pump-water, which is uncommonly hard, and to drink constantly the softer water of a neighbouring spring; and that this change alone, without the use of any medicine, hath rendered the returns of this disorder much less frequent and painful. A lady also, much affected with the gravel, was induced by the perusal of the first edition of Dr. Percival's Essay, to try the effect of soft water; and by the constant use of it remained two years entirely free from her disorder.

When an inflammation is actually raised, the disease is known by the name of *nephritis*, which has been already treated of.

As soon as the stone passes through the ureter, and falls into the bladder, the pain and other nephritic symptoms cease; and every thing will remain quiet, either till the stone is carried into the urethra, or until it has remained long enough in the bladder to acquire weight sufficient to create new distresses.

If a stone happens to be smooth, and of a roundish form, it may lie in the bladder and acquire considerable bulk before it can be perceived by the patient; but when it is angular, or has a rugged surface, even though it may be small in size, yet it seldom fails to raise pain, and occasion bloody urine, or the discharge of a slimy fluid, with tenesmus, and difficulty in making water.

There have been various attempts and pretences made to dissolve the stone. The things which have been found most effectual are those that powerfully absorb the fixed air from bodies, and at the same time readily combining with oils, render them miscible with water. There is scarce any earthy substance that abounds more in oil, and also contains such a quantity of fixed air as the human calculus: and hence it is that the caustic fixed alkaline

salt is such a powerful dissolvent of the stone: but this being of a very acrid nature, it requires to be well sheathed by means of some gelatinous or mucilaginous vehicle. Veal-broth is as convenient as any for this purpose, and accordingly it is used by those who make a secret of the caustic alkali as a vehicle for the soap-lees.

Mr. Blackrie, who has taken much pains in the inquiry, has proved very satisfactorily, that Chittick's nostrum is no other than soap-lees given in veal-broth, which the patients send every day to the Doctor, who returns it mixed up with the medicine, in a close vessel secured by a lock.

It is not every case, however, that either requires or will bear a course of the caustic alkali. Some calculi are of that soft and friable nature, that they will dissolve even in common water; and there are cases wherein it appears that the constant use of some very simple decoction or infusion of an insignificant vegetable, has brought away large quantities of earthy matter, in flakes which apparently have been united together in layers to form a stone. Dr. Macbride assures us, that a decoction of raw coffee, only 30 berries in a quart of water, boiled till it acquired a deep greenish colour taken morning and evening to the quantity of eight or ten ounces, with ten drops of sweet spirit of nitre, had the powerful effect of bringing away, in the course of two months, as much earthy matter in flakes as filled a large tea-cup. The patient was far advanced in years: and, before he began this decoction, had been reduced to great extremities by the continuance of pain and other distressing symptoms: he was purged occasionally with *oleum ricini*.

An infusion of the seeds of *daucus sylvestris* sweetened with honey, is another simple and approved remedy; and has been found to give considerable ease in cases where the stomach could not bear any thing of an acrid nature: the leaves of the *uva ursi* were strongly recommended by the late very celebrated De Haen. But where the stomach will bear it, and there is no ulceration in the case, nor excessive sensibility in the uropoietic organs, either the soap-lees in new milk or veal-broth, or soap-pills, and lime-water, will bid fairest to do effectual service, either by dissolving the stony concretions, or at least rendering the sharp points and rugged surface less capable of injuring the sensible membranes of the parts where these bodies lodge, or happen to pass through.

In such cases as will not allow us to think of dissolving the stony concretions, and where the only scheme is to palliate and procure ease from time to time, little more can be done than to keep the bowels open occasionally by some gentle cathartic, and wash off as much of the loose gravelly matter and slime as can be removed by such mild diuretic infusions and decoctions as shall be found to pass freely and sit well on the stomach. Persons afflicted with the stone should be careful in respect of their diet, and studiously avoid all heavy and flatulent food, as well as high sauces that are apt to turn rancid. For the same reason, butter and acids are to be shunned; for these often create heart-burning, and every thing that offends the stomach raises the nephritic pain; such is the sympathy that obtains between the digestive and the uropoietic organs.

There have been surgeons bold enough to entertain an idea of cutting even into the kidney, in order to extract a stone; this, however, except in cases where an abscess has been formed, and nature points out the way, is merely chimerical. But cutting into the bladder for the same purpose is an ancient and well known operation, and often crowned with success. But a description of this operation belongs to Surgery; and here we shall only make this remark, that a surgeon should never begin his operation, until he and his assistants are perfectly satisfied, from actually feeling the stone, that there is one in the bladder; because it has sometimes happened, that when the incision has been made, no stone could be found: and the patient having died in consequence of the operation, and the body being opened, it has appeared that the symptoms which occasioned the belief of a stone in the bladder arose from some other cause.

When a dysuria proceeds from an acrimonious matter thrown into the blood, it may be readily cured by bleeding, emollient clysters, cooling and diluting drinks with gum arabic or gum tragacanth, linseed tea, or the warm bath. When it arises from inflammations of the bladder or parts adjoining to it, we are to regard it only as a symptomatic affection; and the remedies used to remove the primary disease will also remove the dysuria. Sometimes it may arise from an ulcer of the bladder, in which case it is generally incurable; a mild nutritious diet will, however protract the patient's life.

GENUS LXXIV, AMENORRHEA, SUPPRESSION of the MENSES.

This, with some other symptoms, as dyspepsia, yellowish, or greenish colour of the skin, unusual appetites, &c. constitutes the *chlorosis* already treated of, and which seldom or never appears without a suppression of the menses.

Venesection is recommended as an excellent remedy; the Doctor gives three instances of its success, and says he could give many more. It acts by removing the plethoric state of the uterus, relaxing the fibres, and giving the vessels full play; so that their affection overcomes all resistance, and the evacuation takes place. It is of no great moment from whence the blood is taken; the fa-

MEDICINE.

vein, will, perhaps, empty the uterus most; but it is difficult to get the proper quantity from it, and it cannot be so well measured. The powder of lavine is a powerful remedy; and proved successful in three cases out of four in which it was tried. It was given in the quantity of half a drachm twice a-day. It is a strong topical stimulus, and seems improper in plethoric habits. Madder root is a very powerful medicine in this disease; and proved successful in 14 out of 19 cases in which it was tried, being sometimes exhibited in the quantity of two scruples, or a drachm, four times a-day. It has scarce any sensible effects; never quickens the pulse or excites inflammatory symptoms; on the contrary, the heat, thirst, and other complaints abate; and sometimes these symptoms are removed, though the disease is not cured; but when it succeeds the menses appear from the 3d to the 12th day. For other methods of curing the amenorrhœa, see CHLOROSIS.

MEDICAL ELECTRICITY.

The application of this subtle fluid to medicinal purposes was thought of soon after the discovery of the electric shock; and after various turns of reputation, its medical virtues seem now to be pretty well established. After giving so particular a description of electrical apparatus under the proper System, it would here be superfluous to say any thing farther on that head. We shall only observe, that Mr. Cavallo, who has published the latest and the best treatise on Medical Electricity, entirely disapproves of giving violent shocks, and finds it most efficacious to expose the patient to the electrical aura discharged from an iron or a wooden point; or if shocks are given, they should be very slight, and not exceed 12 or 14 at a time. In this way he recommends it as effectual in a great number of disorders. The patient may be electrified from three to ten minutes; but if sparks are drawn, they should not exceed the number of shocks abovementioned.

Rheumatic Disorders, even of long standing, are relieved, and generally quite cured, by only drawing the electric fluid with a wooden point from the part, or by drawing sparks through flannel. The operation should be continued for about four or five minutes, repeating it once or twice every day.

Deafness, except when it is occasioned by obliteration, or other improper configuration of the parts, is either entirely or partly cured by drawing the sparks from the ear with the glass-tube director, or by drawing the fluid with a wooden point. Sometimes it is not improper to lend exceedingly small shocks (for instance, of one-thirtieth of an inch) from one ear to the other. It has been constantly observed, that whenever the ear is electrified, the discharge of the wax is considerably promoted.

The Tooth-ach, occasioned by cold, rheumatism, or inflammation, is generally relieved by drawing the electric fluid with a point, immediately from the part, and also externally from the face. But when the body of the tooth is affected, electrization is of no use, for it seldom or never relieves the disorder, and sometimes increases the pain to a prodigious degree.

Swellings in general, which do not contain any matter are generally cured by drawing the electric fluid with a wooden point. The operation should be continued for three or four minutes every day. It is very remarkable, that in some cases of white swellings, quite cured by means of electricity, the bones and cartilages were in some measure disfigured.

Inflammations of every sort are generally relieved by a very gentle electrization.

In Inflammation of the Eyes, the throwing of the electric fluid by means of a wooden point is constantly attended with great benefit; the pain being quickly abated, and the inflammation being generally dissipated in a few days. In these cases, the eye of the patient must be kept open; and care should be taken not to bring the wooden point very near it, for fear of causing any spark. Sometimes it is sufficient to throw the fluid with a metal point; for in these cases, too great an irritation should be always avoided. It is not necessary to continue this operation for three or four minutes without intermission; but after throwing the fluid for about half a minute, a short time may be allowed to the patient to rest and to wipe his tears, which generally flow very copiously; then the operation may be continued again for another half minute, and so on for four or five times every day.

The Gutta Serena has been often cured by electrization; but at the same time it must be confessed, it has proved ineffectual in many such cases, in which it was administered for a long time, and with all possible attention. However, it hath never been known that any body was made worse by it. The best method of administering electricity in such cases, is first to draw the electric fluid with a wooden point for a short time, and then to send about half a dozen shocks of one-twentieth of an inch from the back and lower part of the head to the forehead, very little above the eye.

A remarkable disease of the eye was some time ago perfectly cured by electrization; it was an opacity of the vitreous humour of the eyes. This seems to be the only case of the kind to which electricity was applied.

All the cases of *filula lacrymalis* which Mr. Cavallo hath known to have been electrified by persons of ability for a sufficient time, have been entirely cured. The method generally practised, has been that of drawing the fluid with a wooden point, and to take very small sparks from the part. The operation may be continued for about three or four minutes every day. It is

remarkable, that in those cases, after curing the *filula lacrymalis*, no other disease was occasioned by it, as blindness, inflammation, &c. by suppressing that discharge.

Ulcers, or open sores of every kind, even of a long standing, are generally disposed to heal by electrization. The general effects are a diminution of the inflammation, and at first a promotion of the discharge of properly formed matter; which discharge gradually lessens according as the limits of the sore contract, till it is quite cured. In these cases the gentlest electrization must be used, in order to avoid too great an irritation, which is generally hurtful. To draw or throw the fluid with a wooden or even with a metal point, for three or four minutes per day, is absolutely sufficient.

Cutaneous Eruptions have been successfully treated with electrization; but in these cases it must be observed, that if the wooden point is kept too near the skin, so as to cause any considerable irritation, the eruption will be caused to spread more; but if the point be kept at about six inches distance, or farther, if the electrical machine is very powerful, the eruptions will be gradually diminished, till they are quite cured. In this kind of disease, the immediate and general effect of the wooden point is to occasion a warmth about the electrified part, which is always a sign that the electrization is rightly administered.

Scrophulous Tumours, when they are just beginning, are generally cured by drawing the electric fluid with a wooden or metal point from the part. This is one of those kinds of diseases in which the action of electricity requires particularly the aid of other medicines in order to effect a cure more easily; for scrophulous affections generally accompany a great laxity of the habit, and a general cachexy, which must be obviated by proper remedies.

In *Cancers*, the pains only are mostly alleviated by drawing the electric fluid with a wooden or metal point. Mr. Cavallo, however, mentions one case in which a most confirmed cancer of very long standing, on the breast of a woman, has been much reduced in size. It is remarkable, that this patient was so far relieved by drawing the fluid with a metal point from the part, that the excruciating pains she had suffered for many years almost disappeared, and also, that when the electric fluid was drawn by means of a wooden point, the pains rather increased. This person was long under the application of electricity; and the cancers seemed not unlikely to be perfectly cured, although contrary to the expectations even of the judicious physician who electrified her, and who well knew the nature of that dangerous disease.

Abscesses, when they are in their beginning, and in general whenever there is any tendency to form matter, electrization disperses them. For instance, in a case in which matter was formed upon the hip, called the *lumbar abscess*, the disease was perfectly cured by means of electricity. The *sciatica* has also been often cured by it. In all such cases, the electric fluid must be sent through the part by means of two directors applied to opposite parts, and in immediate contact either with the skin or with the coverings, when these are very thin. It is very remarkable, that the mere passage of the electric in the fluid manner, is generally felt by the patients afflicted with those disorders, nearly as much as a small shock is felt by a person in good health. Sometimes a few shocks have been also given, but it seems more proper to omit them; because sometimes, instead of dispersing, they rather accelerate the formation of matter.

Nervous Head-ach, even of a long standing, are generally cured by electrization. For this disease, the electric fluid must be thrown with a wooden, and sometimes even with a metal point, all round the head successively. Sometimes exceedingly small shocks have been administered; but these can seldom be used, because the nerves of persons subject to this disease are so very irritable, that the shocks, the sparks, and sometimes even the throwing the electric fluid with a wooden point kept very near the head, throw them into convulsions.

The Gout, extraordinary as it may appear, has certainly been relieved by means of electricity, in various instances. The pain has been generally mitigated, and sometimes the disease has been removed so well as not to return for some time. In those cases, the electric fluid has been thrown by means of a wooden point, although sometimes, when the pain was too great, a metal point only has been used.

Agues are frequently cured by electricity, so that sometimes one electrization, or two, have been sufficient. The most effectual and sure method has been that of drawing sparks through flannel, or the cloaths, for about ten minutes or a quarter of an hour. The patients may be electrified either at the time of the fit, or a short while before the time in which it is expected.

The Suppression of the Menfes, which is a disease of the female sex that often occasions the most disagreeable and alarming symptoms, is successfully and speedily cured by means of electricity, even when the disease is of a long standing; and after that the most powerful medicines used for it have proved ineffectual. The cases of this sort in which electrization has proved useless are so few, and the successful ones so numerous, that the application of electricity for this disease may be justly considered as an efficacious and certain remedy. Great attention and knowledge is required, in order to distinguish the arrest of the menses from a state of pregnancy. In the former, the application of electricity, as we observed

MEDICINE.

observed above, is very beneficial; whereas, in the latter, it may be attended with very disagreeable effects: it is, therefore, a matter of great importance to ascertain the real cause of the disease, before the electricity be applied in those cases. Pregnant women may be electrified for other diseases, but always using very gentle means, and directing the electric fluid through other parts of the body distant from those subservient to generation. In the real suppression of the menses, small shocks, *i. e.* of about one twentieth of an inch, may be sent through the pelvis; sparks may be taken through the cloaths from the parts adjacent to the seat of the disease; and also the electric fluid may be transmitted by applying the metallic or wooden extremities of two directors to the hips, in contact with the cloaths; part of which may be removed in case they are too thick. These various applications of electricity should be regulated according to the constitution of the patient. The number of shocks may be about 12 or 14. The other applications may be continued for two or three minutes; repeating the operation every day. But either strong shocks, or a stronger application of electricity than the patient can conveniently bear, should be carefully avoided; for by those means, sometimes more than a sufficient discharge is occasioned, which is not easily cured. In cases of uterine hæmorrhages, it is not known that the application of electricity was ever beneficial, neither that it has been often tried. Perhaps a very gentle electrization, as to keep the patient insulated and connected with the prime conductor, whilst the electrical machine is in action, may be of some benefit.

In respect to *unnatural discharges and fluxes* in general, it may be observed, that some discharges are quite unnatural or adventitious, as the fistula lachrymalis, and some species of the venereal disease; but others are only increased natural discharges, such as the menses, perspiration, &c. Now the power of electricity in general, has been found more beneficial for the first, than for the second sort of discharges, which are mostly increased by it.

The application of electricity has been found also beneficial in other diseases besides those mentioned above; but as the facts are not sufficiently numerous, so as to afford the deduction of any general rules, we have not thought proper to take any particular notice of them.

We may lastly observe, that, in many cases, the help of other remedies to be prescribed by the gentlemen of the faculty is required to assist the action of electricity, which by itself would perhaps be useless; and on the other hand, electrization may often be applied to assist the action of other remedies, as of sudorifics, strengthening medicines, &c.

Observations on the MEANS of Preserving HEALTH.

1. RULES for the Management of VALETUDINARIANS.

That part of the medical system which lays down rules for the preservation of health, and prevention of diseases, termed *Hygiene*, is not to be strictly understood as if it respected only those people who enjoy perfect health, and who are under no apprehensions of disease, for such seldom either desire or attend to medical advice; but should rather be considered as relating to valetudinarians, or to such as, though not actually sick, may yet have sufficient reasons to fear that they will soon become so: hence it is that the rules must be applied to correct morbid dispositions, and to obviate the various things that were shewn to be the remote or possible causes of diseases.

From the way in which the several temperaments are usually mentioned by systematic writers, it should seem as if they meant that every particular constitution must be referred to one or other of the four; but this is far from being reducible to practice, since by much the greater number of people have constitutions so indistinctly marked, that it is hard to say to which of the temperaments they belong. When we actually meet with particular persons who have evidently either,

1. Too much strength and rigidity of fibre, and too much sensibility;

2. Too little strength, and yet too much sensibility;

3. Too much strength, and but little sensibility; or,

4. But little sensibility, joined to weakness;—we should look on such persons as more or less in the valetudinary state, who require that these morbid dispositions be particularly watched, lest they fall into those diseases which are allied to the different temperaments.

People of the first-mentioned temperament being liable to suffer from continued fevers especially of the inflammatory species, their scheme of preserving health should consist in temperate living, with respect both to diet and exercise; they should studiously avoid immoderate drinking, and be remarkably cautious lest any of the natural discharges be checked. People of this habit bear evacuations well, especially bleeding; they ought not, however, to lose blood but when they really require to have the quantity lessened; because too much of this evacuation would be apt to reduce the constitution to the second-mentioned temperament, wherein strength is deficient, but sensibility redundant.

Persons of the second temperament are remarkably prone to suffer from painful and spasmodic diseases, and are easily ruffled; and those of the softer sex who have this delicacy of habit, are very much exposed to hysterical complaints. The scheme here

should be to strengthen the solids by moderate exercise, cold bathing, the cortex, and chalybeate water; particular attention should constantly be had to the state of the digestive organs, to prevent them from being overloaded with any species of saburra which might engender stasis, or irritate the sensible membranes of the stomach and intestines, from whence the disorder would soon be communicated to the whole nervous system. Persons of this constitution should never take any of the drastic purges, nor strong emetics; neither should they loose blood but in cases of urgent necessity. But a principal share of management, in these extremely irritable constitutions, consists in avoiding all sudden changes of every sort, especially those with respect to diet and cloathing, and in keeping the mind as much as possible in a state of tranquillity; hence the great advantages which people of this frame derive from the use of medicinal waters drank on the spot, because of that freedom from care and serious business of every kind, which generally obtains in all the places laid out for the reception of valetudinarians.

The third-mentioned temperament, where there is an excess of strength and but little sensibility, does not seem remarkably prone to any distressing or dangerous species of disease; and therefore it can hardly be supposed that persons so circumstanced will either of themselves think of any particular scheme of management, or have recourse to the faculty for their instructions; such constitutions, however, we may observe, bear all kinds of evacuations well, and sometimes require them to prevent an over-fulness, which might end in an oppression of the brain or some other organ of importance.

But the fourth temperament, where we have weakness joined to want of sensibility, is exceedingly apt to fall into tedious and dangerous diseases, arising from a defect of absorbent power in the proper sets of vessels, and from remissness of the circulation in general: whence corpulency, dropsy, jaundice, and different degrees of scorbutic affection. In order to prevent these, or any other species of accumulation and depravation of the animal fluids, the people of this constitution should use a generous course of diet, with brisk exercise, and be careful that none of the secretions be interrupted, nor any of the natural discharges suppressed. These constitutions bear purging well, and often require it; as also the use of emetics, which are frequently found necessary to supply the place of exercise, by agitating the abdominal viscera, and are of service to prevent the stagnation of bile, or the accumulation of mucous humours, which hinder digestion, and clog the first passages. The free use of mustard, horse-radish, and the like sort of stimulating dietetics, is serviceable in these turbid habits.

When the general mass of fluids is accumulated beyond what is conducive to the perfection of health, there arises what the writers term a *plethora*, which may prove the source of different diseases; and therefore, when this overfulness begins to produce languor and oppression, care should be taken in time to reduce the body to a proper standard, by abridging the food and increasing the natural discharges, using more exercise, and indulging less in sleep. But in opposite circumstances, where the fluids have been exhausted, we are to endeavour the prevention of further waste by the use of strengthening stomachics, nourishing diet, and indulgence from fatigue of body or mind.

Vitiated fluids are to be considered as affected either with the different kinds of general acrimony, or as betraying signs of some of the species of morbid matter which gives rise to particular diseases, such as gout, rheumatism, stone, scurvy, &c.

Where the fluids tend to the putrefactive state, which shews itself by rottenness of the teeth, sponginess and bleeding of the gums, a bloated look and livid cast, the diet then should be chiefly of fresh vegetables and ripe fruits, with wine in moderation, brisk exercise, and strengthening bitters.

Where acrimony shews itself by itching eruptions, uncommon thirst, and flushing heats, nothing will answer better than such sulphureous waters as the Harrogate and Moffat in Britain, or the Lucan and Swadlinbar in Ireland; at the same time using a course of diet that shall be neither acrid nor heating. So far with respect to those kinds of morbid matter which do not invariably produce a particular species of disease: but there are others of a specific nature, some of which are generated in the body spontaneously, and seem to arise from errors in diet, or other circumstances of ill management with respect to the animal economy; and hence it is sometime possible, in some degree, if not altogether, to prevent the ill consequences. Thus, there are instances where returns of the gout have been prevented by adhering strictly to a milk diet.

The rheumatism has also been sometimes warded off by wearing a flannel shirt, or by using the cold bath without interruption.

The stone may be retarded in its progress, and prevented from creating much distress, by the internal use of soap and lime-water, or by soap-lees taken in milk or in veal-broth.

The putrid scurvy may be prevented by warm cloathing and perseverance in brisk exercise, by drinking wine or cyder, and eating freely of such vegetable substances as can be had in those situations where this disease is most apt to shew itself.

In constitutions where there is an hereditary disposition to the scrophula, if early precautions be taken to strengthen the solids by cold bathing, a nourishing course of diet, and moderate use of wine,

MEDICINE.

wine, the acrimony which gives rise to the disease will probably be prevented from producing any very bad effects.

The other kinds of morbid matter, which are of the specific nature, are received into the body by infection or contagion. The infection of a putrid fever or dysentery, is prevented by immediately taking an emetic on the first attack of the sickness or shivering; and if that does not completely answer, let a large blister be applied between the shoulders: by this method the nurses and other attendants on the sick in the naval hospitals have often been preserved. As to other infectious morbid matter, see the HYDROPHOBIA, Genus 47. POISONS, &c.

The ill effects that may arise from the different species of saburra are to be obviated, in general, by the prudent administration of emetics, and abstaining from such kinds of foods as are known to cause the accumulation of noxious matters in the first passages. Crude vegetables, milk, butter, and other oily substances, are to be avoided by persons troubled with a sourness at the stomach; brisk exercise, especially riding, is to be used, and they are to refrain from fermented liquors: the common drink should be pure water; or water with a very little of some ardent spirit, such as rum or brandy. Sellers and Vahls waters are to be drunk medicinally; and aromatic bitters, infusions, or tinctures, with the acid elixir of vitriol, from ten to twenty drops, will be found serviceable, in order to strengthen the fibres of the stomach, and promote the expulsion of its contents, thereby preventing the too hasty fermentation of the alimentary mixture. In order to procure immediate relief, the magnesia alba, or *Creta Preparata*, will seldom fail; and the magnesia, as well as the other, may be made into lozenges, with a little sugar and mucilage; and in that form may be carried about and taken occasionally by people afflicted with the acid saburra.

In constitutions where there is an exuberance or stagnation of bile, and a troublesome bitterness in the mouth, it is necessary to keep the bowels always free, by taking occasionally small doses of pure aloes, *oleum ricini*, cream of tartar, some of the common purging salts, or the natural purging waters. When there is a tendency to the empyreumatick and rancid saburra people should carefully avoid all the various kinds of those oily and high-seasoned things generally termed *made-dishes*, and eat sparingly of plain meat, without rich sauces or much gravy; in these cases the best drink is pure water.

2. RULES for those who enjoy perfect HEALTH.

Those who are so happy as to enjoy perfect health, should observe temperance, in order to preserve that inestimable blessing. It is safer to proceed to excess in drink than in meat; and if the debauch should create any extraordinary or distressing degree of pain or sickness, and a temporary fever should ensue, there are two ways of shaking it off, either to lie in bed and encourage perspiration, or to get on horse-back and by brisk exercise restore the body to its natural state. The choice of these two methods must always be determined by the peculiar circumstances of the parties concerned, and from the experience which they may have had which agrees best with them.

If a person should commit excess in eating, especially of high-seasoned things, with rich sauces; a draught of cold water, acidulated with spirit of vitriol, will take off the sense of weight at the stomach, and assist digestion, by moderating and keeping within bounds the alimentary fermentation, and thus preventing the generation of too much stasis. The luxury of ices may be here of real service at the tables of the great, as producing similar effects with the cold water acidulated. Persons in these circumstances ought not to lay themselves down to sleep, but should keep up and exercise until they are sensible that the stomach is unloaded, and that they no longer feel any oppressive weight about the præcordia.

It is also the advice of Celsus to vary the scenes of life, and not confine ourselves to any settled rules: but as inaction renders the body weak and listless, and exercise gives vigour and strength, people should never long omit riding, walking, or going abroad in a carriage; fencing, playing at tennis, or dancing, as each shall be found most agreeable or convenient, are to be used in their turns, according to the circumstances and tendency to any particular species of disease. But when the weakness of old age shall have rendered the body incapable of all these, then dry frictions with the flesh-brush will be extremely requisite to preserve health, by accelerating the flow of humours through the smallest order of vessels, and preventing the fluids from stagnating too long in the cellular interstices of the fleshy parts.

Sleep is the great restorer of strength; for, during this time, the nutritious particles appear to be chiefly applied to repair the waste, and replace those that have been abraded and washed off by the labour and exercise of the day: but too much indulgence in sleep has many inconveniences, both with regard to body and mind, as it blunts the senses, and encourages the fluids to stagnate in the cellular systems; whence corpulency, and its necessary consequences languor and weakness.

The proper time for sleep is the night season, when darkness and silence naturally bring it on: therefore day-sleep in general is not so refreshing; and to some people is really distressful, as creating an unusual giddiness and languor, especially in persons

addicted to literary pursuits. Custom, however, frequently renders sleep in the day necessary; and in those constitutions where it is found to give real refreshment, it ought to be indulged.

With regard to the general regimen of diet, it has always been held as a rule, that the softer and milder kinds of aliment are most proper for children and younger subjects; that grown persons should eat what is more substantial; and old people lessen their quantity of solid food, and increase that of their drink.

INDEX TO THE SYSTEM OF MEDICINE.

- Genus 1. TERTIANA; the Tertian or third day Fever.
 2. QUARTANA; the Quartan or four Day Fever.
 3. QUOTIDIANA; the Quotidian, or Daily Fever.
 4. SYNOCHA; or Diary Fever.
 5. TYPHUS; or Slow Nervous Fever.
 6. FEBRIS; Pestilens, Maligna, Putrid, Pestilential or Malignant Fevers.
 7. SYNOCHUS; or Hætic Fever.
 8. PHLOGOSIS; Heat and painful Tension of some Part.
 9. OPHTHALMIA; or inflammation of the Eyes.
 10. PHRENETIS; Phrenzy, or Inflammation of the Eyes.
 11. CYNANCHE; TONSILLARIS; the Inflammatory Quinzy.
 12. PNEUMONIA; Pneumonic Inflammation.
 13. CARDITIS; or Inflammation of the Heart.
 14. GASTRITIS; or Inflammation of the Stomach.
 15. ENTERITIS; or Inflammation of the Intestines.
 16. HEPATITIS; or Inflammation of the Liver.
 17. SPLENITIS; or Inflammation of the Spleen.
 18. NEPHRITIS; or Inflammation of the Kidneys.
 19. CYSTITIS; or Inflammation of the Bladder.
 20. HYSTERITIS; or Inflammation of the Uterus.
 21. RHEUMATISMUS; or the Rheumatism.
 22. CHRONIC RHEUMATISM.
 23. ODONTALGIA; the Tooth-ach.
 24. PODAGRA; the Gout.
 25. PESTIS; the Plague.
 26. VARIOLA; the Small Pox.
 27. VARICELLA; or the Chicken Pox.
 28. RUBEOLA; the Measles.
 29. SCARLATINA; the Scarlet Fever.
 30. HOEMOPTYSIS; or Spitting of Blood.
 31. HÆMORRHOIS; the Piles.
 32. MENORRHAGIA; or immoderate Flux of the Menfes.
 33. The CATARRH.
 34. DYSENTERIA; the Dysentry.
 35. APOPLEXY.
 36. PARALYSIS; the Palsy.
 37. SYNCOPE; or Fainting.
 38. DYSPESIA; or Difficulty of Digestion.
 39. CONVULSION.
 40. EPILEPSY; or Falling Sickness.
 41. ASTHMA.
 42. COLICA; the Colic.
 43. LUMBRICI INTESTINORUM; Maw or Belly Worms.
 44. DIARRHOEA; or Looseness.
 45. DIABETES; or too great a Quantity of Urine.
 46. HYSTERIA; Hysterics.
 47. HYDROPHOBIA; the Dread of Water.
 48. MELANCHOLIA; Melancholy Madnes.
 49. MANIA; Raving Madnes.
 50. TABES; or Wasting of the Body.
 51. ATROPHY; or Nervous Consumption.
 52. POLYSARCA; or Corpulency.
 53. PNEUMATOSIS; or Windy Swelling.
 54. TYMPANITIS; the Tympany.
 55. PHYSOMETRA; Windy Swelling.
 56. ANASARCA; or Watery Swelling of the Whole Body.
 57. ASCITES; or Dropsy of the Abdomen.
 58. SCROPHULA; or King's Evil.
 59. SYPHILIS; the Lues Venerea; or French Pox.
 60. SCORBUTUS; the Scurvy.
 61. ICTERUS; the Jaundice.
 62. CALIGO; the Cataract.
 63. AMAUROSIS; the Gutta Serena.
 64. PARACUSIS; or Depravation of Hearing.
 65. ANOSMIA; or Defect of Smelling.
 66. AGEUSTIA; or Defect of Tasting.
 67. PROFUSIO; or Flux of Blood.
 68. EPIDROSIS; or Excessive Sweating.
 69. ENURESIS; or Involuntary Flux of Urine.
 70. GONORRHOEA; or Clap.
 71. OBSTIPATIO; Costiveness.
 72. ISCHURIA; or Suppression of Urine.
 73. DISURIA; or Difficulty of making Water.
 74. AMENORRHOEA; Suppression of the Menfes.

n-
re
en
re
er-
en
cir

or

me

the

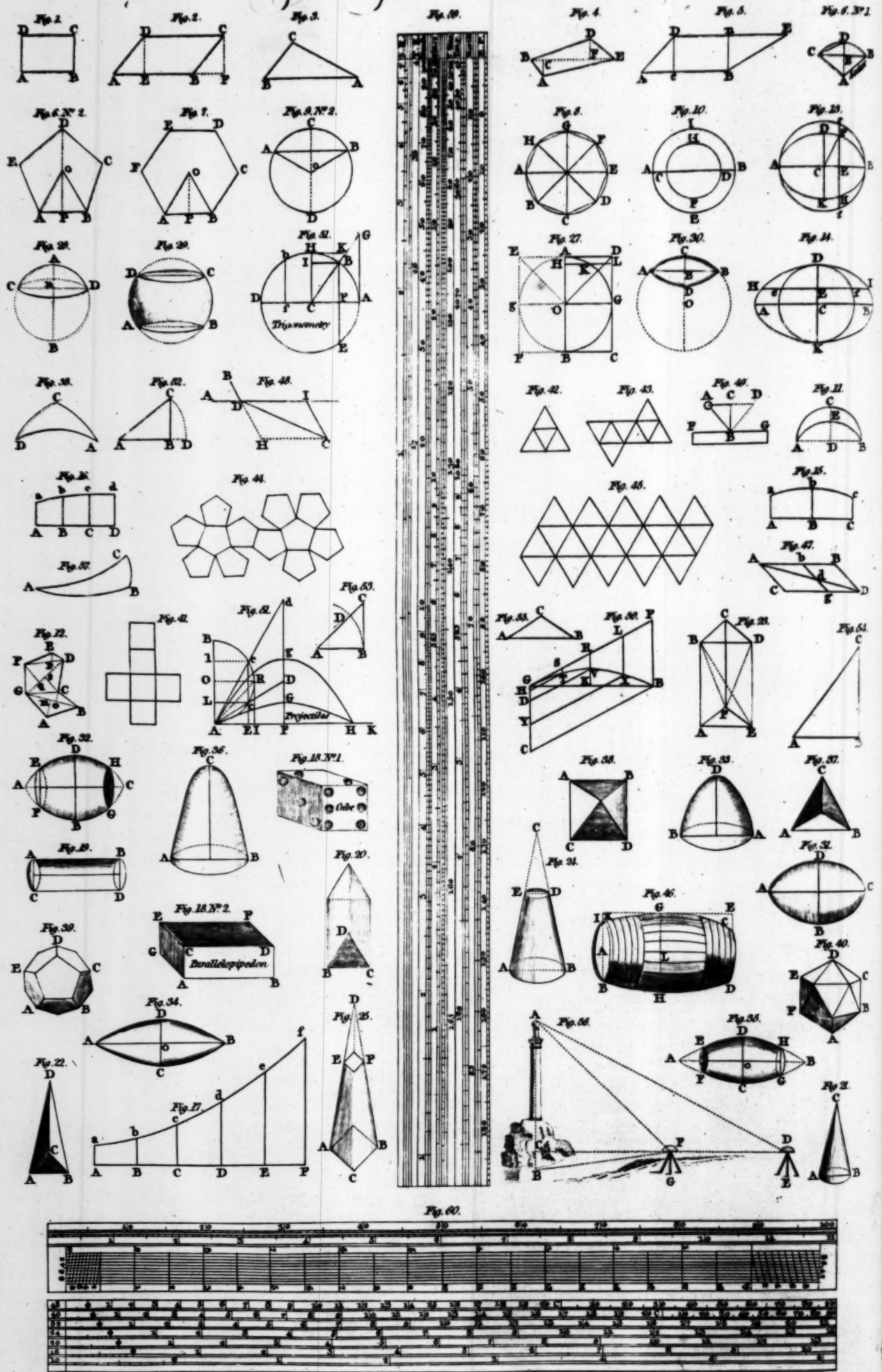
ory

ses.

Billy

'hole

(Miscellaneous Mathematics. See the Treatises on Mensuration,
 Proportion and Trigonometry. See also the Article Motion)



M E L

MEDIUM, in logic, or *Medium of a Syllogism*, called also the *mean* or *middle term*, is an argument, reason, or consideration, for which we affirm, or deny any thing; or, it is the cause why the greater extreme is attributed to or denied of the less, in the conclusion. See the *System*, Part III. Sect. IV.

MEDIUM, in philosophy, is that space or region through which a body passes in its motion towards any point. Thus either is supposed to be the *medium* wherein the heavenly bodies move. Air the *medium* wherein bodies move near our earth. And water is the *medium* in which fishes live and move. And glass is also a *medium* of light, as it affords a free passage. That density or consistence in the parts of the *medium*, whereby the motion of bodies in it is retarded, is called the *resistance* of the *medium*; which, together with the force of gravity, is the cause of the cessation of the motion of projectiles. **MEDIUM**, *subtile* or *athereal*. Sir Isaac Newton makes it probable, that, besides the particular aerial *medium*, wherein we live and breathe, there is another more universal one, which he calls an *athereal medium*; vastly more rare, subtile, elastic, and active, than air; and by that means freely permeating the pores and interstices of all other *mediums*, and diffusing itself through the whole creation; and by the intervention of which he thinks it is, that most of the great phenomena of nature are effected. See **ÆTHER**, **ELECTRICITY**, **FIRE**, &c.

MEDULLA Ossium, or *Marrow of the Bones*, is a soft fatty substance, placed in the cavities or pores of divers bones. See **MARROW** in the *System of Anatomy*, Part I. Sect. I.

MEDULLA Cerebri and Cerebelli, *Medulla Oblongata*, *Medulla Spinalis*. For a copious description of these three articles in *Anatomy*, see the *System*, Part VI. Sect. I.

MEDUSA, in vermology, a genus belonging to the order *Mollusca*. The body is gelatinous, roundish, and depressed; the mouth is in the centre of the under part of the body.

The *aurita*, or aurited medusa; which appears, as floating on the water, to be merely a lifeless lump of jelly. It is of a whitish colour, with a cast of bluish grey, and is of an orbicular figure, elevated into a convexity in the middle on the upper side, flat on the under, and furnished with a ridge of fine and somewhat ridged filaments, round the edge, resembling white hairs. This species is frequent, floating on the surface of the sea, or adhering to rocks about our own coasts; and when the sun shines on them, they have a very beautiful lucid appearance. It is called by some the *sea nettle*, it being one of those animals that, when touched, occasions a very disagreeable tingling in the hands.

The *marfupialis*, or purse medusa, is semi-oval, with four tentacular on the edge. This species is to be met with in vast abundance floating on the surface of the water about Sheppy Island in Kent, and elsewhere on that coast: great quantities of it are destroyed by being thrown on shore with the waves, whence it has no power of getting off again; and in the open seas, many fish skim near the surface, and prey on them. This is the species called by many authors *pulmo marinus*, or the sea lungs.

Mr. Banks, in his passage from Madeira to Rio de Janeiro, discovered a new species, which, when brought aboard by the casting net, had the appearance of metal violently heated, and emitted a white light. With these animals were taken small crabs of three different species, altogether new, each of which gave as much light as the glow-worm, though the creature was not so large by nine-tenths. These luminous animals are one of the causes of that appearance to the sea which has been mentioned by many navigators, and of which various reasons have been assigned. It appeared to emit flashes of light exactly resembling those of lightning, only not so considerable, but so frequent, that sometimes eight or ten were visible at the same moment.

MEDUSÆ Coput, or **MEDUSÆ Head**, in ancient Mythology, occurs frequently both at the breast-plates and shield of Minerva; in some of which it is the most beautiful, and in others the most shocking object. In some figures the face is represented as dead, but with the most perfect features that can be conceived; in others, her face is full of passion, and her eyes convulsed; and in many others, the look is altogether frightful, and formed on purpose to inspire terror. The beauties and horrors of *Medusæ's* face are mentioned by the Roman poets. *Ov. Met. iv. ver. 792.* *Lucan, lib. ix. ver. 680.* *Virg. Æn. viii. ver. 438.* *Spence's Polymetis, p. 91.*

MELANCHOLY, **MELANCHOLY**, formed from *μελας*, *black*, and *χολη*, *bile*, in medicine, a low kind of delirium, without a fever, usually attended with fear, heaviness and sorrow, without an apparent occasion. For a description, causes, and methods of treatment, see the *System*. Genus XLVIII.

MELEAGRIS, in the Linnæan system of ornithology, is the 59th genus of birds, belonging to the order of Gallinæ. The head is covered with spongy caruncles; and there is likewise a membranaceous longitudinal caruncle on the throat. There are three species, viz. 1. The gallopavo, or turkey, has a caruncle both on the head and throat; and the breast of the male is bearded. He lives upon grain and insects: when the cock struts he blows up his breast, spreads and erects his feathers,

No. 105. Vol. III.

M E M

relaxes the caruncle on the forehead, and the naked parts of the face and neck become intensely red. Latham makes the turkey of the 48th genus of the same order. For a representation of this, see Plate III. 2. The cristata, or Brasilian pheasant, has an erect crest of feathers on the head, and violet-coloured temples; it has a caruncle on the throat, but none on the head. Latham makes it the 51st genus. For a representation, see Plate III. 3. The satyra, or horned pheasant, has two blue horns behind its eyes, and a red body, spotted with black and white. It is a native of Bengal.

MELODY, *Μελωδία*, compounded of *μελῆ*, *honey*, and *ωδῆ*, *singing*, in music, is the agreeable effect of different musical sounds, ranged or disposed in a proper succession. *Melody* is the effect only of one single part, voice or instrument; by which it is distinguished from harmony: though in common speech, these two are frequently confounded. Harmony is properly the agreeable result of the union of two or more concurring musical sounds heard in consonance, i. e. at one and the same time; so that harmony is the effect of two parts at least: as therefore a continued succession of musical sounds produces *melody*, so does a continued combination of these produce harmony. Tho' the term *melody* be chiefly applicable to the treble, as the treble is chiefly distinguished by its air; yet so far as the bass may be made airy, and to sing well, it may be also properly said to be melodious. Of the twelve harmonical intervals of musical sound, distinguished by the names of second lesser, second greater; third lesser, third greater; fourth; false fifth, fifth; sixth lesser, sixth greater; seventh lesser, seventh greater, and octave; all *melody*, as well as harmony, are composed: for the octaves of each of these are but replications of the same sound: and whatever is said of any or all of these sounds, is to be understood also of their octaves. For the rules of *melody*, see the *system of Music*.

MELON, *melon*, in botany. For copious directions for the culture and management of melons, see the treatise on **GARDENING**, Part II. *Kitchen Garden*, Month of January, February, &c. &c.

MELPOMENE, the name of one of the nine Muses; who is represented with a mask, to denote her presiding over the stage; and distinguished from Thalia, the comic muse, by greater dignity in her look, stature and dress. *Melpomene* was supposed to preside over all melancholy subjects, as well as tragedy. She is commonly represented with a serious countenance, and in a theatrical dress, holding crowns and sceptres in one hand, and a dagger in the other. See *Horace*, Book I. Ode 24, verse 4.

MEMBRANE, **MEMBRANA**, in anatomy, a similar part of an animal body; being a thin, white, flexible, expanded skin, formed of several sorts of fibres, interwoven together, and serving to cover, or wrap up certain parts of the body. The *membranes* of the body are various, and variously denominated. Such are the peritoneum, pleura, pericardium, peritonæum, &c. Those *membranes* which serve as integuments or covers of vessels are called *coats*, or *tunics*: and those which cover the brain, are, by a peculiar name, called *meninges*.

MEMORY, *μνημη*, a power or faculty of the mind, which receives, retains, and exhibits again, as occasion requires, all ideas presented to the understanding. Of all the faculties, there is none harder to account for, or that has perplexed philosophers more, than the *memory*. Some will have it a mere organ, as the eye, ear, &c. Dr. Hook, in an Essay towards a mechanical Account of Memory, makes it to consist in a stock of ideas or images, formed occasionally by the mind, out of the fine parts of the brain, and disposed or laid by in order.

Descartes and his followers maintain, that the animal spirits, exciting a motion in the most delicate fibres of the brain, leave a kind of traces or footsteps, which occasion our remembrance. Hence it happens, that by passing several times over the same things, the spirits becoming accustomed to the same passages, leave them open, and so make their way without any effort or labour; and in this consists the ease wherewith we recollect such ideas. Thus wine is found to sharpen the *memory*, in regard the spirits of the wine put the animal spirits in motion, and agitate the fibres of the brain more briskly.

Memory, according to Mr. Locke, is, as it were, the storehouse of our ideas. For the narrow mind of man not being capable of having many ideas under view and consideration at once, it was necessary to have a repository, in which to lay up those ideas which it may afterwards have use for. But our ideas being nothing but actual perceptions in the mind, which cease to be any thing when there is no perception of them; this laying up of our ideas in the repository of the *memory*, signifies no more than this, that the mind has a power, in many cases, to revive perceptions it has once had, with this additional perception annexed to them, that it has had them before. And it is by the assistance of this faculty, that we are said to have all those ideas in our understandings, which we can bring in sight, and make the objects of our thoughts, without the help of those sensible qualities which first imprinted them there.

In *memory*, the mind is oftentimes more than barely passive; for it often sets itself to work to search out some hidden ideas; some-

M E M

times they start of their own accord; and sometimes tempestuous passions tumble them out of their cells. This faculty other animals seem to have to a great degree, as well as men, as appears by birds learning of tunes, and their endeavours to hit the notes right. For it seems impossible that they should endeavour to conform their voices (as it is plain they do) to notes whereof they have no idea. Essay concerning Human Und. book ii. chap. 10.

Dr. Hartley, agreeably to his mechanical theory of the human mind, defines *memory* to be that faculty by which traces of sensation and ideas recur, or are recalled, in the same order and proportion, accurately or nearly, as they were once presented; and he observes, that *memory* depends entirely or chiefly on the state of the brain, which is peculiarly conformable to his notion of VIBRATIONS. The rudiments of memory, he says, are laid in the perpetual recurrency of the same impressions, and clusters of impressions: and thus he endeavours to account for the peculiar imperfections of the *memory* in children and aged persons, as well as for other facts pertaining to the exercise of this faculty. Obs. on Man, vol. i. p. 374. &c. For the difference between *memory* and imagination, see IMAGINATION.

A ready recollection of our knowledge, at the moment when we have occasion for it, is a talent of the greatest importance. The man possessed of it seldom fails to distinguish himself in whatever sort of business he may be engaged. It is indeed evident, that when the power of retention is weak, all attempts at eminence of knowledge must be vain; for "memory is the primary and fundamental power, without which there could be no other intellectual operation. Judgment and ratiocination suppose something already known, and draw their decisions only from experience. Imagination selects ideas from the treasures of remembrance, and produces novelty only by varied combinations. We do not even form conjectures of distant, or anticipations of future events, but by concluding what is possible from what is past."

No man will read with much advantage who is not able at pleasure to evacuate his mind, or who brings not to his author an intellect defecated and pure, neither turbid with care, nor agitated with pleasure. If the repositories of thought are already full, what can they receive? If the mind is employed on the past or the future, the book will be held before the eyes in vain.

Seneca says of himself, that, by the mere effort of his natural *memory*, he was able to repeat two thousand words upon once hearing them, each in its order; though they had no dependence or connexion on each other. He also mentions Cynaeas, ambassador to the Romans from king Pyrrhus, who, in one day, had so well learnt the names of his spectators, that the next day he saluted the whole senate, and all the populace assembled each by his name.

The perfection of *memory* consists in two things; readily to admit the impressions or images of things; and to preserve them from oblivion, that the understanding may have recourse to them, and employ them for such purposes as reason shall direct. In order to assist and improve this faculty, every kind of intemperance and excess must be carefully avoided; and when we would commit any thing to *memory*, our first concern should be to understand it thoroughly.

But to write an abridgement of a good book may sometimes be a very profitable exercise. In general, when we would preserve the doctrines, sentiments, or facts, that occur in reading, it will be prudent to lay the book aside, and put them in writing in our own words. This practice will give accuracy to our knowledge, accustom us to recollection, improve us in the use of language, and enable us so thoroughly to comprehend the thoughts of other men, as to make them in some measure our own.

As the mind is not at all times equally disposed for the exercise of this faculty, such seasons should be made choice of as are most proper for it. The mind is seldom fit for attention presently after meals; and to call off the spirits at such times from their proper employment in digestion, is apt to cloud the brain, and prejudice the health. Both the mind and body should be easy and undisturbed when we engage in this exercise, and therefore retirement is most fit for it: and the evening, just before we go to rest, is generally recommended as a very convenient season, both for the stillness of the night, and because the impressions will then have a longer time to settle before they come to be disturbed by the accession of others proceeding from external objects; and to call over in the morning what has been committed to the memory over-night, must, for the same reason, be very serviceable. For, to review those ideas while they continue fresh upon the mind, and unmixed with any others, must necessarily imprint them more deeply.

Some ancient writers speak of an artificial memory, and lay down rules for attaining it. Simonides the poet is said first to have discovered this, or at least to have given the occasion for it. This action therefore of Simonides was afterwards improved into an art, and the nature of it is this: They bid you form in your mind the idea of some large place or building, which you may divide into a great number of distinct parts, ranged and

M E N

disposed in a certain order. These you are frequently to revolve in your thoughts, till you are able to run them over one after another without hesitation, beginning at any part. Then you are to impress upon your mind as many images of living creatures, or any other sensible objects which are most likely to affect you, and be soonest revived in your memory. These, like characters in short hand, or hieroglyphics, must stand to denote an equal number of other words, which cannot so easily be remembered. When therefore you have a number of things to commit to memory in a certain order, all that you have to do is, to place these images regularly in the several parts of your building. And thus they tell you, that by going over several parts of the building, the images placed in them will be revived in the mind; which of course will give you the things or words themselves in the order you desire to remember them. The advantages of the images seem to be this; that, as they are more like to affect the imagination than the words for which they stand, they will for that reason be more easily remembered. Thus, for instance, if the image of a lion be made to signify *strength*, and this word *strength* be one of those I am to remember, and is placed in the porch, when, in going over the several parts of the building, I come to the porch, I shall sooner be reminded of that image than of the word *strength*. Some ancient as well as modern writers relate wonderful effects of this artifice. But they all agree it much more assists us to remember any number of separate and unconnected words, than a continued discourse; unless so far as the remembrance of one word may enable us to recollect more.

But, doubtless, the most effectual way to gain a good memory, is by a constant and moderate exercise of it; for the memory, like other habits, is strengthened and improved by daily use. It is indeed hardly credible, to what a degree both active and passive remembrance may be improved by long practice. Scaliger reports of himself, that in his youth he could repeat above 100 verses, having once read them; and Beroaldus declares, that he wrote his *Comment upon Claudian* without consulting the text. To hope, however, for such degrees of memory as these, would be equally vain as to hope for the strength of *Hercules*, or the swiftness of *Achilles*. And pleaders, or other orators who speak in public and extempore, often discover, in calling instantly to mind all the knowledge necessary on the present occasion, and every thing of importance that may have been advanced in the course of a long debate, such powers of retention and recollection as, to the man who has never been obliged to exert himself in the same manner, are altogether astonishing. As habits, in order to be strong, must be formed in early life, the memories of children should therefore be constantly exercised; but to oblige them to commit to memory what they do not understand, perverts their faculties, and gives them a dislike to learning. In a word, those who have most occasion for memory, as orators and public speakers, should not suffer it to lie idle, but constantly employ it in treasuring up and frequently revising such things as may be of most importance to them; for by these means, it will be more at their command, and they may place greater confidence in it upon any emergency.

Men complain of nothing more frequently than of deficient memory: and indeed every one finds that, after all his efforts, many of the ideas which he desired to retain have slipped irretrievably away; that acquisitions of the mind are sometimes equally fugitive with the gifts of fortune. To assist this weakness of our nature, many methods besides those which we have mentioned have been proposed; all of which may be justly suspected of being ineffectual: for no art of memory, however its effects may have been boasted or admired, has been ever adopted into general use; nor have those who possessed it appeared to excel others in readiness of recollection or multiplicity of attainments. The reader who is desirous to try the effect of those helps, may have recourse to a treatise entitled *A new Method of Artificial Memory*, but the true method of memory is attention and exercise.

MENDICANTS, or BEGGING FRIARS, several orders of religious in Popish countries, who having no settled revenues, are supported by the charitable contributions they receive from others. This sort of friars began in the 13th century. The Waldenses, who made profession of renouncing their estates, and leading a life of poverty, gave occasion to this institution. Buchannan tells us, the Mendicants in Scotland, under an appearance of beggary, lived a very luxurious life; whence one wittily called them, not *Mendicant*, but *Manducant* friars.

MENINGES, or MENYNGES, in anatomy, a name given to the dura and pia mater of the brain. See the SYSTEM, Part IV. Section I.

MENSES, CATAMENIA, in medicine, the monthly evacuations from the uterus of women not with child, or not giving suck. For the disorders which follow a suppression or too great a flow of the menses, see the SYS: EM, Genius 32 and 74.

MENSTRUUM, in chymistry, any body which, in a fluid or subtilized state, is capable of interposing its small parts of other bodies, so as to divide them subtilly, and form a new uniform compound of the two.

TREATISE ON MENSURATION AND GAUGING.

MENSURATION is the comparing of any proposed quantity or magnitude with another of the same kind; thus a line is compared with a line, a surface with a surface, and a solid with a solid. The quantity with which the proposed quantity is to be compared is always esteemed an unit; and the number which shews how often the measuring unit is contained in the proposed quantity, is called the content of the quantity so measured; thus a line is measured by another of an inch, a foot, a yard, &c. in length; a surface by a surface of an inch square, a foot square, a yard square, &c. and a solid by a cubic inch, a cubic foot, a cubic yard, &c.

SECT. I. MEASURING OF SURFACES.

ARTICLE I. To find the Area of any Parallelogram, whether it be a Square, a Rectangle, a Rhombus, or Rhomboides.

RULE. Multiply the length by the perpendicular height, and the product will be the area. Thus suppose in the rectangle ABCD (fig. 1, in Plate of Miscellaneous Mathematics) if the length AB or DC=6 inches, and the breadth AD or BC=4 inches, the area is $4 \times 6 = 24$ square inches, as is easily seen by dividing the length into 6 equal parts, and the breadth AD into 4, and from thence drawing lines parallel to the length and breadth; for the rectangle will then be divided into 24 squares, each of which represents the measuring unit, viz. an inch square. In like manner in the Rhomboides ABCD (fig. 2.) if a perpendicular be let fall from D to AB, the area will be equal to $AB \times DE$; for draw CF perpendicular to DC and AB, then since it has been shewn in the geometry that all parallelograms on the same base are equal, it follows that the Rhomboides ABCD is equal to the rectangle EDCF; but it has been shewn above that the area of the rectangle is equal to $DC \times DE$, therefore the area of the Rhomboides which is equal to it is the same.

Hence in a square rectangle, whose sides are equal, multiply the side into itself, and you have the area.

II. To find the Area of a Triangle.

RULE. Multiply half the base by the perpendicular; or half the perpendicular by the base; or take $\frac{1}{2}$ the product of the perpendicular and base, and you will have the area required. This rule is evident, for every triangle is equal to half a parallelogram of the same base and altitude.

III. To find the Area of a Triangle without a Perpendicular, by having the Three Sides given.

RULE. From half the sum of the three sides subtract each side severally; multiply the half sum and three remainders in one continual product, and the square root thereof will be the area required. Thus in the triangle ABC (fig. 3.) if $BC=24$, $CA=36$, and $AB=48$ chains, by proceeding according to the rule, the area will be found 418.282.

IV. To measure a right-angled Triangle by having the Base and one of the acute Angles given.

RULE. As radius is to the sine of double the acute angle, so is the square of half the hypotenuse to the area.

V. Having two Sides and the included Angle of any Triangle given to find the Area.

RULE. As radius is to the sine of the given angle, so is half the product of the including sides to the area of the triangle.

VI. To find the Area of a Triangle by having a Side and two Angles given.

RULE. As the product of radius, and the sine of the angle opposite the given side, is to half the square of the given side, so is the product of the sines of the other two angles to the area.

N. B. These three last cases are extremely useful in surveying.

VII. To measure a Trapezium, or four-sided Figure, as BDEA, (fig. 4.)

RULE. Multiply the diagonal BE by half the sum of the perpendicular AC and DF, and you will have the area. This is obvious from what has been said concerning triangles.

VIII. To find the Area of a Trapezoid, or Quadrangle, Two of whose Sides AB and DE are parallel.

RULE. Multiply half the sum of the parallel sides by the perpendicular distance between them (DE or Bn,) and you will have the area. The reason of which follows from what has been said of triangles and parallelograms.

IX. To find the Area of a regular Polygon, whether Pentagon, as ABCDE, (Fig. 6.) or Hexagon, as (ABCDEF, Fig. 7) or other regular Polygon whatever.

RULE. Let fall a perpendicular from the centre of the figure, which will fall on the middle of one of the sides, as oP in either of the said figures, then the length of that perpendicular being known, multiply it by half one of the sides, as AP, and that product by the number of sides, or multiply the perpendicular by half the whole perimeter, and you will have the area. The reason of this is evident, for $AP \times OP =$ area of triangle AOB, and the figure contains as many such triangles as it has sides.

X. To find the Area of a regular Polygon, without knowing the Length of the Perpendicular.

RULE. Divide 360° by the number denoting the number of sides in the polygon, and it will give the angle AOB (Fig. 6 and 7.) at the centre, which subtracted from 180° , will leave the sum of the other two; and AOB being $\triangle$, therefore the angles OAB and OBA will be equal, and each equal to half the said

sum; wherefore the angles being known, the area of the triangle AOB may be found by Art. VI. and that multiplied by the number of sides will give the area.

XI. To find the Area of a Circle, as ABCDEFGH (Fig. 8.)

RULE. Multiply the radius, or half the diameter (AE) by half the circumference ABCDEFGH, or, which is the same thing, multiply the circumference by the diameter, and take $\frac{1}{2}$ of the product, and you will have the area. The reason of this rule is easily inferred from the last article, for since in any circle a polygon may be inscribed of as many sides as we please, and by increasing the number of sides the polygon will approach nearer and nearer to the circle, so as to come within any assigned difference, in as much, if it is possible to conceive the sides infinitely small and infinitely numerous, they would exactly coincide with the circle, it follows; that if the distance from the centre be multiplied by half the perimeter, you will have the area sought. But the circumference of any circle being in a certain ratio to the diameter, it is not necessary to measure both the circumference and the diameter also; for the one may be found from the other, by the following method.

XII. The Diameter of a Circle being given to find the Circumference.

RULE. Multiply the diameter by 3.1416, and you will have the circumference. Hence, the circumference being given, the diameter will be had by dividing by 3.1416, or multiplying by its reciprocal .31831.

XIII. To find the Area of a Circle from the Diameter only.

RULE. Multiply the square of the diameter by .7854, and you will have the area. For by Article 11, the $\frac{\text{diameter} \times \text{circumference}}{4}$

= area; and by Art. 12, the circumference = diameter $\times 3.1416$, therefore the diameter $\times$ by diameter $\times \frac{3.1416}{4} = \text{area} = \text{square of diameter} \times .7854$.

XIV. To find the Area by having the Circumference given.

RULE. Divide the square of the circumference by 12.5664, or multiply it by .079577, and you will have the area. For by Art. 11, $\frac{\text{diameter} \times \text{circumference}}{4}$

= area; and by Article 12, the diameter = $\frac{\text{circumference}}{3.1416}$, therefore, $\frac{\text{circumference} \times \text{circumference}}{4 \times 3.1416} = \text{the area} = \frac{12.5664}{\text{square of circumference}}$ = square of circumference $\times .079577$.

REMARK. It is proper to observe that the ratio to the circumference of the diameter cannot be exactly ascertained in finite terms, but has been carried to 100 places of decimals, by the late Mr. John Machin, Professor of Mathematics in Gresham College; and before him, Van Ceulen, a Dutchman, determined it, by the continual bisection of an arc, to 36 places, which at that time was thought such an insurmountable undertaking, that the figures were engraven upon his tomb-stone, in St. Peter's church yard, Leyden. Indeed, it must have cost him immense trouble; but since the improvement in Geometry, by the discovery of fluxions, a great deal of that is obviated. The proportion of the diameter to the circumference to 100 places, is as 1 to 3.141592653, 58979323846264338327.9502884197.1693993751.0582097494 4592307816.4062862089.9862803482.5342117067.9—said to be true to the last figure. The following series, from which Mr. Machin made his computation, is given in Mr. Jones's Synopsis Pal. Math. p. 263. The diameter to the circumference is truly as 1 to

$\frac{16}{5} - \frac{4}{239} + \frac{16}{5^3} - \frac{4}{239^3} + \frac{16}{5^5} - \frac{4}{239^5} + \dots$ &c. ad infinitum

This series of Mr. Machin converges much faster than any other that has yet been discovered.

Archimedes, who flourished about 2000 years ago, stated the proportion of the diameter to the circumference, as 7 to 22, which is near enough for many common purposes.

XV. To find the Area of a Sector, or that Part of a Circle which is bounded by any two Radii, as AC and AB (fig. 9.) and their included Arc CDB.

RULE. Multiply the radius by the $\frac{1}{2}$ length of the arc CB, and the product will be the area; or if the angle at A, or the degrees of the arc be known, say as 360° is to the area of the whole circle, so is such degrees to the area of the sector.

XVI. To find the Length of an Arc CB of a Circle.

RULE. Multiply the degrees of the arc by .01745329, &c. and that product by the radius of the circle, and you will have the length. Note, when the degrees of the arc are not known, the following rule will serve very well for common purposes, viz. From 8 times the chord of half the arc, subtract the chord of the whole arc, and $\frac{1}{2}$ of the remainder will be the length of the arc nearly.

XVII. To find the Area of a Segment of a Circle ACB or ADB, (Fig. 9.)

RULE. Find the area of the sector having the same arc with the segment by the 15th Article, and find the area of the sector, viz. the triangle ABO, then, when the segment is less than a semicircle, as ACB, subtract that area of the triangle from the area of the sector, and it will give the area of the segment; but if the segment is greater than a semicircle, add the area of the triangle to the area sector, and you will have the area required: or the following rule will do for common cases: add the square of half the chord of the segment to the square of its height, and multiply the square root

MENSURATION.

root of the sum by 4: take the $\frac{2}{3}$ of this product, and add to it the whole chord of the segment; then multiply the sum by $\frac{1}{3}$ of the height, and you will have the area very nearly.

XVIII. To find the Area of a Circular Ring, or the Space included between the Circumference of two Concentric Circles; as for Instance, the Area of the Space included between the two Circles AIBE and CHDF, Fig. 10.

RULE. Multiply the sum of the diameters (CD+AB) by their difference (AB-CD) and that product by .7854, and it will give the area required.

XIX. To find the Area of a Lune, or the Space ACBE (Fig. 11.) included between the intersecting of two Eccentric Circles.

RULE. Find the areas of the two segments ACBD, and AEBD, and their difference will be the area required.

N. B. The following are the most useful cases relating to the circle and its equal inscribed square.

1. Diameter $\times .8862$ = side of an equal square.
2. Circumference $\times .2821$ = side of an equal square.
3. Diameter $\times .7071$ = side of the inscribed square.
4. Circumference $\times .2251$ = side of inscribed square.
5. Area $\times .6365$ = side of the inscribed square.
6. Side of a square $\times 1.4142$ = diameter of its circumscribed circle.
7. Side of a square $\times 4.443$ = circumference of circumscribing circle.
8. Side of a square $\times 1.128$ = diameter of an equal square.
9. Side of a square $\times 3.545$ = circumference of an equal square.

XX. To find the Area of any irregular straight lined Figure, as ABCDEFG (Fig. 12.)

RULE. Divide it into triangles and trapeziums, and find the area of each by itself; then the sum of the whole will be the area of the whole irregular polygon.

XXI. To find the Area of an Oval or Ellipsis.

RULE. Multiply the transverse diameter by the conjugate, and the product again by .7854, and it will give the area required.

XXII. To find the Area of an Elliptical Segment cut Parallel to either Axis.

1. When cut Parallel to the Conjugate, the transverse and conjugate axes, and the distance CE (Fig. 13.) from the centre being known, find the area of the corresponding circular segment in the circumscribing circle; multiply the same by the conjugate, and divide the product by the transverse, and you will have the area of the elliptical segment FBH.

2. When it is cut Parallel to the Transverse, (Fig. 14.) find the area (ADF) of the corresponding circular segment in the inscribed circle; multiply this area by the transverse, and divide the product by the conjugate, and you will have the area of the elliptical segment HDI.

N. B. In either case, when the degrees of the circular arc, cut off by the base of the segment (EF) are known, multiply the same by .0174533, and from the product take the natural sine of the said degrees; then multiply the remainder by the transverse, and that product by the conjugate, and divide by 8, and you will have the area of the elliptical segment.

XXIII. To find the Circumference of an Ellipsis.

RULE. Multiply the square root of half the sum of the squares of the two diameters by 3.1416, and the product will be the circumference nearly. Or multiply half the sum of the two diameters by 3.1416, and you will have the circumference exact enough for most practical purposes. Or find the circumference both by the last and preceding methods, and $\frac{1}{2}$ the sum of the results will give the answer extremely near.

N. B. The following may serve as a practical rule for finding the length of the arc DF (Fig. 13.) Find the length of a circular arc intercepted by CD and CF, and whose radius is half the sum of CD and CF, and it will be the elliptical arc nearly. But if strict accuracy in those matters is required, recourse must be had to infinite series, as founded upon the fluxional calculus.

XXIV. To find the Area of a Parabola.

RULE. Take $\frac{2}{3}$ of the product of the base and height, and you will have the area.

XXV. To find the Area of the Frustum of a Parabola, viz. when the top Part is cut off Parallel to the Base.

RULE. Divide the difference of the cubes of the two ends of the frustum by the difference of their squares, and multiply the quotient by $\frac{1}{3}$ of the altitude, will give the area required.

XXVI. To find the Area of an Hyperbola.

RULE. To the product of the transverse and abscissa add $\frac{1}{4}$ of the square of the abscissa, and multiply the square root of the sum by 21. Add 4 times the square root of the product of the transverse and abscissa to the last found product, and divide the sum by 75. Lastly, divide 4 times the product of the conjugate and abscissa by the transverse, and this quotient multiplied by the former, will give the required area nearly.

N. B. For the better understanding of what has been said on the Ellipses, Parabola, Hyperbola, and all the other subjects, here treated of, we refer our readers to our System of Geometry, where the properties of each figure are fully explained and demonstrated.

XXVII. A general Method to Measure any irregular Figure bounded by a Curve, as Fig. 15, 16, 17.

RULE. Divide the base AC in fig. 15, into two equal parts, AB

and BC, and measure the perpendiculars Aa, Bb, Cc, then the sum of Aa and Cc, added to 4 times Bb, and that sum multiplied by $\frac{1}{3}$ of the length AC, will be the area nearly. Or if more exactness is required, divide the base into three equal parts (as in fig. 16.) and measure the perpendiculars Aa Bb, Cc, Dd; then to the sum of the two ends Aa and Dd, add thrice the sum of the two interior perpendiculars Bb and Cc, and multiply that sum by $\frac{1}{4}$ of the base AD, and you will have the area very near. But if the surface be very large, it may be proper to divide it into a still greater number of equal parts, as in fig. 17. and then it may be measured at two or three times by the foregoing rules. Thus, where there are five perpendiculars, the figure will be measured at twice by the first of these rules; where there are six, so much of it as extends to the third perpendicular, may be measured by the first rule, and then the remaining part may be measured by the second rule; if there are seven perpendiculars, each part from the middle of the base will be measured by the second rule. Or the whole base need not in such case be divided into equal parts, but into two or more either equal or unequal parts, as shall seem convenient; and then each of those parts must be divided into two or three equal parts, and so measured separately by one or other of the foregoing rules. By these means, when a sufficient number of perpendiculars are taken, you will have the area exact, let the nature of the curve be what it may.

SECT. II. MEASURING OF SOLIDS.

ARTICLE I. To measure a Cube.

DEFINITION. A cube is a solid contained under six equal square sides, such as a die that is played with, Fig. 18.

RULE. Multiply the side of a cube by itself, and that product again by the side, and it will give the solid required. For conceive the base of the cube to be divided into a number of little squares, each equal to the superficial measuring unit, suppose an inch, then will those squares be the bases of a like number of small cubes, which are each equal to the solid measuring unit; also the number of little squares contained in the bases of the cube, being equal to the square of the side of that base, as has been shewn in Art. I. Sect. I. it is plain, if the base be cut off, as the height of a measuring unit, which we have already supposed to be an inch, the part so cut off will contain as many inch cubes, as the base contains inch squares; and if again, another equal part be cut off from the proposed cube, that part will contain the same number of inch cubes as the last; the like for another part; and so on: hence the content is equal to the square of the side of the base, multiplied by the height of that figure, viz. (because the height is equal to the side of the base) to the square of the side of the base, multiplied by the side of the base.

N. B. The surface of the cube is equal to six times the square of the side.

II. To find the Content of a RIGHT PRISM, whether of a Triangular Square, Circular, or other Base.

RULE. Multiply the area of the base by the height or length of the prism, and the product will be the solidity. For if the prism be cut any where parallel to the base, the section made will be equal to the base: it follows, that if it be cut at the distance of an inch from the base, the part cut off will contain as many cubic inches as the base contains square inches; and therefore the whole of the cubic inches in the prism, will be equal to the cubic inches, at 1 inch in height, depth, or length, multiplied by the number of inches in the height, depth, or length, viz. equal to the area of the base, multiplied by the height, depth, or length. If the prism has a square base, as (Fig. 18.) it is called a parallelepipedon; if a circular base, as (Fig. 19.) it is named a cylinder; if a triangular base, as (Fig. 20.) a triangular prism, &c. and in all other cases, it takes its name from the base where it has a regular one: if the base be an irregular polygon of any number of sides, the prism is then called an irregular prism.

N. B. To find the square inches, &c. on the regular surface of any prism, multiply the perimeter of the base by the height or length, to which add twice the area of the base, and you will have the whole surface. If it is an irregular prism, the area of each side must be found separately.

III. To find the Content of a Pyramid, whether the Base be Triangular, Circular, Square, or any other Figure.

DEFINITION. A right pyramid is solid, formed by having one end of a right line fixed to a given vertical point, and the other end moved quite round the base, so as to touch it in every point; when the base is circular, as (Fig. 21.) it is named a cone; when triangular, as (Fig. 22.) a triangular pyramid; if a square, a square pyramid, &c.

RULE. Multiply the area of the base by $\frac{1}{3}$ of the height or length, and you will have the solidity.

The above rule is thus demonstrated. In the planes of the three sides of the triangular prism, ABCDEFA, (Fig. 23.) let the diagonals BE, BF, FD, be drawn, then will the part FBCE, cut off by a plane, extended by FB and FD, be a pyramid on the base BCD, having the same altitude with the prism itself. And if the remaining part of the prism be cut by a plane extended by FB and FE, it will be divided into two other pyramids, whose bases and height are equal to the former. The prism therefore being thus divided into three equal pyramids, it follows that a triangular pyramid is equal to $\frac{1}{3}$ of a prism of the same base and height. The like demonstration

MENSURATION.

monstration may be extended to any other prism; for if the base of the prism has four sides, and there be a pyramid of the same base and height, then the prism may be divided into two triangular prisms of the pyramid, into two triangular pyramids, and each of the triangular prisms may be divided into three pyramids, each of equal size with the two pyramids; and thus it will appear, that the prism contains 6 of such small pyramids as the two into which the given pyramid was divided; and hence, the square prism is treble the square pyramid of the same base and height; when the prism contains more sides, the demonstration may be effected in like manner; if we imagine the sides infinite in number, it will coincide with the circle; and hence it is concluded, that a cone is the $\frac{1}{3}$ of a cylinder of the same base and height. And hence the foregoing rule is manifest.

The surface of a regular upright pyramid is found by multiplying the slant height into half the perimeter of the base, and adding thereto the area of the base. When the pyramid is not a cone, the slant height must be measured from the vertex to the middle of one of the sides of the base. If it be an irregular pyramid, the surface of each side must be measured separately, and the sum of the whole will be the measure of the surface.

IV. To measure the Frustum of a Pyramid, of what Kind soever, the Frustum being cut off Parallel to the Base; see Fig. 24 and 25.

RULE. To the areas of the two ends of the frustum add the square root of their product, and this sum being multiplied by $\frac{1}{2}$ the height, will give the solidity.

For the frustum of a cone, this rule will be shorter, viz. To thrice the rectangle of the top and bottom diameters, add the square of their difference; multiply the sum by $\frac{1}{6}$ of the height, and that product by .7854. The surface of a frustum of any regular pyramid, is obtained by multiplying half the sum of the perimeters of the two ends by the slant height, (taken between the middle points of two sides like the ends when it is not a frustum of a cone.) to which add the areas of the two ends, the sum will be the whole surface.

V. To measure a Sphere or Globe, as Fig. 26.

Every Sphere is $\frac{2}{3}$ of its circumscribing Cylinder. For let AB, Fig. 27, be the axis, about which the sphere and cylinder are generated, by the revolution of the semicircle AGB, and the rectangle AGDB: let HL be any right line perpendicular to AB, cutting the periphery in K, and let OK and OD be drawn. Now AO=AD, and HL is parallel to AD, and HI=OH; also the circle described by HI, or the section of the cone generated by the rotation of the triangle AOD, about the axis AB, will be equal to the difference of the two circles generated by HL and HK, viz. equal to the Annulus described by KL, or the section of the solid which remains when the sphere is taken out of the cylinder. Therefore these two sections being every where equal to each other, the solids themselves will likewise be equal; that is, the cone (EOD) will be equal to the excess of the cylinder, (GDEg) above the inscribed hemisphere (GAg), whence the cone or excess being $\frac{1}{3}$ part of the cylinder, the hemisphere must necessarily be two-thirds thereof.—Hence the whole sphere is $\frac{2}{3}$ of its circumscribing cylinder.

Hence if the diameter be cubed, and $\frac{2}{3}$ thereof be multiplied by .7854, you will have the solidity of the sphere.

The convex surface of a sphere is found by multiplying its diameter by the circumference.

VI. To measure the Segment of a Sphere, as ACD, Fig. 28.

RULE. To three times the square of the radius of its base (Cn) add the square of its height (An), and this product being multiplied by $\frac{1}{6}$ of the height, and then by .7854, will give the solidity. The curve surface is found by multiplying its height by the whole circumference of the spheres.

VII. To find the Solidity of a Frustum or Zone of a Sphere, as ABCD (Fig. 29.)

RULE. To half the sum of the squares of the radii of the two ends, $\frac{D_1^2 + D_2^2}{2}$ (viz. $Dn^2 + An^2$) add $\frac{1}{6}$ of the square of their distance ($=\frac{1}{2}am$) and multiply the sum by twice the said distance, and that product again by .7854, and you will have the solidity.

The convex surface is found as in the last article.

VIII. To find the Solidity of a Circular Spindle, ACBD (Fig. 30.)

RULE. To the square of half the length of the spindle add the square of half the middle diameter; divide the sum by the middle diameter, and you will obtain Ao, the Radius of the Circle: Take half the middle diameter from the radius of the circle, and it will give the central distance Eo. Then find the area of the generating circular segment, by Art. XVIII. Sect. I. and from $\frac{1}{3}$ of the cube of the length of the spindle, subtract the product of the said area by 8 times the central distance; multiply the remainder by .7854, and you will have the solidity.

In order to obtain the measure of the surface of the spindle, you must find the length of the circular arc, by Art. XVI. Sect. I. Then from the product of the longest diameter AB, and the radius of the revolving arc Ao, subtract the product of the said arc's length and central distance; and multiply 8 times the remainder by .7854, and you will have the measure of the surface.

IX. To find the Solidity of a Spheroid, as ABCD (Fig. 31.)

RULE. Multiply the square of the revolving axis by the fixed

axis, and $\frac{1}{2}$ of that product by .7854, and you will have the solidity.

X. To find the Contents of the middle Frustum of a Spheroid, when the Ends are circular or parallel to the revolving Axis; see EDHGBF, Fig. 32.

RULE. To twice the square of the middle diameter DB, add the squares of the diameters EF and GH at the ends, then $\frac{1}{2}$ of this sum being multiplied by the length, and that product by .7854, will give the solidity.

XI. To find the Solidity of a Parabolic Conoid, as BDA, Fig. 33.

RULE. Multiply the area of the base by half the altitude, and the product will be the content.

XII. To find the Solidity of a Parabolic Spindle, Fig. 34.

RULE. Multiply the square of the middle diameter by the length of the spindle; also multiply $\frac{1}{3}$ of that product by .7854, and you will have the solidity.

XIII. To find the Solidity of the Middle Frustum of a Parabolic Spindle, as EFGH, Fig. 35.

RULE. Add 8 times the square of the middle diameter, 3 times the square of the less, and 4 times the product of those diameters, into one sum, multiply that sum by $\frac{1}{2}$ of the length, and that product by .7854, and you will have the contents.

XIV. To find the Solidity of a Hyperboloid, as ACB, Fig. 36.

RULE. To the square of the radius of the base add the square of the middle diameter, between the base and the vertex; multiply the sum by $\frac{1}{3}$ of the altitude, and that product by .7854, will give the content.

XV. To find the Solidities of the five regular Bodies.

The first or tetraedron has four equal triangular faces, see fig. 37. The second, or hexaedron, or cube, has six equal square faces, of which we have before treated.

The third, or octaedron, has eight equal triangular faces, fig. 38. The fourth, or dodecaedron, has 12 equal pentagonal faces, fig. 39.

The fifth, or icosaedron, has 20 equal triangular faces, fig. 40. Besides these no other regular solids (viz. such as have their respective sides or bases all equal and similar) can be formed. The rules for measuring their contents are as under.

For the tetraedron, multiply $\frac{1}{6}$ of the cube of the linear side by the square root of 2, and the product will be the solidity.

For the octaedron, multiply $\frac{1}{6}$ of the cube of the linear side by the square root of 2, and the product will be the solidity.

For the dodecaedron, to 21 times the square root of 5, add 47, and divide the sum by 40, then the square root of the quotient being multiplied by five times the cube of the linear side, will give the solidity.

For the icosaedron, to three times the square root of 5 add 7, then the square root of half that sum, being multiplied by $\frac{1}{6}$ of the cube of the linear side, will give the solidity. If figures 41, 42, 43, 44, and 45, are drawn upon pasteboard, cut half through, and turned up and glewed, they will form the five regular bodies.

The foregoing articles include all cases that are likely to occur in practice; which we flatter ourselves is as much as our readers will expect in a work of this nature. Those who wish to see more of Mensuration, we refer to that excellent treatise of J. Robertson, late librarian to the Royal Society, and to that valuable quarto work of Dr. Hutton, professor of Mathematics at the Royal Academy at Woolwich. We shall however add, as a supplement to this section, the method of cross multiplication, viz. the method of multiplying feet, inches, and parts, by feet, inches, and parts, without reducing them to decimals, it being much practised by artificers in the measurement of their work, &c.

RULE. Begin with the highest denominator of the multiplicand; and having multiplied by it, begin with the next highest, and so on, till you have multiplied by them all; observing that feet multiplied by feet give feet, feet by inches give inches, feet by parts give parts, inches by inches give parts, inches by parts give seconds, and parts by parts give thirds.

Hereafter having multiplied by 2 feet, I begin with 6 inches, which, multiplied by 4 parts, gives 24 seconds, or 2 parts to be carried to the next row; then the next product produces 18 parts, which makes 8 to write down, and 1 to carry, which makes the next product 6 feet 1 inch to be set down. The last line is wrought in a similar manner.

SECT. III. STEREOMETRY, OR THE ART OF GAUGING.

By gauging is chiefly understood the art of finding the content of any hollow vessel, utensil, or cask, in ale or wine gallons, if the vessel be of any regular form mentioned in the preceding section. Find the content in inches from the internal dimensions; and then divide by 282 for ale gallons, and by 231 for wine gallons; the reason of which is because 282 cubic inches is an ale gallon, and 231 cubic inches is a wine gallon. But since divided by 282, or 231, is the same as multiplying by $\frac{1}{282}$ or $\frac{1}{231}$; therefore, if these fractions be reduced to decimals, you will have multipliers if you would prefer multiplication) which will answer the same purpose. These multipliers are .003546 for ale, and .004329 for wine. Likewise, since in vessels of a circular or elliptical

MENSURATION.

form, you will have to multiply by .7854, in order to obtain the content in inches, and then to multiply or divide by the former multipliers or divisors; it will be useful to shew how one operation may be made to serve for both. Thus, to multiply by .7854, and afterwards divide by 282 or 231, is the same thing as to multiply by $\frac{.7854}{282}$ or $\frac{.7854}{231}$. These therefore reduced to decimals will give the multipliers to be used in circular or elliptical vessels, for finding the ale or wine gallons, without multiplying first by .7854. The multipliers in these cases are .0027851 for ale, and .00339999 for wine; or, if you would prefer division, then it is the same thing to multiply by $\frac{.7854}{282}$, $\frac{.7854}{231}$, as to divide by $\frac{282}{.7854}$, $\frac{231}{.7854}$; these therefore reduced to mixed numbers by actual division, become 359.05 for ale; and 294.12 for wine. Thus you have the several multipliers and divisors for ale or wine, with the methods of finding them. In like manner if you have to gauge malt, you must divide the content in inches by 2150.42, and you will have the bushels, because 2150.42 cubic inches make one bushel. Also $\frac{2150.42}{.000465}$, the proper multiplier. In circular vessels, the multiplier (in order to save the trouble of multiplying by .7854 for the inches) will be $\frac{.7854}{2150.42} = .000365$; or the divisor for that purpose $= \frac{2150.42}{.7854} = 2738$.

In the same manner may multipliers and divisors be found for gauging or ascertaining the quantities of bodies by weight, provided their specific gravities are known. Thus 27.14 cubic inches of hard soap is equal to one pound; therefore if the content of any vessel in inches be divided by 27.14, it will give the pounds of hard soap that such vessel will hold, and by proceeding as above, the multiplier, instead thereof, will be found .036845. But for circular utensils, it will be .028939, and their divisor 34.56.

N. B. A pound of green soft soap contains 25.67 cubic inches; a pound of white soft soap, 25.56 cubic inches; a pound of green starch 34.8 cubic inches; a pound of dry starch, 40.3 cubic inches; and a pound of net tallow, 31.4 cubic inches; for which the several multipliers and divisors may be found as above, and the artist be thereby equipped for gauging any of those articles.

OF THE SLIDING RULE.

For the ease of computations, there is an artificial instrument invented, called the Gauger's Sliding Rule, by which any calculations are readily performed as it were by inspection, and to a sufficient exactness for practice. This rule consists of certain scales of logarithms adapted to particular purposes; and since multiplication by logarithms is performed by addition, and division by subtraction, it is easy to conceive that by moving the slide forward or backward, with respect to the numbers on the fixed part of the rule, you will obtain the product or quotient of the two numbers you are concerned with. The lines of numbers on the sliding rule are marked A, B, C, D, MD, and N. Also there are other lines marked SS, LL, &c. The value of the first figure on the rule may be assigned at pleasure either 1, 10, 100, 1000, &c. or .1, .01, .001, &c. and whatever that first figure 1 is supposed to be, the first 2 is twice as much, the first 3 thrice as much, &c. and the second 1 is ten times the first, the second 2, 3, 4, &c. are ten times the value of the first, 2, 3, 4, &c.

THE METHOD OF USING THE RULE.

ARTICLE I. To multiply by the Sliding Rule.

RULE. Set 1 on B to either of the factors on A, then against the other factor on B is the product on A.

II. To divide by the Sliding Rule.

RULE. Set 1 on A to the divisor on B, then opposite the dividend on B is the quotient on A.

III. To perform a Proportion by the Sliding Rule.

RULE. Set the first term on B to the second on A, then opposite to the third on B is the fourth on A.

IV. To extract the Square Root.

RULE. Set the first 1 on C to the first 1 on D, then against the given number on C is its root on D.

V. Between two Numbers given, to find a Geometrical mean Proportion.

RULE. Set one of the given numbers on C to the same number on D; then against the other given number on C is the geometrical mean on D.

VI. To measure any Malt Floor, Couch, &c. by the Sliding Rule.

RULE. Set the length on B to the breadth on MD, then against the height on A is the content on B.

VII. An Account of the Gauge Points on the Rule.

The operations on the rule for finding the contents of solids, are founded on this principle, that similar surfaces are to one another as the squares of the diameters or homologous sides; and similar solids, as the cubes of their diameters or homologous sides; therefore if the side of a square be found, whose area or content, at 1 inch deep, is one gallon, 1 bushel, &c. then it will be as the square of that diameter or side (called a gauge point) is to 1, so is the square of any other diameter to the corresponding area in gallons, bushels, &c. at one inch deep; and therefore if the solid to be gauged be a square or circular prism, that area multiplied by the length will be the content; or, which is the same, as the square of the gauge point is to the length, so is the square of the diameter or side to the content.

The side of a square whose ale area is 1, is 16.79 inches, and whose wine area is 1, is 15.19 inches. And these are named the ale and wine gauge points for squares. The diameter of a circle whose ale area is 1, is 18.95 inches; and whose wine area is 1, is 17.15 inches; and these are named the circular gauge points for ale and wine respectively. The side of a square whose area is 1 malt bushel, is 46.37 inches; and the diameter of a circle whose content is 1 malt bushel, is 52.32 inches; which are therefore the square and circular gauge points for malt.

These sides, diameters, or gauge points, are the square roots of the proper divisors, and consequently by extracting the square roots of the proper divisors for ale, malt, fope, tallow, &c. you will obtain the corresponding gauge points to each.

VIII. To gauge a Prism by the Sliding Rule.

RULE. Find a mean proportion between the two sides or diameters of the base, as has been already taught; then as the proper gauge point on D is to the length on C, so is such mean proportion on D to the content on C.

A pyramid is gauged in the same manner, only, instead of the length, use $\frac{1}{3}$ of the length.

IX. To gauge any Frustrum of a Right Cone or Square Pyramid by the Sliding Rule.

RULE. Set the proper gauge point on D to the height on C, then against half the sum of the top and bottom diameters, or side on D, take the corresponding number on C; and set the said gauge point to $\frac{1}{2}$ of the length of C, and against $\frac{1}{2}$ the difference between the top and bottom diameters, or sides, take the opposite number on C, the sum of these two numbers thus found is the content.

X. To gauge any Globe or Sphere by the Sliding Rule.

RULE. Set the circular gauge point on D to $\frac{2}{3}$ of the diameter on C, and against the diameter on D is the content on C.

XI. To gauge any Spheroid by the Sliding Rule.

Set the circular gauge point on D to $\frac{2}{3}$ of the transverse axis on C, and against the conjugate axis on D is the measure of the spheroid on C.

XII. To gauge the Frustrum of any Spheroid by the Sliding Rule.

RULE. Set the circular gauge point on D to the height or length of the frustrum on C, then the greater and less diameters of the frustrum's end being found D, take twice the number opposite to the first or greater diameter on C, and add it to the number opposite to the less diameter on C, and you will have the content.

CASK GAUGING. See Fig. 46.

The only true method of cask gauging, that has ever been proposed, is by taking a middle diameter between the bung and head; that being done, the following Rule will give the content.

RULE. To the Square of twice the Middle Diameter, add the Squares of the Head and Bung Diameters. Multiply the Sum by $\frac{1}{2}$ of the Length, and that Product multiplied or divided by the Circular Multipliers or Divisors for Ale or Wine, as the Case shall be, will give the Content in Gallons.

To ullage a Cask, or find the Quantity of Liquor remaining in a Cask, when Part is drawn out.—This by the revenue officers is thus performed. On their sliding rules, made by Mr. Roberts, of the Old Jewry, there is one face made for ullaging standing casks, and another for lying casks; the former marked S. S. or segment standing; the other S. L. or segment lying. The slider is marked N. Then for a } standing } $\frac{1}{2}$ length } $\frac{1}{2}$ S. S. }
lying } $\frac{1}{2}$ bung diameter } $\frac{1}{2}$ S. L. }
and against the wet or dry inches on N, is the reserved number on { S. S. }
{ S. L. } Again, set 100 on B, to the whole content on A, then again the reserved number on B is the ullage on A, viz. what remains in the cask, if you used the wet inches; but what is drawn out, if you used the dry.

But the same in standing casks, by having a middle diameter taken between the liquor's surface and the nearest head, may be performed after the manner of gauging the whole cask; by which means the content of that part intercepted between the liquor's surface and nearest head, will be determined by using in the calculation $\frac{1}{2}$ of that distance instead of the length, and the diameter of the liquor's surface instead of the bung; then if the cask be not half full, you have the quantity of liquor remaining therein; but if it is more than half full, subtract the content found as above from the whole content of the cask, and the remainder will be the quantity of liquor in it. N. B. The diameter of the liquor's surface and the intermediate diameter may be taken after the same manner as has been described for taking the middle diameter of a full cask. Also in a similar way, but it will be attended with a little more trouble, may the ullage of a lying cask be found; for by knowing the wet or dry inches taken at the bung, the wet or dry inches at the middle and head will also be had. Then these being known, the area of the circular segments answering thereto, must be found in ale or wine gallons; and four times the middle area added to the sum of the other two, and that sum multiplied by $\frac{1}{4}$ of the cask's length, will give the true ullage.

In cask gauging we have purposely insisted on that method only which is performed by a middle diameter, it being the only true method; for without a middle diameter there are not sufficient data.

M E R

MENTHA, MINT, in botany, a genus of the gymnospermia order, belonging to the didymia class of plants; and in the natural method ranking under the 42d order *Verticillatae*. The corolla is nearly equal, and quadrid, with one segment broader than the rest, and emarginated; the stamina are erect, standing asunder. There are many species; but not more than three are cultivated for use, namely, the viridis or common spearmint, the piperita or peppermint, and the pulegium or pennyroyal. All these are so well known as to need no description; and all of them are very easily propagated by cuttings, parting the roots, or by offsets.

Uses. For culinary purposes, the spearmint is preferable to the other two; but for medicine, the peppermint and pennyroyal have in some places almost entirely superseded it. A conserve of the leaves is very grateful, and the distilled waters, both simple and spirituous, are universally thought pleasant. The leaves are used in spring fallads; and the juice of them boiled up with sugar is formed into tablets.

The virtues of mint are those of a warm stomachic and carminative: in loss of appetite, nausea, and continual retching to vomit, there are few simples of equal efficacy. In cholicky pains, the gripes to which children are subject, henteries, and other immoderate fluxes, this plant frequently does good service. It likewise proves beneficial in many hysteric cases, and affords an useful cordial in languors and other weaknesses consequent upon delivery. The best preparation in these cases is a strong infusion of the dried herb in water (which is much superior to the green) or rather a tincture or extract prepared with rectified spirit. These possess the whole virtues of the mint; the essential oil and distilled water contain only the aromatic part; the expressed juice only the astringency and bitterness, together with the mucilaginous substance common to all vegetables. The peppermint is much more pungent than the others.

Pennyroyal has the same general characters with the mint, but is more acrid and less agreeable when taken into the stomach. It has long been held in great esteem, and not undeservedly, as an aperient and deobstruent, particularly in hysteric complaints and suppressions of the menses. For these purposes the distilled water is generally made use of, or, what is of equal efficacy, an effusion of the leaves. It is observable, that both water and rectified spirit extract the virtues of this herb by infusion, and likewise elevate the greatest part of them by distillation. The expressed juice, with a little sugar, is not a bad medicine in the chincough.

MENYANTHES, MARSH-TREFOIL, or Buckbean: a genus of the monogynia order, belonging to the pentandria class of plants. The corolla is hairy: the stigma bifid; the capsule unilocular. This plant grows wild in moist marshy places in many parts of Britain. According to Mr. Lightfoot, the flowers of this plant are so extremely beautiful, that nothing but their native soil could exclude it from a place in every garden. They grow in an elegant spike; are white, dashed with pink, and fringed internally with hairs. The Highlanders esteem an infusion or tea of the leaves as good to strengthen the stomach. According to Dr. Withering, an infusion of the leaves is prescribed in rheumatism and dropsies: a dram of them in powder purges and vomits, and is sometimes given to destroy worms. In a scarcity of hops, the plant is used in the north of Europe to bitter the ale. The powdered roots are sometimes used in Lapland instead of bread, but they are unpalatable. Some people say, that sheep will eat it, and that it cures them of the rot; but from the Upsal Experiments it appears, that though goats eat it, sheep sometimes will not. Cows, horses, and swine, refuse it. Dr. Lewis informs us, that it is an efficacious aperient and deobstruent; promotes the fluid secretions; and, if liberally taken, gently loosens the belly. It has of late gained great reputation in scorbutic and scrophulous disorders; and its good effects in those cases have been warranted by experience. Inveterate cutaneous diseases have been removed by an infusion of the leaves, drank to the quantity of a pint a day, at proper intervals, and continued for some weeks. Boerhaave relates, that he was relieved of the gout by drinking the juice mixed with whey.

MEPHITIC, a name expressing any kind of noxious vapour; but generally applied to that species of vapour called *fixed air*. See **AIR, FIXED AIR, GAS, &c.**

MERCATOR's Chart, or Projection, is a sea-chart, or projection of the surface of the earth in plano. For the construction, use, advantages, &c. of which see the **System of NAVIGATION, Part II. Sect. VI.** and the Article **CHART**.

MERCHANT, a person who buys and sells commodities in gross, or deals in exchanges; or that traffics in the way of commerce, either by importation or exportation. In republics, trading is still more valued; but no where more than in England, where the younger sons and brothers of the best families are frequently bred up to merchandize. Add to this, that many of the Italian princes are the principal merchants of their states, and think it no discredit to make their palaces serve as warehouses, and that many of the kings of Asia, and most of those on the coast of Africa and Guinea, traffic with the Europeans,

M E R

sometimes by their ministers; and sometimes in person. There are companies of *merchants* in London for carrying on considerable joint trade to foreign parts. See **COMPANY**.

Besides these companies, there are other *merchants*, who are distinguished by the country to which they trade; as Dutch *merchants*, who trade to the West Indies; Canary and Portugal *merchants*; Italian *merchants*, who trade to Leghorn, Venice, &c. French and Spanish *merchants*. The law of England, as a commercial country, pays a very particular regard to foreign *merchants*, in innumerable instances. Thus it is provided by Magna Charta, c. 30. that all *merchants*, unless before-hand publicly prohibited, shall have safe conduct to depart from, to come into, or tarry in, and to go through England, for the exercise of merchandize, without any unreasonable imposts, except in time of war: and if a war breaks out between us and their country, they shall be attached, if in England, without harm of body or goods, till the king, or his chief justiciary, be informed how our *merchants* are treated in the land with which we are at war; and if ours are secure in that land, they shall be secure in ours. Upon which Montesquieu remarks, with admiration, that the English have made the protection of foreign *merchants* one of the articles of their national liberty: and also, that the English know better than any other people upon earth, how to value at the same time these three great advantages, religion, liberty, and commerce. In this respect their disposition is very different from the genius of the Roman people; who, in their manners, their constitution, and even in their laws, treated commerce as a dishonourable employment, and prohibited the exercise of it to persons of birth, rank, or fortune; and equally different from the bigotry of the canonists, who looked on trade as inconsistent with Christianity, and determined at the council of Melfi, under Pope Urban II. A. D. 1090, that it was impossible with safe conscience to exercise any traffic, or follow the profession of the law. See **COMMERCE**.

Previous to a person's engaging in a general trade, and becoming an universal dealer, he ought to measure up such a fund of useful knowledge, as will enable him to carry it on with ease to himself, and without risking such losses as great ill-concerted undertakings would naturally expose him to. A merchant should therefore be acquainted with the following parts of commercial learning. To be expert in the forms of invoices, accounts of sales, policies of insurance, charter parties, bills of lading, and bills of exchange. He should know the agreement between the money, weights and measures of all parts. If he deals in silk, woollen, linen, or hair manufactures, he ought to know the places where the different sorts of merchandizes are manufactured, in what manner they are made, what are the materials of which they are composed, and from whence they come, the preparations of these materials before working up, and the places to which they are sent after their fabrication. If he confines his trade to that of oils, wines, &c. he ought to inform himself particularly of the appearances of the succeeding crops, in order to regulate his disposing of what he has on hand; and to learn as exactly as he can, what they have produced when got in, for his direction in making the necessary purchases and engagements. He ought to be acquainted with the sorts of merchandizes found more in one country than another, those which are scarce, their different species and qualities, and the properest method for bringing them to a good market either by land or sea. To know which are the merchandizes permitted or prohibited, as well on entering as going out of the kingdoms or states where they are made. To be acquainted with the price of exchange, according to the course of different places, and what is the cause of its rise and fall. To know the customs due on importation or exportation of merchandizes, according to the usage, the tariffs, and regulations, of the places to which he trades. To know the best manner of folding up, embalming, or tunning, merchandizes for their preservation. To understand the price and condition of freighting and insuring ships and merchandizes. To be acquainted with the goodness and value of all necessities for the construction and repairs of shipping, the different manner of their building; what the wood, the masts, cordage, cannon, sails, and all requisites, may cost. To know the wages commonly given to the captains, officers, and sailors, and the manner of engaging with them. He ought to understand the foreign languages, or at least as many of them as he can attain to; these may be reduced to four, viz. the Spanish, which is used not only in Spain, but on the coast of Africa, from the Canaries to the Cape of Good Hope; the Italian, which is understood on all the coasts of the Mediterranean, and in many parts of the Levant; the German, which is understood in almost all the northern countries; and the French, which is now become almost universally current. He ought to be acquainted with the consular jurisdiction, with the laws, customs, and usages of the different countries he does or may trade to; and in general all the ordinances and regulations both at home and abroad that have any relation to commerce. Though it is not necessary for a merchant to be very learned, it is proper that he should know something of history, particularly that of his own country; geography, hydrography; and be acquainted with the discove-

ries of the countries in which trade is established; in what manner it is settled, of the companies formed to support those establishments, and of the colonies they have sent out.

All these branches of knowledge are of great service to a merchant who carries on an extensive commerce; but if his trade and his views are more limited, his learning and knowledge may be so too: but a material requisite for forming a merchant is, his having on all occasions a strict regard to truth, and his avoiding fraud and deceit, as corroding cankers that must inevitably destroy his reputation and fortune.

Trade is a thing of so universal a nature, that it is impossible for the laws of Britain, or of any other nation, to determine all the affairs relating to it: therefore all nations, as well as Great Britain, shew a particular regard to the *law merchant*, which is a law made by the merchants among themselves: however merchants and other strangers are subject to the laws of the country in which they reside. Foreign merchants are to sell their merchandize at the port where they land, in gross, and not by retail; and they are allowed to be paid in gold or silver bullion, in foreign coin or jewels, which may be exported. If a difference arises between the king and any foreign state, the merchants of that state are allowed six months time to sell their effects and leave the kingdom; during which time they are to remain free and unmolested in their persons and goods.

MERCHANT Court, or *Court MERCHANT*, a kind of judicatory power, invested in *merchants*, chosen for that purpose, in several parts of Europe, in order to decide and determine in a summary way, all differences and litigations among themselves and their dependants. The affairs of *merchants* are accompanied with such variety of circumstances, such new and unusual contingencies, which change and differ in every age, with a multitude of niceties and punctilios, and those again altering, as the customs and usages of countries and states alter, that it has been found impracticable to make any laws that could extend to all cases; and our law itself does tacitly acknowledge its own imperfection in this case, by allowing the custom of *merchants* to pass a kind of law in cases of difficulty.

MERCURY, in natural history. The use of mercury in medicine seems to have been little known before the 15th century. The ancients looked upon it as a corrosive poison, though of itself perfectly void of acrimony, taste, and smell: there are examples of its having been lodged for years in cavities both of bones and fleshy parts, without its having injured or affected them. Taken into the body in its crude state, and undivided, it passes through the intestines unchanged, and has not been found to produce any considerable effect. It has indeed been recommended in asthma and disorders of the lungs; but the virtues attributed to it in these have not been warranted by experience. Notwithstanding the mildness and inactivity of crude quicksilver undivided, when resolved by fire into the form of fume, or otherwise divided into very minute particles, and prevented from re-uniting by the interposition of proper substances, or combined with mineral acids, it has very powerful effects; affording the most violent poisons, and the most excellent remedies, that we are acquainted with.

The mercurial preparations, either given internally, or introduced into the habit by external application, seem to liquify all the juices of the body, even those in the minutest and most remote vessels; and may be so managed as to promote excretion through all the emunctories. Hence their common use in inveterate chronic disorders proceeding from a thickness and sluggishness of the humours, and obstinate obstructions of the excretory glands; in scrophulous and cutaneous diseases; and in the venereal lues. If their power is not restrained by proper additions to certain emunctories, they tend chiefly to affect the mouth; and, after having fused the juices in the remoter parts, occasion a plentiful evacuation of them from the salivary glands.

The salutary effects of mercurials do not depend on the quantity of sensible evacuation. This medicine may be gradually introduced into the habit, so as, without occasioning any remarkable discharge, to be productive of very happy effects. To answer this purpose, it should be given in very small doses, in conjunction with such substances as determine its action to the kidneys or the pores of the skin. By this method inveterate cutaneous and venereal distempers have been cured, without any other sensible excretion than a gentle increase of perspiration or urine. Where there are ulcers in any part, they discharge for some time a very fetid matter, the quantity of which becomes gradually less, and at length the ulcer kindly heals. If the mercury should at any time, from cold or the like, affect the mouth, it may be restrained by omitting a dose, and, by warmth or suitable medicines, promoting the perspiration.

Cooling purgatives are also often employed with advantage: but perhaps the most effectual means of giving with safety a sudden check to a mercurial salivation, is by the application of a large blister to the back.

Mercury, as used in medicine, has been employed in a vast variety of different forms. But there is reason to believe, that every useful purpose to be answered by mercury may be obtained from a very few. The mercurial preparations in general, with

a view to their use both externally and internally, may be divided into two great classes, the mild and the acrid. Almost every purpose to be answered by the former, may be accomplished by the unguentum hydrargyri and pilulæ ex hydrargyro of the London and Edinburgh pharmacopœias; while most of the effects to be obtained from the latter, may be derived from the proper use of those preparations hitherto generally known under the title of *calomel* and *corrosive sublimate mercury*.

Quicksilver has sometimes been used in its pure metallic state, with the view of removing obstructions in the alimentary canal, from an idea that it would operate by its weight. But it is seldom attended with a good effect, and sometimes it must do harm.

Whole volumes have been written respecting its operation and use in different diseases, and particularly in venereal affections. Some refer its operation to an evacuant power, others to its operating as a peculiar stimulus, and a third set to its possessing a power of destroying or neutralizing the venereal virus. Of these opinions, the latter is the most generally received, and perhaps the best founded. But for a more full view of the controversy, we may refer our readers to late publications on the venereal disease, and on mercury, by Mr. John Hunter, Dr. Schwediauer, and Dr. Duncan.

In a virulent gonorrhœa, it is doubted whether mercury be necessary. This disease is commonly treated like any similar inflammation: and the chief things attended to are cleanliness of the parts, a regular belly, and an abstinence from every thing stimulant in food, drink, &c. An injection of oil with calomel, or white precipitate, is much used; and some prefer a watery solution of opium. The more active injections have sometimes very disagreeable consequences. See the *System of Medicine*.

When the constitution is affected, which is known by ulcers on the glands, buboes, ulcers in the mouth or throat, copper-coloured spots and ulcers on the surface, nodes, &c. mercury is thrown into the body either by friction or by the mouth. The general rule is, to keep up a slight soreness of the gums for some short time after the symptoms disappear; at the same time it is to be remembered, that mercury sometimes continues gleet, and induces ulcers, that are difficultly distinguished from venereal ones: and that these last only yield to warm bathing, diaphoretic diluents, opiates, country air, and milk diet. Corrosive sublimate is sometimes used, as more speedily arresting disagreeable, spreading, or dangerous ulcers; but the completion of the cure should always be trusted to the mild preparations alone. Mercury is also used in rabies canina, in worms, in hydrocephalus internus, in tetanus, and is by some considered as an antidote to the variolous matter. For a further account see the *System of CHYMISTRY*, Part III. Chap. II. Sect. V.

MERCURY, in the heathen mythology. Most of the actions and inventions of the Egyptian Mercury have likewise been ascribed to the Grecian, who was said to be the son of Jupiter and Maia, the daughter of Atlas. No one of all the heathen divinities had so many functions allotted to him as this god: he had constant employment both day and night, having been the common minister and messenger of the whole Pantheon; particularly of his father Jupiter, whom he served with indefatigable labour, and sometimes indeed in a capacity of no very honourable kind. Lucian is very pleasant upon the multitude of his avocations; and, according to the confession of the emperor Julian, Mercury was no hero, but rather one who inspired mankind with wit, learning, and the ornamental arts of life, than with courage. The pious emperor, however, omits some of his attributes; for this god was not only the patron of trade, but also of theft and fraud.

His most magnificent temple was on mount Cylene, in Arcadia. He is described by the poets as a fair beardless youth, with flaxen hair, lively blue eyes, and a smiling countenance. He has wings fixed to his cap and sandals, and holds the caduceus (or staff surrounded with serpents with two wings on the top, see *CADUCEUS*) in his hand; and is frequently represented with a purse, to shew that he was the god of gain. The animals sacred to him, were the dog, the goat, and the cock. In all the sacrifices offered to him, the tongues of the victims were burnt; and those who escaped imminent danger, sacrificed to him a calf with milk and honey.

MERCURY, in heraldry, a term used in blazoning by planets, for the purple colour used in the arms of sovereign princes. See the *SYSTEM*, Article III.

MERCURY, γ , in astronomy, the smallest of the inferior planets, and the nearest to the sun. See the *SYSTEM*, Sect. VIII.

MERGUS, in the Linnæan system of *ornithology*, the name of a distinct genus of birds, of the order of the *anseres*. The distinguishing characteristic of this genus is, that the beak is somewhat cylindric, and has a crooked point, and its denticulations of a subulated form. There are six species; the largest of which is the merganser, or goosander, a native of Europe. These birds frequent our rivers and other fresh waters, especially in hard winters; they are great divers, and live on fish. They are never seen in the southern parts of Great Britain during

ded
ur-
un-
and
b-
oie
mel

ate,
hal,
is
do

and
ns.
oe-
g a
efe
he
we
fe,
nd

be
lar
of
ng
o-
a-
e-
cf

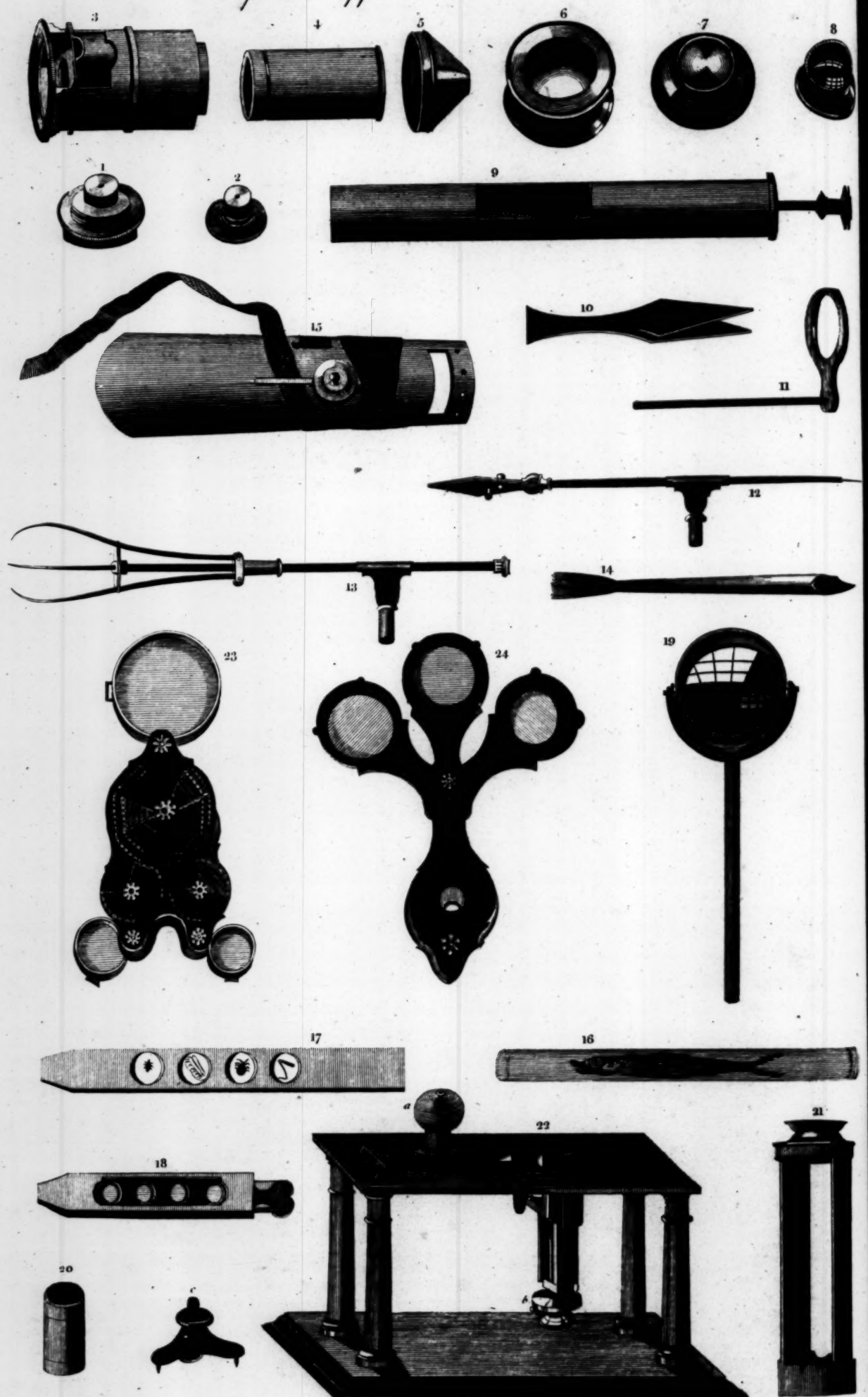
ers
r-
is
he
ne
to
n-
s:
u-
is
g.
ys
ed
s,
r.
l.

ns
o-
nd
i-
nd
n-
ly
r,
d.
;
y
t,
e.
;
ft

a.
m
s
r-
e,
d
o
d

,
e
r
f
-
t
-
g

Microscopical Apparatus. — See the Article.



*Copied by Permission from H. Adams Essays on the Microscope.
Published at the Art Direct, by C. Gode, N° 17, Boulevard des Capucines.*

ing summer; when they retire far north to breed; for in that season they have been shot in the Hebrides. They are uncommonly rank, and scarce eatable. The male weighs four pounds: its length is two feet four inches; the breadth three feet two. The bill is three inches long, narrow, and finely toothed, or serrated; the colour of that and of the irides is red. The *dun diver*, or the female, is less than the male: the head and upper part of the neck is ferruginous; the throat white, the feathers on the hind part are long, and form a pendent crest; the back, the coverts of the wings, and the tail, are of a deep ash-colour: the greater quill-feathers are black, the lesser white: the breast and middle of the belly are white, tinged with yellow. Latham makes this bird of the 91st genus. For a representation, see Plate V.

MERIDIAN, in geography, a great circle supposed to be drawn through any part on the surface of the earth, and the two poles; and to which the sun is always perpendicular at noon. In astronomy, the circle is supposed to be in the heavens, and exactly perpendicular to the terrestrial one. See Treatise on the GLOBES.

MEROPS, in the Linnæan system of ornithology, is the 23d genus belonging to the order of Picæ. The bill is crooked, flat, and carinated; the tongue is jagged at the point; and the feet are of the walking kind. There are six species. The *apiaster*, or bee eater, has an iron-coloured back; the belly and tail are of a bluish green; and the throat is yellow. It inhabits the south of Europe. Latham makes the *apiaster*, or bee-eater, belonging to the 26th genus. For the representation, see Plate I.

MESENTERY, **MESENTERIUM**, formed of *μεσος*, middle, and *εντερον*, intestine, or **MESARÆUM**, in anatomy, a fatty membranous body; thus called as being placed in the middle of the intestines, which it connects to one another. The *mesentery* is almost of a circular figure, with a narrow production; to which the end of the colon, and the beginning of the rectum, are tied. See the SYSTEM, Part III. Sect. VI.

MESOCOLON, *μεσocolον*, in anatomy, that part of the **MESENTERY** which, having reached the extremity of the ileum, contracts and changes its name. At this place the particular lamina, which is turned to the right side, forms a small transverse fold, called *ligamentum coli dextrum*. Afterwards the *mesocolon* ascends towards the kidney, where it seems to be lost by the immediate adhesion of the colon to that kidney, and to the first incurvature of the duodenum. Then it appears again, and increasing in breadth, continues its course almost transversely under the liver, stomach and spleen, where it begins to turn downward, under the left hypocondrium, towards the kidney on the same side. See the SYSTEM, Part III. Sect. VI.

MESSIAH, a word signifying one anointed, or installed into an office by unction. It was usual among the Jews to anoint kings, high-priests, and sometimes prophets, at the designation or installment of them, to signify emblematically the mental qualifications necessary for discharging these offices. Saul, David, Solomon, and Joash, kings of Judah, received the royal unction. The name **MESSIAH**, *Anointed*, or *Christ*, (*Χριστος*) was given to the kings and high-priests of the Jews. The patriarchs, and prophets are also called by the name of *Messiahs*, or the *Lord's anointed*. See 1 Sam. xii. 3, 5. 1 Chron. xvi. 22. Ps. cv. 15.

But this name *Messiah* was principally and by way of eminence given by the Jews to their expected great Deliverer, whose coming they still vainly wait; and is a name the Christians apply to *Jesus Christ*, in whom the prophecies relating to the *Messiah* were accomplished. The sum of these prophecies is, That there should be a glorious person named *Messiah*, descended from Abraham, Isaac, and Jacob, who should be born at Bethlehem, of a virgin of the family of David, then in its decline, before the Jews ceased to be a people, while the second temple was standing, and about 500 years after Ezra's time; who, though appearing in mean circumstances, should be introduced by a remarkable forerunner, whose business it should be to awaken the attention and expectation of the people. That this illustrious person called *Messiah*, should himself be eminent for the piety, wisdom, and benevolence of his character, and the miraculous works he should perform: yet that, notwithstanding all this, he should be rejected and put to death by the Jews; but should afterwards be raised from the dead, and exalted to a glorious throne, on which he should through all generations continue to rule, at the same time making intercession for sinners. That great calamities should for the present be brought on the Jews for rejecting him; whereas the kingdom of God should by his means be erected among the Gentiles, and disperse itself even unto the ends of the earth; wherever it came, destroying idolatry, and establishing true religion and righteousness. In a word, that this glorious Person should be regarded by all who believed in him, as a divine teacher, an atoning sacrifice, and a royal governor: by means of whom, God would make a covenant with his people, very different from that made with Israel of old; in consequence of which they should be restored to, and established in, the divine favour, and fixed in a state of

No: 105. VOL. III.

perpetual happiness. *Jesus Christ* asserts himself the *Messiah*. In St. John. iv. 25. the Samaritan woman says to *Jesus*, *I know that when Messiah comes, who is called the Christ, he will tell us all things.* *Jesus answered her, I that speak to thee am he.* See **JESUS Christ**, and **CHRISTIANITY**.

METACARPUS, or **METACARPUM**, from *μετα*, behind, and *καρπος*, hand, in anatomy, that part of the hand between the wrist and the fingers. For a description, see the SYSTEM, Part I. Sect. IV. For a representation, see Plate I. fig. 1. Letters i. &c.

METAL, in natural history, a simple, ponderous, shining, fixed, opaque body, that fuses, and becomes fluid, by fire, and by cold coagulates and hardens into a solid mass, capable of being distended under the hammer. *Metal* is said to be simple; as it may be affirmed of every the minutest particle of a *metal*, e. g. a grain of gold, that it is gold, or has all the properties of gold. *Fusible* by fire; that is, when exposed to a great fire, it dissolves into parts which are easily moveable among themselves, or are in actual motion. See **FUSION**. *Fixt*, i. e. bearing the fire without flying off in vapours; though it is only up to a certain degree that *metals* are fixed; for, by the large burning-glasses of Mess. Tschirnhausen and Villette, all *metals* are found to evaporate. Such is the proper idea of *metals*, which is not applicable to any other body in nature; for a diamond, or other stone, though a simple body, is not fusible in the fire, nor capable of being stretched under the hammer. And salt, though dissolvable by fire, is not malleable, but breaks under the hammer. See SYSTEM of CHYMISTRY. Part II. under the Article *Metallic Substances*.

METAL, in heraldry. There are two metals used in heraldry, by way of colours, viz. gold and silver, in blazon called *or* and *argent*. In the common painting of arms these metals are represented by white and yellow, which are the natural colours of those metals. In engraving, gold is expressed by d tting the coat, &c. all over; and silver, by leaving it quite blank. It is a general rule in heraldry, never to place metal upon metal, nor colour upon colour: so that if the field be of one of the metals, the bearing must be of some colour; and if the field be of any colour, the bearing must be of one of the metals. See the SYSTEM, Sect. III. Plate II.

METALLURGY, according to Boerhaave, comprehends the whole art of working metals, from the glebe or ore, to the utensil; in which sense, assaying, smelting, refining, parting, smithery, gilding, &c. are only branches of metallurgy. But in the present work, Gilding, Parting, Purifying, Refining, &c. are treated under their proper names. With others, therefore, we have chosen to restrain *Metallurgy* to those operations required to separate metals from their ores for the uses of life. These operations are of two kinds: the smaller, or assaying; and the larger, or smelting. See the articles *Assaying*, *Smelting*, *Gilding*, *Refining*, &c.

METAMORPHOSIS, *Μεταμορφωσις*, formed of *μετα*, change, or removal from one place or state to another, and *μορφη*, form, or figure transformation; the change of a person or thing into another form.

METAPHOR, **METAPHORA**, *Μεταφορα*, translation or displacing, of *μετα*, trans, and *Φερω*, I bear, or carry, in rhetoric, a figure of speech, or a species of trope, whereby a word is transferred from its proper signification to another, different from it, by reason of some similitude between them; or whereby the proper denomination of one thing is applied to another; which other thing is more elegantly explained by this tralatitious or foreign name, than by that which naturally belongs to it. See Treatise on ORATORY, Part III. Sect. III.

METAPHYSICS, is that part of philosophy which considers the nature and properties of thinking beings. Aristotle, after treating on physics, begins his next book (in which he pretends to elevate the mind above corporeal objects, to fix it on the contemplation of God, of angels, and of things spiritual, and to enable it to judge of the principles of sciences by abstraction) with the Greek words *μετα τα φυσικα*, *post physicam*, i. e. *after physics*. His disciples, and succeeding philosophers, have formed, of these two, one word, **METAPHYSICS**, by which they mean that science of which we have just now given the definition.

Metaphysics is divided, according to the objects that it considers, into six principal parts, which are called, 1. *Ontology*, 2. *Cosmology*. 3. *Anthropology*. 4. *Psychology*. 5. *Pneumatology*. 6. *Theodicy*, or *Metaphysical Theology*.

1. The doctrine that is named ontology, is that part of metaphysics which investigates, and explains, the nature and general essence of all beings, as well as the qualities and attributes that essentially appertain to them, and which we ought to assign them by abstraction, as considering them *a priori*. Hence it appears, that this doctrine should proceed in its operations from the most simple ideas; such as do not admit of any other qualities of which they may be compounded. These simple ideas are, for example, those of being, of essence, of substance, of mode, of existence, as well with regard to time as place; of a necessary cause, of unity, the idea of negation, the difference

between a being that is simple or compound, necessary or accidental, finite or infinite; the idea of essential and abstract properties, as of the greatness, perfection, and goodness of beings: and so of the rest. The business therefore of ontology, is to make us acquainted with every kind of being in its essence and abstract qualities, and such as are distinct from all other beings. This knowledge being once established on simple principles, just consequences may from thence be drawn, and those things proved after which metaphysics enquires, and which is its business to prove.

It is easy to conceive, that even a clear knowledge of beings, and their essential properties, would be still defective and useless to man, if he did not know how to determine and fix his ideas by proper denominations, and consequently to communicate his perceptions to those whom he would instruct, or against whom he is obliged to dispute, as they would not have the same perceptions that he has. It is, by the way, perhaps, one of the greatest advantages that we have over other animals, to be able so to determine our ideas by signs or denominations, either of writing or speech, as to refer each particular perception to its general idea, and each general perception to its particular idea. To render therefore our ideas intelligible to others, we must have determinate words or denominations for each being; and the qualities of each being; and ontology teaches us those terms which are so necessary to fix our ideas, and to give them the requisite perspicuity and precision, that we may not dispute about words, when we endeavour to extend the sphere of our knowledge, or when we debate concerning the essence of an object or endeavour to make it more evident.

2. Metaphysics, after having, in as solid a manner as possible, explained and established the principles above mentioned, continues its enquiries to the second part, that is called Cosmology, and examines into the essence of the world, and all that it contains; its eternal laws; of the nature of matter; of motion; of the nature of tangible bodies, of their attributes and essential qualities, and of all that can be known by abstraction, and sometimes also by adding the lights that man acquires concerning them by the experience of his senses. It is also in cosmology that we examine the Leibnitzian system; that is, whether God, in creating the world, must necessarily have created the best world, and if this world be so in effect. And in this manner they pursue the argument from consequence to consequence to its last resort. All philosophers, however, do not go equally deep. Each mind has its dose of penetration. Due care should likewise be taken, that subtilty, in this chain of reasoning, carried beyond the general bounds of the human mind, do not prejudice either the perspicuity or the truth of ideas; seeing that error here too nearly approaches the truth; and that every idea, which cannot be rendered intelligible, is in effect equal to a false idea.

3. Anthropology, or the knowledge of man, forms the third branch of metaphysics. It is subdivided into two parts. The first, which consists in the knowledge of the exterior parts of the human frame, does not belong to this science: anatomy and physiology teach that. The business here is only a metaphysical examination of man, his existence, his essence, his essential qualities and necessary attributes, all considered *a priori*; and this examen leads at the same time to

4. Psychology, which consists in the knowledge of the soul in general, and of the soul of man in particular; concerning which the most profound, the most subtle and abstract researches have been made, that the human reason is capable of producing; and concerning the substance of which, in spite of all these efforts, it is yet extremely difficult to assert any thing that is rational, and still less any thing that is positive and well supported.

5. The fifth part of metaphysics is called pneumatology. It is not a very long time since this term has been invented, and that metaphysicians have made of it a distinct doctrine. By this they mean the knowledge of all spirits, angels, &c. It is easy to conceive that infinite art is necessary to give an account of what we do not absolutely know any thing, and of which, by the nature of the subject itself, we can never know any thing. But the metaphysician presently offers to shew us, "what is the idea of a spirit; the effective existence of a spirit; what are its general qualities and properties; that there are rational spirits, and that these rational spirits have qualities that are founded in the moral qualities of God:" for this is, in so many words, what is taught us by pneumatology.

6. Metaphysical theology, which M. Leibnitz and some others call Theodicy, is the sixth and last doctrine of metaphysics. It teaches us the knowledge of the existence of God, to make the most rational suppositions concerning his divine essence, to form a just idea of his qualities and perfections, and to demonstrate them by abstract reasoning *a priori*. Theodicy differs from natural theology, in as much as this last borrows, in fact, from theodicy, proofs and demonstrations to confirm the existence of a supreme being; but after having solidly established that great truth, by extending its consequences, natural theology teaches us what are the relations and connections that subsist between that Supreme Being and man, and what are the moral

duties that result from that connection. As pneumatology is a science highly insidious and chimerical, so is metaphysical theology susceptible of sound argument and demonstration; to the great comfort of mankind, the whole of whose happiness is founded on the certainty of this science. If the effects and operations of spirits in the universe were as evident as the effects and operations of the Deity, and their necessary existence as capable of being proved *a priori*, pneumatology would be a doctrine of equal certainty with theodicy: but as neither one nor the other can be proved with regard to spirits in general, whilst God manifests himself in every part of nature, we have only to descend from the most simple and abstract ideas, to those that are the most compound; and from thence to reascend, by a chain of reasoning, from the creature up to the Author of the creature and of all nature: we shall find, that the result of all these operations of the mind will constantly be, The necessity of the existence of a God; and we may at all times determine, though very imperfectly, from the weakness of our discernment, what that Supreme Being must be, by positively determining what he cannot be. Every thing that can concur to furnish new proofs on this subject, or to elucidate and establish those which are already known, is therefore of inestimable value to mankind: and though this were the only object of metaphysics, it would highly merit the attention of those of the most refined and most exalted genius.

METEOR, (by the Greeks called *μετεωρα*, q. d. *sublimia*, or "high raised;" by the Latins *impressiones*, as making signs or impressions in the air,) commonly denotes any bodies in the air that are of a flux or transitory nature. Hence it is extended to the phenomena of hail, rain, snow, thunder, &c. but is most commonly confined to those unusual and fiery appearances named *falling stars*, *ignes fatui*, *auroræ boreales*, &c. whether they appear at a great distance from the earth or not. Till the discovery of electricity these meteors could not be accounted for; but they are now resolved, by the universal consent of philosophers, into the action of that fluid; which, though unheeded, hath shewed itself in all ages. See LIGHT.

METHOD, *METHODUS*, from *μεθοδος*, in logic and rhetoric, the art or rule of disposing things in such a manner, as that they may be easily comprehended; either in order to discover the truth, which we ourselves are ignorant of, or to shew or demonstrate it to others when known, or to fix it in the memory. See the Treatise on LOGIC, Part IV. and the Treatise on ORATORY, Part II.

METHODISTS. The *Methodists* form a very considerable class principally of the lower people in this country. They sprung up about fifty years ago, at Oxford, and were soon divided into two parties; the one under the direction of Mr. George Whitefield, and the other under that of the two brothers, John and Charles Wesley. The theological system of Mr. Whitefield and his followers is calvinistic; that of Mr. Wesley and his disciples Arminian; and the latter maintains the possibility of attaining sinless perfection in the present state.

METONYMY, *Μετωνυμία*, from *μετα*, *trans*, and *ονομα*, *nomen*, *name*; a rhetorical trope, consisting in a transmutation or change of names; or a putting of the effect for the cause, or the subject for the adjunct; and *vice versa*. See the Treatise on ORATORY, Part III. Sect. III.

MEZZO-TINTO, in engraving, a particular manner of engraving figures on copper. It is very different from the common way of engraving. See ENGRAVING. To perform it, they rake, hatch, or punch the surface of the plate all over with a knife, or instrument made for the purpose, first one way, then the other, across, &c. till the face of the plate be entirely furrowed with lines or scratches, close, and as it were contiguous to each other; so that, if any impression was thus taken from it, it would be one uniform blot or smut. This done, the design is drawn, or marked, on the surface; after which, they proceed with burnishers, scrapers, &c. to expunge or take out the dents or scratches in all the parts where the lights of the piece are to be; and that more or less, as the lights are to be stronger or fainter; leaving those parts black, which are to represent the shadows. As it is much easier to scrape or burnish away parts of a dark ground corresponding with the outline of any design sketched upon it, than to form shades upon a light ground, by an infinite number of hatches, strokes, and points, which must all terminate with exactness on the outline, as well as differ in their force and manner, the method of scraping, as it is called, in *Mezzo-tinto*, consequently becomes much more easy and expeditious than any other method of engraving. The instruments used in this kind of engraving are, *cradles*, *scrapers*, and *burnishers*.

MICAH, or *The Book of MICAH*, a canonical book of the Old Testament, written by the prophet Micah, who is the seventh of the twelve lesser prophets.

MICROMETER, an astronomical machine, which, by means of a very fine screw, serves to measure extremely small distances in the heavens, as the apparent diameters of the planets, to a great degree of accuracy. The word comes from the Greek *μικρος*, *parvus*, and *μετρον*, *mensura*; in regard to a small length,

length, e. g. an inch, is hereby divided into vast numbers of parts, e. g. some 2800, and in others more.

MICROSCOPE, an optical instrument consisting of lenses, or mirrors, by means of which small objects appear larger than they do by the naked eye. Single microscopes consist of lenses, or mirrors; or if more lenses or mirrors be made use of, they only serve to throw light upon the object, and not contribute to enlarge the image of it. Double microscopes are those in which the image of an object is composed by means of more lenses or mirrors than one. For the principles on which the construction of microscopes depend, and the best methods of making them, see the System of OPTICS. Part IV. Section II. and Plate IV. Fig. 30, 31, 32.

MICROSCOPIC APPARATUS. See the PLATE.

Fig. 9. A cylindrical piece, intended for the solar opaque microscope: by pulling back the spiral spring, smaller or larger objects may be confined in it.

Fig. 10. A pair of forceps to take up any occasional object.

Fig. 11. A piece to hold the speculum; this piece is generally fitted to the microscopes which will be described in the plates in the System of OPTICS.

Fig. 12. A long steel wire, with a small pair of pliers at one end, and a steel point at the other; the wires slip backwards or forwards in a spring tube, which is affixed to a joint, at the bottom of which is a pin to fit one of the holes in the stage; this piece is used to confine small objects.

Fig. 13. A pair of triangular nippers for taking hold and confining a large object.

Fig. 14. A camel's hair pencil to brush the dust off the glasses; the upper part of the quill is scooped out, to take up a drop of any fluid, and place it on either of the glasses for examination.

Fig. 15. A fish pan, whereon a small fish may be fastened, in order to view the circulation of the blood; its tail is to be spread across the oblong hole at the smallest end, and tied fast by means of the ribbon affixed; by shoving the knob which is on the back of it through the slit made in the stage, the tail of the fish may be brought under the lens which is in use.

Fig. 16. A glass tube to receive a small fish, &c.

Fig. 17. Represents one of the ivory sliders, wherein objects are placed between two pieces of talc, and confined by a brass ring.

Fig. 18. A brass slider, into which is fitted a flat piece of glass, and a brass slider, containing one or two small concave glasses, the others flat; it is designed to confine small living objects, and when used is to be placed between the upper plates of the slider hold.

Fig. 19. A convex lens, which fits the stage, by means of the long pin adhering to it; it is designed to collect the light from the sun or a candle, and to throw them on any object placed on the stage: this piece is but little used at present.

Fig. 20. An ivory box, containing at one end spare talc for the ivory sliders, and at the other, spare rings for pressing the talcs together and confining them to the slider.

Fig. 22. An instrument for cutting thin transverse sections of wood. It consists of a wooden base, which supports four brass pillars; on the top of the pillars is placed a flat piece of brass, near the middle of which there is a triangular hole. A sharp knife, which moves in a diagonal direction, is fixed on the upper side of the aforementioned plate, and in such a manner, that the edge always coincides with the surface. The knife is moved backwards and forwards by means of the handle. The piece of wood is placed in the triangular trough which is under the brass plate, and is to be kept steady therein by a milled screw, which is fitted to the trough; the wood is to be pressed forward for cutting by the micrometer screw. The pieces should be applied to this instrument immediately on being taken out of the ground, or else they should be soaked for some time in water, to soften them, so that they may not hurt the edge of the knife. When the edge of the knife is brought in contact with the piece of wood a small quantity of spirits of wine should be poured on the surface of the wood to prevent its curling up; it will also make it adhere to the knife, from which it may be removed by pressing a piece of blotting paper on it.

Letter c. An appendage to the cutting engine, which is to be used instead of the micrometer screw; being preferred by some practitioners to it. It is placed over the triangular hole, and kept flat down upon the surface of the brass plate, while the piece of wood is pressed against a circular piece of brass, which is on the under side of it. This circular piece of brass is fixed to a screw, by which its distance from the flat plate on which the knife moves may be regulated.

It is necessary that the curious microscopic observer should be furnished with the following instruments, as the most convenient for investigating the objects of his pursuits, as it rises before him.

In the case, fig. 23, are three lenses of different magnifying powers, that all turn up and shut into the case.

Fig. 24, contains also three lenses of different foci, which are all made to turn into the case, and may be used combined

or separately. The three lenses in themselves afford three different magnifying powers; by combining two and two we make three more; the three together make a seventh magnifying power with three lenses. When the three lenses are used together, it is best to turn them into the case, and look through the hole; as this combined magnifying power is so great, that it requires to have a portion of the light which falls in the lenses excluded, in order to attain distinct vision. Further, the eye is also by this means made to coincide more easily with the axis of the glasses.

Those who wish for further information respecting the Microscopical Apparatus, its uses, &c. are referred to Mr. Adams's Essays on the Microscope.

MICROSCOPIC Objects. All things too minute to be viewed distinctly by the naked eye, are proper objects for the microscope. Dr. Hooke has distinguished them to be exceeding small bodies; exceeding small pores, or exceeding small motions. Under one or other of these three heads, almost every thing about us affords us matter of observation, and may conduce both to our amusement and instruction. An examination of these objects, however, so as to discover truth, requires a great deal of attention, care, and patience, with some skill and dexterity, to be acquired chiefly by practice, in the preparing, managing, and applying them to the microscope.

Whatever object offers itself as the subject of our examination, the size, contexture, and nature of it, are first to be considered, in order to apply it to such glasses, and in such a manner, as may shew it best. The first step should always be to view the whole together, with such a magnifier as can take it in all at once; and after this the several parts of it may the more fitly be examined, whether remaining on the object, or separated from it. The smaller the parts are which are to be examined, the more powerful should be the magnifiers employed; the transparency or opacity of the object must also be considered, and the glasses employed accordingly suited thereto; for a transparent object will bear a much greater magnifier than one which is opaque, since the nearness that a glass must be placed at, unavoidably darkens an object if in its own native opaque, and renders it very difficult to be seen, unless by the help of the apparatus contrived for that purpose, which has a silver speculum. Most objects however become transparent by being divided into extremely thin parts.

The nature of the object also, whether it be alive or dead, a solid or a fluid, an animal, a vegetable, or a mineral substance, must likewise be considered, and all the circumstances of it attended to, that we may apply it in the most advantageous manner. If it be a living object, care must be taken not to squeeze or injure it. If it be a fluid, and that too thick, it must be diluted with water; and if too thin, we should let some of its watery parts evaporate. Some substances are fittest for observation when dry, others when moistened; some when fresh, and others after they have been kept some time.

Light is the next thing to be taken care of; for on this the truth of all our observations depends; and a very little observation will shew how very different objects appear in one degree of it, to what they do in another: so that every new object should be viewed in all degrees of light, from the greatest glare of brightness to perfect obscurity, and that in all positions to each degree, till we hit upon the certain form and figure of it. In many objects it is very difficult to distinguish between a promineny and a depression, a black shadow and a black stain, and in colour between a bright reflection and a whiteness. The eye of a fly in one kind of light appears like a lattice drilled full of holes, in the sun-shine like a solid substance covered with pyramids, in another with cones, and in others with still different shapes.

The degrees of light must always be suited to the object; if that be dark, it must be seen in a full and strong light; but if transparent, the light should be proportionably weak; for which reason there is a contrivance both in the single and double microscope to cut off abundance of the rays, when such transparent objects are to be examined by the largest magnifiers. The light of a candle for many objects; and especially for such as are very bright and transparent, and very minute, is preferable to day-light: for others a serene day-light is best; but sun-shine is the worst light of all, for it is reflected from objects with so much glare, and exhibits such gaudy colours, that nothing can be determined from it with any certainty.

Most objects require also some management, in order to bring them properly before the glass. If they are flat and transparent, and such as will not be injured by pressure, the best way is to inclose them in sliders between two Muscovy talcs or isinglasses, as in Fig. 17. Plate III. Microscopic Apparatus. In this way the feathers of butterflies, the scales of fishes, and the farina of flowers, may be very conveniently preserved; as also the parts of insects, the whole bodies of minute ones, and a great number of other things. These are to be kept in sliders, each containing three, four, or more holes, and these must not be filled promiscuously; but all the things preserved in one slider should be such as require one and the same magnifying power to view

view them, that there may not be a necessity of changing the glasses for every object, and the sliders should be marked with the number of the magnifier it is proper to be viewed with. In placing the objects in the sliders, it is always proper to have a small magnifier, of about an inch focus, in your hand, to examine and adjust them by, before they are fixed down with the rings.

Small living objects, such as lice, fleas, bugs, mites, minute spiders, &c. may be placed between these talcs without injuring them, if care be taken to lay on the brass rings without pressing them down, and they will remain alive many weeks in this manner; but if they are too large to be treated thus, they should be either preserved between two concave glasses, or else viewed immediately, by holding them in the pliers, or sticking them on the point at the other end of that instrument. If fluids come under examination, to discover the animalcules in them, a small drop is to be taken with a hair pencil, as in fig. 14, or on the nib at the end of it, and placed on a plate of glass; and if they are too numerous to be thus seen distinctly, some water warmed, by holding it in the mouth, must be added to the drop, and they will then separate and be seen distinctly. This is particularly necessary in viewing the animalcules in the *semen masculinum* of all creatures; which, though extremely minute, are always so numerous, that without this caution their true form can seldom be seen. But if we are to see the salts in a fluid, the contrary method must be observed, and the plate of glass must be held gently over the fire, till part of the liquor is evaporated.

The dissection of minute animals, as lice, fleas, &c. requires patience and care; but it may be done very accurately by means of a needle and a fine lancet, placing the creature in a drop of water, for then the parts will readily unfold themselves, and the stomach, guts, &c. be very distinctly seen. These seem the best ways of preserving transparent objects; but the opaque ones, such as seeds, woods, &c. require a very different treatment, and are best preserved and viewed in the following manner:

Cut cards into slips about half an inch long, and a tenth of an inch broad; wet these half way of their length in gum-water, and with that fasten on several pieces of the object, and as the spots of cards are of different colours, such should be chosen for every object as are the most different from its own colours. These are very convenient for viewing by the microscope made for opaque objects with the silvered speculum: but they are proper for any microscope that can view opaque bodies.

Great caution must be used in forming a judgment on what is seen by the microscope, if the objects are extended or contracted by force or dryness. Nothing can be determined about them, without making the proper allowances; and different lights and positions will often shew the same object very different from itself. There is no advantage in any greater magnifier, than such is capable of shewing the object in view distinctly; and the less the glass magnifies, the more pleasantly the object is always seen. The colours of objects are very little to be depended on, as seen by the microscope; for the several component particles being by this means removed to great distances from one another, may give reflections very different from what they would, if seen by the naked eye.

The motions of living creatures also, or of the fluids contained in their bodies, are by no means to be hastily judged of; for what we see by the microscope, without due consideration; for as the moving body, and the space wherein it moves, are magnified, the motion must be so too; and therefore that rapidity with which the blood seems to pass through the vessels of small animals must be judged of accordingly. Baker's Microscope, p. 52, 62.

The frog affords the curious in microscopic observations, a very beautiful view of the circulation of the blood; but the method of examining it to advantage was never hit upon till the contrivance of the late ingenious Dr. Stuart for that purpose. This he did by the solar microscope in the following manner: The looking-glass, tube, and convex lens, are the same in this as in the common solar microscope; but instead of the little pocket microscope of Wilson, he used the belly part of the common large reflecting one, fixed horizontally on a pedestal, just at an equal height with the tube. This stands on a little shelf made to support it; and to its snout, which lies on a level with the tube, the magnifiers are screwed: the object being extended and fastened with strings and pins on a frame, contrived for that purpose, is applied between the tube and the magnifier, whereby the sun's rays, reflected from the looking-glass, through the tube upon the object, pass on through the magnifier, and exhibit upon the screen an image of the object most prodigiously enlarged. Baker's Microsc. p. 132.

To view a frog with this apparatus, the skin of the belly is to be opened from near the anus to the throat, and then giving it a little snip side-ways both at the top and bottom, and sticking a fish-hook into each corner of the skin, it was easily extended before the microscope, and shewed on the screen the most beautiful view imaginable of the veins and arteries of the skin, with the blood circulating through them. In the arteries thus viewed, the blood is seen to stop and recede a little at every pulsation by the dilatation, and rush forcibly on again by the contraction of

the heart; while in the veins it ever kept the same equable and uniform current, with a surprising rapidity; and when the screen was removed farther back, and the object by that means more enlarged, the alternate expansion and contraction of the sides of the arteries were very visible. After this, the abdomen of the frog being opened, and the muscles of it being extended before the microscope in the same manner as the skin was, the structure of these muscles is beautifully seen; being all made up of bundles of transparent strings of fibres, all lying parallel to one another, and joined by a common membrane.

These strings or fibres appeared also through their whole length made up of roundish vesicles, and resembled rustics divided longitudinally; but there is no certainty of any circulation being seen in these.

When this has been sufficiently examined, part of the creature's guts being pulled out and extended with the mesentery, there is seen the finest of all views of the circulation of the blood. Words are not able to describe this wonderful scene. The blood is seen passing through numberless vessels at one and the same instant, in some one way, and in others directly the contrary. Several of the vessels are thus magnified to more than an inch in diameter, and the globules of the blood rolling through them, appear near as large as pepper corns; while in many of the minutest vessels only single globules were able to find their passage, and that too by changing their shape into an oblong spheroid. The pulsation and acceleration of the blood in the arteries are thus also very beautifully seen. As the animal under examination grows languid and near expiring, the blood in the arteries will often stop on a sudden, and seem as if it were coagulating, and will then run back for some time; after which it will recover its natural course with a great deal of rapidity. A due consideration of these particulars may possibly account for the intermissions, starts, and irregularities, in the pulse of persons near death. Baker's Microscope, p. 136.

EXPLANATION OF THE PLATES ON MICROSCOPIC OBJECTS. Plate I.

Fig. 1. The *Hydra Grisea* Polype is about three-fourths of an inch when stretched out; some are found an inch and a half long. It can be made to contract itself either by touching, or agitating the water in which it is contained. It contracts itself so much when taken out of the water, as to appear only as a lump of jelly. It can contract or extend its arms without extending or contracting its body, or the body without making any alterations in the arms: or it can contract or dilate only some of the arms independent of the rest; it can also bend the body and arms in all possible directions.

Fig. 2. The *Hydra* Polype represented in this figure, is with its arms hanging down, making different turns and returns, often directing some of them back again to the top of the water. It can also dilate the body at different places, sometimes at one part, and then again at another; sometimes they are thick set with folds, which, if carelessly viewed, might be taken for rings.

Fig. 3. A Polype suspended in the water by a piece of pack-thread, a millipede seized by it, and drawn towards its mouth by one of its arms, while another is employed in seizing a small aquatic insect.

Fig. 4. Represents a Polype engaged with a very large worm.

Fig. 6. Represents a Polype that has swallowed a small fish, and taken the shape of it.

Fig. 7. Is a Polype that has swallowed a worm, which, from its transparency, may be distinctly seen in this figure. The worm is at first macerated in the stomach of the Polype, and when the nutritious juices are separated from it, the remainder is discharged by the mouth. It is with these as with other voracious animals, as they eat a great deal at once, so also they can fast for a long time: the history of insects furnishes us many examples of this kind.

Fig. 8. Represents the *Hydra viridis* Polype adhering to the common pond weed. The arms of this polype are seldom longer than their bodies.

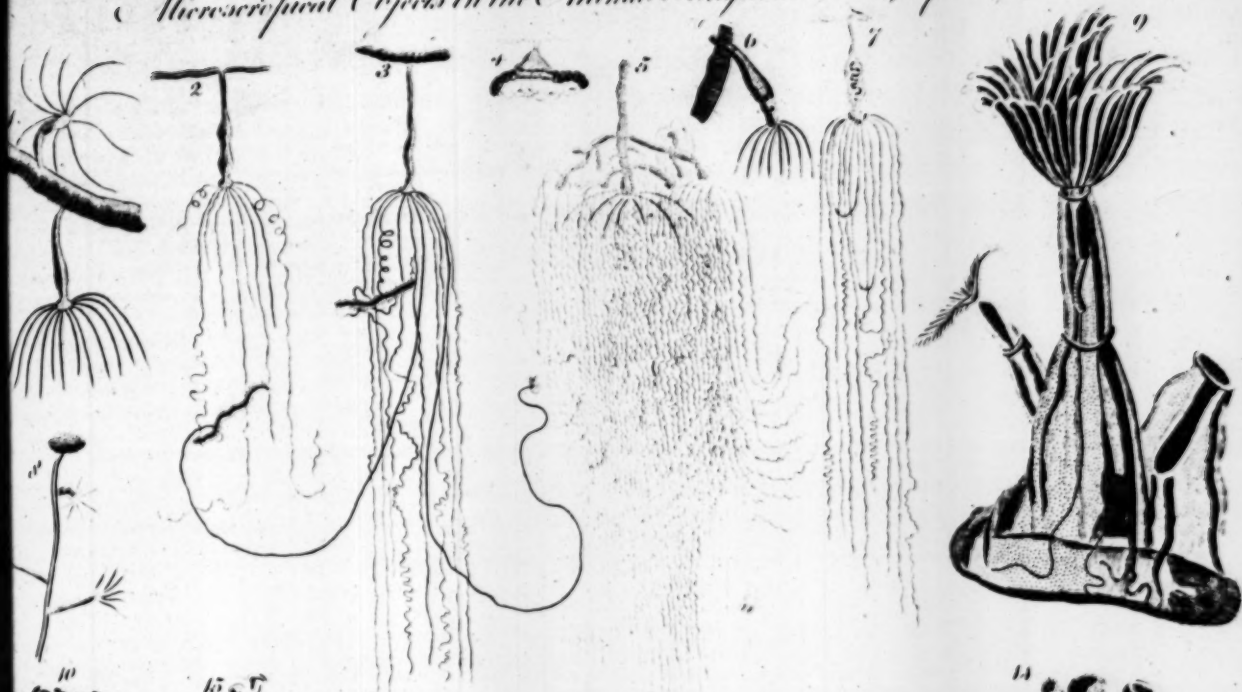
Fig. 5. From this figure of the *Hydra* Polype the reader may form an idea of the promptitude with which these creatures increase and multiply; the whole groupe formed by the parent and its young was about an inch and an half long, and one inch broad, the arms of the mother and her nineteen little ones hanging down towards the bottom of the vessel: the animal would eat about twelve monocoli per day, and the little ones about twenty among them, or rather more than thirty for the groupe.

Of the Reproduction of Polyps.

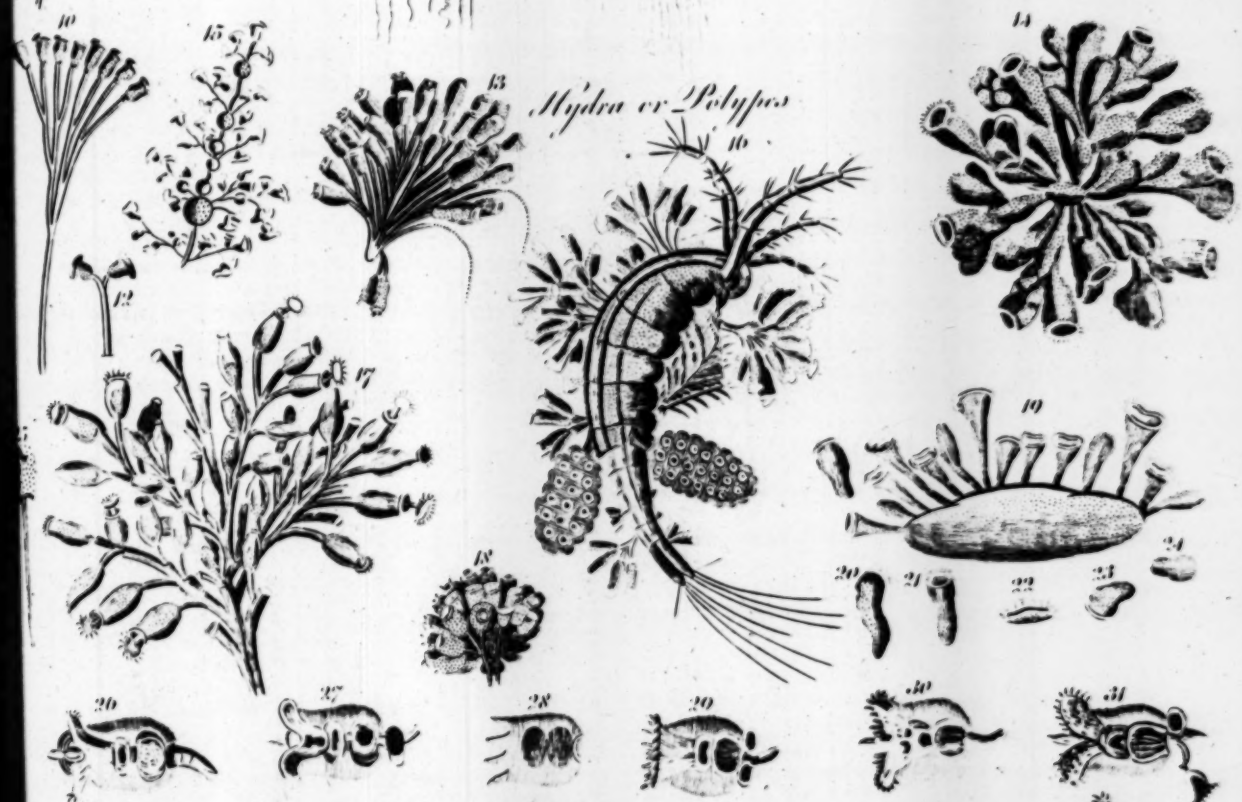
A Polype cut transversely or longitudinally in two or three parts is not destroyed; each part becomes in a little time a perfect Polype. This species of fecundity is so great in these animals, that even a small portion of their skin will become a little Polype; a new animal rising as it were from the ruins of the old, each small fragment yielding a Polype. If the young ones are mutilated while they grow upon the parent, the mutilated parts are re-produced: the same changes succeed also in the parent. A truncated portion will put forth young before it is perfectly formed itself, or has acquired its new head and tail: sometimes the head of the young one supplies the place of that which would grow out of the anterior part of the trunk.

(Microscopical Objects in the Animal Kingdom (Magnified.)

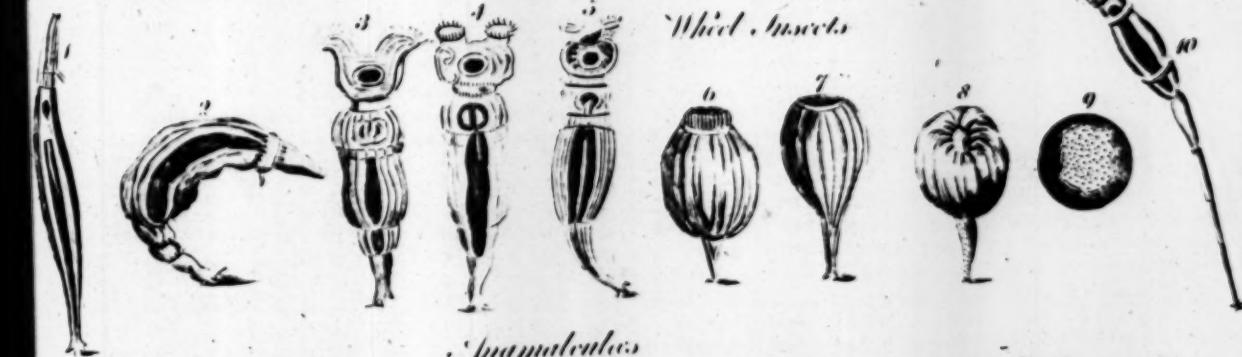
Plate 1



Hydra or Polypus



Whirl Insects



Inamolecules



I
the
and
into
hea
teen
thei
of
in
Hy
A
fici
circ
selv
mal
is t
men
vari
num
to n
part
thu
7
cate
pull
sing
por
fills
then
Poly
on
proc
7
then
kno
It is
of o
thei
kept
graf
doub
and
T
we l
ble k
notw
live
and
ston
F
anim
ten
case
to a
to b
aqu
T
tran
diffi
bell
is a
larg
to b
whi
B
thel
of t
tion
The
nun
nun
from
dow
beco
T
in o
who
who
Wh
a vi
brin
near
if ag
by a
may
T
ing
The
is v
figu
N

If a Polype is slit, beginning at the head, and proceeding to the middle of the body, a Polype will be formed with two heads, and will eat at the same time with both. If the Polype is slit into six or seven parts, it becomes an hydra, with six or seven heads. If these are again divided, we shall have one with fourteen; cut off these, and as many new ones will spring up in their place, and the heads thus cut off will become new Polypes, of which so many new hydras may again be formed: so that in every respect it exceeds the fabulous relation of the Lernean Hydra.

As if the wonders already related of the Polype were not sufficient to engage our attention to these singular animals, new circumstances, as surprising as the foregoing, present themselves to convince us of the imperfections of our ideas of animality, and of the greatness of the power of the Creator, who is the source and origin of every degree of life, in all its immense gradations, as unity is the origin of number, in all its varied series, multiplied proportions and combinations: now as numbers may be considered as being recipient of unity, in order to make manifest its wonderful powers; so the universe and its parts are adapted to receive life from the source of all life, and thus become representatives of his immensity and eternity.

The Polypes may be as it were grafted together. If the truncated portions of a Polype are placed end to end, and then pushed together with a gentle force, they will unite and form a single one. The union is first made by a single thread, and the portions are distinguished by a narrow neck, which gradually fills up and disappears, the food passing from one portion to another. Portions not only of the same, but pieces of different Polypes, may be thus united together. You may fix the head on one Polype to the trunk of another; and that which is thus produced, will grow, eat, and multiply like another.

There is still another method of uniting these animals together, more wonderful in its nature, and less analogous to any known principles of animation, and more difficult to perform. It is effected by introducing one within another, forcing the body of one in the mouth of the other, and pushing it down, so that their heads may be brought together. In this state it must be kept for some time: the two individuals are at last united, and grafted into each other; and the Polype, which was at first double, is converted into one, with a large quantity of arms, and performs all its functions like another.

The hydra fulca furnishes us with another prodigy, to which we know nothing that is similar, either in the animal or vegetable kingdom. They may be turned inside out like a glove, and notwithstanding the improbability of the circumstance, they live and act as before. The lining or coating of the stomach, and the former epidermis, now constitutes the coating of the stomach.

Fig. 9. Tubularia Campanulata, the bell-flowered, or plumed animal. These little creatures dwell in colonies together, from ten to fifteen in number, living in a kind of slimy mucilaginous case, which, when expanded in the water, has some resemblance to a bell with its mouth upwards. These bells or colonies are to be found adhering to the large leaves of duck-weed, and other aquatic plants.

The bell or case, which these animals inhabit, being very transparent, all the motions of its inhabitants may be discerned distinctly through it. There are several ramifications, or smaller bells, proceeding from the larger ones; in each of these there is an inhabitant. The opening at the top of these bells is just large enough for the creature's head and a small part of its body to be thrust out from it, the rest remaining in the case, into which it also draws the head on the least alarm.

Besides the particular and separate motions which each of these creatures is able to exert within its case, and independent of the rest, the whole colony has a power of altering the position of the bell, and removing it from one place to another. These animalcula seem not to like to dwell in societies whose number exceeds fifteen; when the colony happens to increase in number, the bell may be observed to split gradually, beginning from about the middle of the upper extremity, and proceeding downwards towards the bottom, till they at last separate, and become two colonies independent of each other.

The arms are very near each other, sixty may often be counted in one plume, having each the figure of an Italic S, one of whose hooked ends are fastened to the head; and altogether, when expanded, compose a figure somewhat like a horse-shoe. When the arms are thus extended, the creature, by giving them a vibratory motion, can produce a current in the water, which brings the animalcula, and other minute bodies that are floating near it, into its mouth, situated between the arms. The food, if agreeable to the creature, is swallowed, if not, it is rejected by a contrary motion. As the skin is transparent, the animal may be seen every way plain when it has retired within the tube.

The body is about one eighth of an inch long, without reckoning the plume. It is cylindrical, and the skin is very transparent. The plume is only a continuation of this transparent skin; it is very broad in proportion to the body, and of a remarkable figure; the base is of the shape of an horseshoe; from this base

No. 106. Vol. III.

the arms project, they bend rather outwards. The plume which they form gives them a resemblance to some flowers. The arms may be compared, from their firmness and transparency, to very fine threads of glass.

The plumed Polype is very voracious, devouring a great number of small animals. The arms when observed attentively with the microscope, will be found to bend from moment to moment within-side of the plume, and then rise up again; then another performs the same: thus, by the continued motion of its arms, it puts the water into violent agitation, and brings into its mouth the food whereby it is nourished.

Fig. 10. Vorticella Umbellaria, with ciliated globous marked florets, and an umbellated stem; we often find in divers places, upon water, plants, and other bodies in water, a whitish substance, that looks like mould; plants, pieces of wood, snail shells, &c. are often entirely covered with these substances, and often so united as to form together a sort of branches or clusters, from whence they have been termed clustering Polypes.

The length of those represented in this figure is about the 240th part of an inch; they are of a bell shape. The anterior part, as in *fig. 11*, generally appears open; the posterior part is fixed to a stem or pedicle; it is by the extremity of this pedicle that the vorticella fixes itself to any substance. It appears in the microscope of a brownish colour, except at the bottom, where it is transparent, as well as the whole pedicle. When the broad part is open, a very lively motion may be perceived about its edges; and when it presents itself in a particular manner, something very much resembling the little wheels of a mill, moving with great velocity, may be discovered on both sides the edges of this broad part.

Fig. 12. represents two Vorticellæ joined by their posterior extremity to one pedicle; soon after the division, each vorticella begins to shew a pedicle of its own.

Fig. 10. represents a cluster of eight Vorticellæ; by this figure we may form some idea in what manner the pedicles are disposed as their number increases. There were at first only two that proceeded from the centre of the figure, and then divided into four; and as they branched upwards, they then divided into eight.

Fig. 13. Vorticella Pyraria, is somewhat of a pear shape; the base is pellucid; the top truncated: the lateral arms, which are a pair on each side, cannot be distinguished without some attention; they are sometimes to be seen disengaged from the pedicle, and rolling swiftly in a kind of circle.

Fig. 14. Hydra Socialis. This species of Hydra has been described by many writers. In this Figure, these animals are represented as considerably magnified; they appear like a circle, surrounded with crowns, or ciliated heads, tied by small thin tails to a common centre, from whence they advance towards the circumference, where they turn like a wheel, with a great deal of vivacity and swiftness, till they occasion a kind of whirlpool, which brings into its sphere the proper food for the Polype. When one of them has been in motion for a time, it stops, and another begins. Sometimes two or three may be perceived in motion together. They are often to be found separate, with the tail sticking in the mud. The body contracts and dilates very much, so as sometimes to have the appearance of a cudgel, at others to assume almost a globular form. The young Polypes of this species have been sometimes taken for the *Hydra Stenotera*.

Fig. 15. Vorticella Anastatica. These Polypes form a groupe resembling a cluster, or more properly an open flower. This flower, or cluster, is supported by a stem, which is fixed by its lower extremity to some of the aquatic plants, or extraneous bodies that are found in water; the upper extremity forms itself into eight or nine lateral branches perfectly similar to each other; these have also subordinate branches, whose collective form much resembles that of a leaf. Every one of these assemblages is composed of one principal branch or nerve, which makes the main stem of the cluster an angle, somewhat greater than a right one; from both sides of this nerve the smaller lateral branches proceed; these are shorter the nearer their origin is to the principal branch.

At the extremity of the principal branch, and also of all the lateral ones, there is a Polype or Vorticella. There are others on both sides of the lateral twigs, but at different distances from their extremity. These Polypes are all exceeding small, and of a bell-like figure: near their mouth a quick motion may be discerned, though not without a sufficient distinctness to convey an adequate idea of its cause, and upon the branches of these clusters are round bodies, which will be hereafter mentioned. Each of these branches is bent a little inwards, so that all of them taken together form a kind of shallow cup. If the eye is placed right over the base of this cup, the appearance of the whole eight or nine branches is like unto that of a star, with so many rays proceeding from the centre; if the cluster is slightly touched, all the branches instantly fold up, and form a small round mass. The stem which supports the cluster contracts also at the same time, folding up, like a workman's measuring rule, that consists of three or four joints. This extraordinary assemblage

blage constitutes one organized whole, formed of a multitude of similar and particular ones. A new species of society, in which all the individuals are members of each other in the strictest sense, and all participate of the same life.

A few days after one of these clusters is formed, small round bodies or bulbs may be perceived to protrude in several places from the body of the branch; these grow very fast, and arrive at their greatest growth in two or three days. The bulbs detach themselves from the branches out of which they spring, and go away, swimming, till they can settle upon some substance. Mr. Trembley observed from one round bulb, in about twenty-four hours, by repeated divisions, one hundred and ten vorticella to be formed.

Fig. 25. Represents one of the globular bodies after it has parted from the cluster, and has fixed itself to some other body, and after the globule itself and its pedicle have begun to lengthen.

Fig. 16. *Vorticella Digitalis*. This species of the Vorticella is very scarce; it seems only to have been seen by Roefel, who found it on the monocolus quadricornis, till 1784, when it was discovered by Mr. Muller, who had sought for it several years before in vain.

Fig. 17. *Vorticella Opercularia*. These vorticellæ are of a lemon shape, and are generally found in clusters, branching out from a stem, which mostly adheres to some convenient substance. That species of them described by Mr. Baker had a very short pedicle, and these animals were much longer than those represented in this figure. The mouths of these animalcula are not ciliated, but they are furnished with a round operculum, or cover, connected by a long ligament, or muscle, which extends downwards through the body, and is affixed within side of it, near the tail. The ligament may be contracted or dilated, so that the cover may be removed to some distance from the mouth: in this situation several short hairs may be found to radiate from it: these have a vibratory motion, by which they excite a current of water, most probably to draw a proper nourishment, after which they shut or pull down the cover, which they again extend at pleasure: when the cover is pulled close down, the mouth contracts, and no hairs are to be seen.

Fig. 18. *Vorticella Cratægaria*. The figure represents a parcel of these vorticellæ united together. These animals are to be found in the month of April, both in the head and upon the tail of the monocolus quadricornis; they are generally heaped together in the manner they are represented in the figure; they are of a spherical form, and united to one common stalk. They are also often to be found without any pedicle; the body is rather contracted; the aperture is circular and surrounded with a marked margin; it has two small arms; with a deep magnifier, a vehement rotary may be seen; they sometimes separate from the community, and go forwards in a kind of spiral line, and then in a little time come back again to the rest.

Among the other authorities for this animal, M. Linnæus refers to Mr. Baker's description of the mulberry insect. "Employment for the Microscope," page 348, which, as it differs a little from the preceding account, we shall insert here. That from which his drawing was made, and which he has described, was found in a ditch near Norwich; he called it the mulberry insect, from the resemblance it bore to that fruit; though the protuberances that stand out round it are more globular than those of a mulberry. It is to be seen rolling about from one place to another, and is probably a congeries of animalcula. They are to be met with in different numbers of knobs or protuberances, some having fifty or sixty, others more or less, down to four or five. The manner of moving is the same in all. They are generally of a pale colour.

Fig. 19. *Hydra Stentorea*. This species of hydra is very common, and has been described by almost every writer on these subjects. They are named by Mr. Baker, and Mr. Trembley, the funnel-like Polype. There are three species of them, which are of different colours, green, blue, and white. The white ones are the most common. It is necessary to observe them often, and in various attitudes, in order to obtain a tolerable idea of their structure. They do not form clusters, but adhere singly by their tail to whatever comes in their way; their anterior end is wider than their posterior, and being round, gives the animal somewhat of a funnel form. The edge of this opening is furnished with a great number of fimbriæ, which by their brisk and continual motion excite a current of water; the small bodies that float or swim near the current, are forced by it into the mouth of the little animal. Mr. Trembley says, that he has often seen a number of very small animalcula fall one after another into the mouth, some of which were afterwards let out again at another opening, which he was not able to describe. They can fashion their mouths into several different forms. If any thing touches them they shrink back, and contract themselves. They live independent of each other, swimming freely through the water in search of their prey, and fix to any thing they meet with.

From the various methods by which different species of Polypes are multiplied, we are led to form more exalted ideas of

nature; and to see that the little we discover is but an exceeding small part of her contents. We learn also to be more cautious in reasoning from analogy, and laying down the known for a model to the unknown, because we find that the operations in nature are varied *ad infinitum*. The growth of the *Hydra Fusca* is very quick; but that of the *Hydra Stentorea* is much more so. The progress of the fetus is always more rapid than that of the infant and adult animal; but in these organized atoms, the evolution is so rapid, as to appear almost like an immediate creation.

Fig. 22. represents the *Hydra Stentorea*, or funnel Polype, fixed to the upper side of a piece of some vegetable substance; they are in this figure of their natural size.

Fig. 19. The same Polype magnified; the different forms they assume are also seen here, sometimes short and thick, as in fig. 23. sometimes nearly globular, as in fig. 24. extended to the full size, as in the upper part of fig. 19.

Vorticella Urceolaris.

Fig. 26, 27, 28, 29, 30, 31. This animal has been seen and described by most microscopical writers; but as Mr. Baker seems to us to be the most perfect, we shall principally follow his account of it. He discovered three species of them; two of them, which are under the *Vorticella Urceolaris*, fig. 26, 27, 28, are of the first species; fig. 29, 30, 31, are of the second species. The first sort, when extended, is about twice as long as it is broad. It is contained in a shell; the fore part of this is armed with four sharp teeth or points; the opposite side has no teeth, but is waved or bent in two places, like the form of a Turkish bow. At the bottom there is a hole, through which passes the tail. It fastens itself by this tail to another convenient substance, when it intends to use its rotatory organs; but when it is floating in the water, and at all times, when not adhering to any body, it wags the tail backwards, and forwards, something like a dog.

The form and situation of the two branches is sometimes changed; the ends thereof becoming more round, the vibratory motion is altered to a rotatory one; this alteration is represented at fig. 27; the head also appears in this figure. The thorax is annexed to the lower part of the head; it is muscular; within it there is a moving intestine, which has been supposed to be either the lungs or the heart of the little creature.

When the water in which this little animal is placed is nearly dried away, or when it has a desire to compose itself to rest, it contracts the head and fore part of the body, and brings them down into the shell, and pulls the tail upwards, so that the whole of this minute creature is contained within the shell. See fig. 28. The shell is so transparent that the terminations cannot be easily distinguished when the animal is extended; but whatever is transacted within the shell, is as plain as if there was no substance between the eye and the interior parts.

Fig. 29, 30, 31, exhibit the appearance of another species of these animals, which differ from the foregoing kind. This species has also a head, a thorax, and abdomen. Like the other species, it draws the head and tail within the shell, which then appears to have six teeth or spikes on one side, and two on the other: it very seldom protrudes its head so far out as the other; sometimes the fimbriæ may be seen within the margin of the shell.

Both species carry their young in an oval integument or bag, fastened externally to the lower part of the shell, somewhere about the tail; these bags are sometimes opaque at one end, and seemingly empty at the other: see fig. 27: sometimes the middle is opaque, with a transparent margin; see fig. 29.

It is highly entertaining to see a young one burst its integument, and gradually force its way out: in performing this operation, it is much assisted by the motion of the tail of the parent. The head comes out first; it then sets its rotatory organ in motion, by which it is completely disengaged, leaving the integument behind, which the vorticella freed itself from, by repeated strokes with its tail. A young one almost disengaged is seen at the bottom of the right side of fig. 31; another embryo is seen at the bottom of the left side of the same figure.

TRICHODA, OR WHEEL INSECTS.

A genus of animalcules, which have an apparatus of arms for taking their prey. This apparatus has been supposed, by microscopical writers, to be a kind of wheels.

The wheel-animal, described by Mr. Baker, has two seeming wheels, with a great many teeth or notches, coming from its head, and turning round as it were on an axis. On the least touch, this animalcule draws its wheel into its body into the sheath; but when every thing is quiet, throws them out, and works them again.

In order to find these animalcules, choose such roots of duck-weed as are long, and proceed from strong old plants, for the young roots seldom afford any; they should not be covered with that rough matter which is frequently found about them, nor any way tending to decay, as they will often be.

In the water found remaining in leaden pipes or gutters on the tops of houses, there are also found great numbers of these wheel animals. These are of a different species from the former;

mer; and when the water dries away, they contract their bodies into a globular or oval figure, and are then of a reddish colour, and remain mixed with the dirt, growing together in a lump as hard as clay. This, whenever it is put in water, in half an hour's time discovers the animals living again, and as brisk as ever; and they have been found to be living in this manner, after the matter had been kept dry twenty months.

It should seem from this, that as the water dries up, their pores become shut in the manner of those of such animals as remain torpid for the winter; and that when they find water come on again from rain, they then unfold themselves, and live and feed as long as it lasts. Baker's Microscope, p. 91. There are several species of this genus.

Fig. 1 and 5. *Trichoda Charon*. The body is oval. It resembles a boat both in shape and motion, the upper part hollowed, the under part furrowed and convex, the stern round, with several hairs projecting from it. Several hairs may also be seen in one side. It is found in salt water. Near the middle of the left side of fig. 5 is a pellucid bubble, that is sometimes to be seen.

Fig. 2. *Trichoda Cyllidium*. Pellucid, replete with globules of different sizes in the hind extremity, the fore-part narrower, without any footsteps of an external organ.

Fig. 3. *Trichoda Pulex*. With an incision in the fore-part; the front and the base hairy.

Fig. 4. *Trichoda Vermicularis*. Long cylindrical *Trichoda*, with a short neck; the apex hairy. Gelatinous; the fore-part pellucid, the hind part full of molecules. It was found in river water. It is represented in different appearances in the figure.

Fig. 6. *Trichoda Melitea*. Oblong ciliated *Trichoda*, with a dilatable neck, the apex globular, and surrounded with hairs; the edge is ciliated, and a kind of peristaltic motion may be perceived. It is very rarely found, and even then in salt water.

Fig. 7. *Kerona Cypris*. This animalculum is compressed, and somewhat in a pear shape; the fore-part broad and blunt; the front is furnished with short hairs, or little vibrating points inserted under the edge; the motion is retrograde. It is found in water which is covered with lemna.

Fig. 8. *Kerona Patella*. With one valve, or orbicular, crystalline, the fore-part somewhat notched; the fleshy body lies in the middle of the shell; above and below are hairs or horns of different lengths jutting out beyond the shell, and acting instead of feet and oars.

Fig. 9. *Kerona Vannus*. Oval and rather flat *Kerona*, one edge bent, the opposite edge ciliated.

Fig. 10. *Trichoda Musculus*, a smooth animalculum, the fore-part narrow and furnished with short hairs, that are continually playing about; underneath the hind-part is a small tail. It is furnished with molecular entrails, and moves slowly. It is found in infusions of hay, which have been kept for some months.

ANIMALCULA.

Fig. 1. This is the same animalculum which was dignified by Mr. Baker with the name of *Proteus*, on account of its assuming a great number of different shapes, so as scarce to be known for the same animal in its various transformations; and indeed, unless it be carefully watched while passing from one shape to another, it will often become suddenly invisible.

When water, wherein any sorts of vegetables have been infused, or animals preserved, has stood quietly for some days, or weeks, in any glass or other vessel, a slimy substance will be collected about the sides; some of which being taken up with the point of a pen-knife, placed on a slip of glass, in a drop of water, and viewed through a microscope, will be found to harbour several kinds of little animals that are seldom seen swimming about at large. The insect we are treating of is one of these, and was discovered in such slime-like matter taken from the side of a glass jar, in which small fishes, water snails, and other creatures had been kept.

Fig. 2. *Enchelis Truncus*. This is the largest of this kind of animalcula; the body is cylindrical, mucose, grey, long, and rather opaque; the fore-part globular, the hind-part obtuse. Something like three teeth may be sometimes seen to proceed from one of the sides; it can alter its shape considerably. Globules of different sizes may be seen within the body: it rolls about slowly from right to left.

FIGURES 3, 4, 5. *Vibrio Paxillifer*. This is a wonderful animalculum, or rather a congeries of animalcula. It is invisible to the naked eye, and consists of a transparent membrane, with yellow intestines, and two or three visible points: they are generally found collected together in different parcels, from seven to forty in number, and ranged in a variety of forms; sometimes in a straight line, as in fig. 5, then forming the concave fig. 3, at others moving in a zig-zag direction, as in fig. 4. When at rest they are generally in a quadrangular form, and found in great plenty with the *ulva latissima*. This little animal is extremely slender, and not uncommonly one hundred and fifty times longer than broad. Its resemblance to an hair induced

Mr. Baker to call it the hair-like insect. As no eyes can be discerned, it is difficult to judge which is the head or tail. All its motions are extremely slow, and require much patience and attention in the observer. It has neither feet, nor fins, nor hairs; but appears perfectly smooth and transparent, with the head bending one way, and the tail another, so as to be like a long *Italicus*; nor is any internal motion, or particular opaque part, to be perceived, which may determine one to suppose it the stomach, or other of the intestines.

These creatures are so small, that millions of millions might be contained in an inch square. When viewed singly, or separated from one another, they are exceedingly transparent, and of a lovely green; but, like all other transparent bodies, when numbers of them are brought together, they become opaque, and lose their green colour in proportion as the quantity increases; till at last they appear entirely black. Notwithstanding the extreme minuteness of these animalcula, they seem to be fond of society; for on viewing for some time a parcel of them taken up at random, they will be seen to disperse themselves in a kind of regular order. If a multitude of them are put in a jar of water, they will form themselves into a regular body, and ascend slowly to the top; where, after having remained some time exposed to the air, their green colour changes to a beautiful sky-blue: when they are weary of this situation, they form themselves into a kind of rope: a small quantity of the matter containing these creatures, having been put into a jar of water, it so happened, that one part went down immediately to the bottom, whilst the other continued floating on the top: after some time, each of these swarms of animalcula began to grow weary of its situation, and had a mind to change its quarters. Both armies, therefore, set out at the same time, the one proceeding upwards, and the other downwards; so that after some hours journey they met in the middle. A desire of knowing how they would behave on this occasion, engaged the observer to watch them carefully; and to his surprise he saw the army that was marching upwards open to the right and left, to make room for those that were descending. Thus, without confusion, or intermixture, each held on its way; the army that was going up marching in two columns to the top, and the other proceeding in one column to the bottom; as if each had been under the direction of wise leaders.

Fig. 6. *Trichoda Sol*. This splendid creature constitutes a peculiar genus. It is a little crystalline round corpuscle, the upper part convex: it is beset with innumerable diverging rays, which are longer than the body, proceeding from every part of its surface: in the inside are similar molecules. The body contracts and dilates itself, the animalculum remaining confined to the same spot. It was found in water which had been kept for three weeks.

Fig. 7. *Anguillula Glutinis*, or *Paste Eel*. These eels are in general of a large size, and may be seen with a common magnifying glass, being about one thirtieth of an inch in length, and one hundred and fortieth broad. This figure represents one of them magnified about one hundred and twenty times; they are in general of a bright chestnut colour, and the extremity is whiter and more transparent than the rest of the body.

The principal phenomena of blighted wheat is probably owing to these animalcula, which prevent the regular circulation of the sap. They increase in their size in a certain proportion to the plant, so that at last they may be observed with great ease by the naked eye, being two tenths of an inch long, and nearly one tenth in diameter.

A most satisfactory view of these eels is obtained by examining them with the solar microscope; it affords one of the most surprising and magnificent spectacles: two generations may be often seen; one which draws near the allotted period of its existence; and another which only begins to enjoy the blessings of life. Some arrive at their full growth, others are quite small, &c. In some we may perceive the young animalcula in motion in the eggs, in others no such motion can be observed; with a variety of other circumstances too tedious to enumerate, though they afford great pleasure to the spectator.

One of the most remarkable circumstances in these animalcula is the faculty they have of receiving again the powers of life, after having lost them for a considerable time; for instance, when some of these blighted grains, that have been preserved for many years, have been soaked in water for ten or twelve hours, you will find in it living eels of this species; if the water evaporates, or begins to fail, they cease to move; but on a fresh application will be again revived. It may be proper to notice here, that, according to the observations of M. Roffredi, those eels which have done laying eggs are incapable of being resuscitated upon being moistened; the same seems also to be the case with those that are very young; it is probable they must attain a certain age and degree of strength before they are endowed with this wonderful faculty.

Fig. 8. *Trichoda Orbis* is orbicular, smooth and pellucid, a little notched in the fore-part; the hairs, which are longer than usual, occupy this incision; the rest of the margin has no hairs: the whole is composed of vesicular molecules.

Fig

Fig. 10. *Gonium Pedicellae*. These sixteen little oval bodies are nearly equal in size, of a greenish colour, pellucid, and set in a quadrangular membrane, like the jewels in the breast plate of the high priest, reflecting light on both sides. Its animality is evinced by its spontaneous motion, advancing alternately towards the right and left: these little bodies seem oval when in motion, round when at rest; the four interior ones are a little larger than the rest. Found in pure water.

Fig. 11. *Vorticella Polygona*. Compound Vorticella, truncated with a bending, branching stalk. When viewed with a small magnifier, they appear like so many little trees; the upper part or heads are egg shaped, the top truncated, the lower part filled with intestines; the branches are thick set with little knobs.

Fig. 12. *Kolpoda Cucullus*. It is very pellucid, with a well defined margin, filled with little bright vesicles, differing in number and size. The figure of the most part is oval, the top bent into a kind of an obtuse beak, seldom an acute one, but sometimes oblong. Its intestines are formed of from eight to twenty-four bright little vesicles, these are not conspicuous in their young ones; some have supposed that there were animalcula that had been so allowed by the Kolpoda; but Mr. Muller thinks they are of the offspring of the Kolpoda. In some, only one crystalline vesicle occupies the middle of the body. When the water is almost exhaled, and death nigh, it moves more slowly than usual, and protrudes its offspring with violence. It moves in general with great vivacity and in all directions. It is found in infusions of vegetables and in fetid hay.

Fig. 13, 14, 16. *Vorticella Polymorpha*. Many shaped vorticella, green, opaque. To the naked eye it appears as a most agile green point: when viewed by the microscope, it puts on every moment so many and such various forms, that they can neither be exhibited to the eye by drawing, nor described by words: it is truly one of the wonders of nature, astonishing the mind, fatiguing the eye, and exciting the admiration of the spectator. The figures represent it in three different forms: 13 is the fore part; 14 the hind part; and 16 the fore part turned in or doubled. The body is granulous; a series of pellucid points is sometimes to be observed.

Fig. 15. *Vorticella Nafuta*. This animalculum is invisible to the naked eye, but when it is armed with microscopic lenses, it appears curiously furnished with a rotatory organ, which encompasses the middle of the body. It is pellucid, cylindrical, of an unequal size, the fore part truncated, and ciliated, and a triangular prominence in the middle of the aperture; the hind part obtuse, a point on each side of the middle of the body. This is the appearance of this little creature when in motion; but when the water is nearly exhaled, some further parts of its structure are rendered visible: besides the rotatory organ in the anterior part, another is now discovered encompassing the middle of the body; the hairs of this are in vehement motion. There are other fascicles of moving hairs to be discovered at the same time. The variegated and quick motion of this apparatus, (more particularly if the animal is big with young, and moving at the same time within the mother,) fill the mind with amazement.

Fig. 17. *Trichoda Cometa*. Spherical, the fore part hairy, with an appendant globule. It is a pellucid globule, replete with bright intestines, the fore part furnished with hairs, the hind part with a pellucid appendant globule.

Fig. 18. *Trichoda Cimex*. The body is oval, the back convex; the belly flat; an incision in the edge of the fore part: the edges of this incision are seen to move. Its intestines are pellucid. It both swims and walks. When it meets with any obstacles, four small bristles, which are fixed underneath, come into view; these it uses as feet.

Description of PLATE II. which represents MICROSCOPIC OBJECTS in their natural size, and as they appear when magnified.

PLATE II. FIG. I. *Leucospis Dorfigera*, mentioned in the Plate as a nondescript Insect. This very beautiful and singular insect was first pointed out to Mr. Adams (from whom we are favoured with the description) by Mr. Marham, who had seen it in the cabinet of insects belonging to the Queen, in the royal Observatory at Richmond. Her Majesty was pleased to permit Mr. Adams to have the drawing taken from it, from which this Figure was engraved. When Mr. Marham first saw it at Richmond, he considered it as an undescribed insect, and an antique in this country. But he has since found that it is mentioned by Fabricius in his *Systema Entomologiae*, as a new genus, under the name of *Leucospis Dorfigera*; and there is one of these insects in the cabinet of the celebrated Linnæus, now in the possession of T. E. Smith, M. D. F. R. S.

It appears at first sight like a wasp, to which genus the folded wings would have given it a place, had not the remarkable sting of tube on the back removed it from thence. It is probably a species between and uniting the sphex and wasp, in some degree partaking of the characters of both. The antennæ are black and cylindrical, increasing in thickness towards the extremity; the joint nearest the head is yellow; the head is black; the thorax also is black, and encompassed round with a

yellow line, and furnished with a cross one of the same colour, near the head. The scutellum is yellow; the abdomen black with two yellow bands, and a spot of the same colour on each side between the bands. A deep polished groove extends down the back from the thorax to the anus, into which the sting turns and is deposited, leaving the anus very circular. A yellow line runs on each side the sting. The anus and the whole body, when viewed with a shallow magnifier, appear punctuated: these points, when examined in the microscope, appear hexagonal, and in the centre of each hexagon a small hair is to be seen. The feet are yellow, with black spots. The insect is found in Italy, Switzerland, France and Germany. The principal Figure in the Plate shews this beautiful insect very much magnified: above it is the object of its real size.

Fig. 2. *Chrysomela Asparagi*. This common, though elegant, insect of the Coleoptera class, is represented as seen in the lucernal microscope, and in its natural size. It is called by Linnæus, *Chrysomela Asparagi*, from the larva feeding on the leaves of that plant. Its figure is oblong, the antennæ black, composed of many joints nearly oval. The head is a bright but deep blue, the thorax red and cylindrical, the elytra blue, with a yellow margin, with three spots of the same colour on each, one at the base of an oblong form, and two united with the margin. The legs are black; but the under side of the belly is of the same colour with the elytra and head. This little animal, when viewed by the naked eye, scarcely appears to deserve any notice; but when examined by the microscope, is one of the most pleasing opaque objects we have. This insect is found in June on the asparagus, after it has run to seed.

Fig. 3. *Pediculus*, or *Louse*. Various as are the antipathies of mankind, all seem to unite in their dislike to this animal, and to regard it as their natural and most noxious enemy. "Whenever wretchedness, disease, and hunger, seize upon man, the louse seldom fails to add itself to the tribe, and to increase in proportion to the number of his calamities."

When the human louse is examined by the microscope, its deformity fills us with disgust. In the head we may distinguish two fine black eyes; near this are the two antennæ; the fore-part of the head is rather long; the hinder more obtuse or rounder; there is a small part that projects from the nose or snout; this serves as a sheath or case to the proboscis, which the creatures thrusts into the skin to draw out the blood and humours which are its destined food; for it has no mouth that opens in the common way.

This proboscis has been estimated to be seven hundred times smaller than a hair, and is contained in another case within the first, and can be drawn in or thrust out at pleasure; the skin is hard and transparent. From the under side proceed six legs, each of which has five joints, and terminates in two unequal hooked claws, as well as all over the legs; the body finishes in a cloven tail, which is generally covered and partly concealed by hairs.

From the extreme transparency of its skin, many of its internal parts may be seen, as the various ramifications of the veins and arteries, and the peristaltic motions of the guts. When the louse feeds, the blood is seen to rush like a torrent into the stomach; and its greediness is so great, that the excrement contained in the intestines is ejected at the same time, to make room for this new supply. There is scarce any animal that multiplies so fast as this unwelcome intruder; the moment it is excluded from the egg, it begins to breed. It would be endless to describe the various creatures which go under the name of lice, and swarm upon every part of nature. The reader who wishes for a more particular account of those which infest various animals, is referred to Rhedi's Treatise, *De Generatione Insectorum*. See LOUSE and PEDICULUS.

Fig. 4. *The Lobster Insect*. This extraordinary little creature was found by a curious gentleman of Edmonton. He was at the New Inn, Waltham Abby, where it was seen by some labouring men who were drinking their ale. The man who first perceived it thought it was of an unusual form; this occasioned a nicer inspection, and it was supposed to be a louse with unusual long horns; others thought it was a mite. This occasioned a debate, which drew the attention of the gentleman, who obtained the insect from them for further observation. Mr. Martin has given some account of it in the third Volume of "The Young Gentleman and Lady's Philosophy." It appears to be quite a distinct species from the phalangium caneroides of Linnæus, of which a good drawing has been given by Hook, Roessel, Schæfer, &c. not one however of the descriptions agrees with the animal under consideration. It is very probable that there are several species nearly similar. Mr. Marham, secretary to the Linnæan Society, who favoured us with a System of Entomology, has two of these animals in his possession, one like the drawing of Reaumur; the other not to be distinguished from that represented in the Figure, except that it wants the beak or dent in the claws, which is so conspicuous in this. Mr. Marham found his fixed by its claws to the thighs of a large fly, which he caught on a flower in Essex the first week in August, and from which he could not disengage it without great difficulty.

Microscopic Objects of the Animal Kingdom, in their natural size and as they appear when magnified.



Fig. 3.



The Pediculus or Louse.

Fig. 4.



The Lobster Insect.

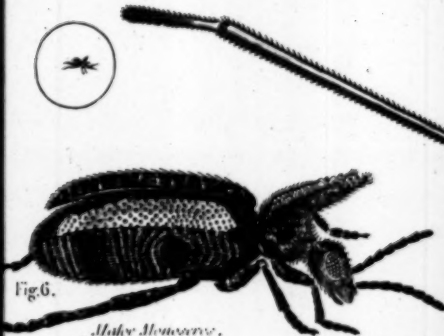
Fig. 2.



Chrysomela, leucostriata.



Fig. 1.



House Muscivora.

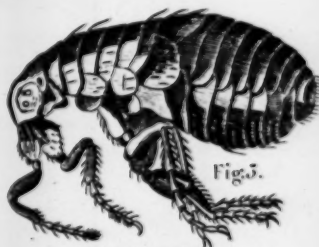


Fig. 5.

The Pulv or Flat.



Fig. 7.



In Insect found on the Leaves of the Nymphaea Tree.

Fig. 8.



Black Fly with white wings.

Fig. 9.



The Mite or Mite.

Fig. 10.



The Exulcorans or Tick animal.



Anax, dragonfly Insect of the Hemiptera Class.

Copied by permission from H. L. Linné's Essay on the Muscivora.

Published by the Author, London, 1793.

the
a
b
t
l
w
th
p
o
ar
it
p
p
w
w
ful
co
the
bal
the
wi
the
nig
the
dift
mag
und
tag
ties
und
dete
mak
Nat
cer
G
had
figu
plan
natu
nifie
F
vers
little
hinde
If the
small
exqui
prini
minu
to fol
mann
when
foldin
cover
Adam
tions,
shop,
They
erosco
plied i
Fig
origin
bladder
ties of
bladder
places
is wall
fects a
in the
Fig
two ey
cula.
very n
No.

difficulty, and tearing off the fly's leg, which he did on a piece of writing paper, and was much surprised to see the little creature spring forwards full a quarter of an inch, with great impetuosity, and again seize its prey, from which he had great difficulty to disengage it.

Fig. 5. *Pulex, or Flea.* The flea, when examined by the microscope, is not an unpleasing object: it is difficult however to obtain such a view of it as will display the mechanism and apparatus belonging to the head. The neck is long, and finely arched, and much resembles the tail of a lobster. The body is covered all over with a suit of fable armour, formed of a hard shelly substance, curiously joined and folded over one another, and yet yielding to all the nimble motions of the little animal. It has two sharp eyes to look before it leaps; for which purpose its legs are admirably adapted, for the joints are so constructed, that it can fold them up, and when it leaps spring them out all at once, whereby its whole strength is exerted, and the body often raised two hundred times its own diameter. The proboscis or sucker, with which it penetrates the skin, is placed at the end of the snout, and is not easily seen, except the two fore legs are removed. In it are included a couple of darts or lancets, which, after the proboscis has made an entrance, are thrust further into the flesh, and make the blood flow from the adjacent parts, and occasion that round red spot with a hole in the centre of it called a flea bite. Every one is acquainted with the agility and blood-thirsty disposition of the flea; the caution with which it comes to the attack, and the readiness with which it avoids a pursuit. This creature is produced from eggs, which they deposit on the animals that afford them food, or affix them to the wool of blankets, rugs, &c. Of these eggs, are hatched white worms, which adhere closely to the body of the animal or other substance on which they are produced. In a fortnight they come to a tolerable size, and are very lively and active; but if they are touched at this time, they will roll themselves up in a ball. About eleven days from the time of their being hatched, they seek a place to hide in, and if viewed by a microscope, will be found weaving a covering or bag, in which they assume the pupa state, where they continue from nine days to a fortnight, when having acquired sufficient strength, they burst from their confinement perfectly formed, and armed with powers to disturb the peace of an emperor. For its representation in a magnified state, see Plate II.

Fig. 6. *Meloe Monoceros.* The insect which now comes under our inspection, is peculiarly adapted to shew the advantages of the microscope, which alone will discover the peculiarities of its figure: this is so remarkable, that naturalists appear undetermined as to its genus: even Linnaeus himself could not determine at first where to place it, for in the *Fauna Suecica* he makes it an *Attelabus*; but in the late edition of the *Systema Naturæ*, he has fixed it as a *meloe*, calling it the *Meloe Monoceros*.

Geoffroy and Schœffer have given figures of it; but as they had not that kind of microscope which would assist them, their figures are imperfect. Geoffroy says it is found on umbelliferous plants; the one here represented was found in May. The natural size is seen above that which is represented in the magnified state.

Fig. 7. This flying insect has two horns, which consist of divers joints and hairs. Its eyes are furnished with a number of little lenses. It has also six feet armed with talons. The hinder part of the body is jointed as it were with hollow notches. If the wing be considered, it will be found to consist of several small vessels or nerves, that assist in the expansion of it. The exquisite neatness with which this minute wing is folded, is surprisingly beautiful. With what wonderful nerves must these minute wings be furnished, that can enable this insect so readily to fold up the extremity of this filmy membrane in so neat a manner, and to expand it again, as it were, instantaneously, whenever it is inclined to fly! The extremity shews these neat foldings, which together with the strength of the nerves discover the wisdom of the Almighty in their contrivance. Mr. Adams, to whom we are indebted for our microscopic observations, found these insects in summer-time flying about his workshop, and he observed them to answer the above description. They are so small that Mr. Adams has applied them to the microscope in the ivory sliders; but they are better seen when applied in the nippers.

Fig. 8. *Black Trips*, with white wings. This insect was originally named *Phylopus* by Mr. de Geer, on account of the bladders at the feet. Linnaeus terms it *Trips*. The extremities of the feet are furnished with a membranaceous and flexible bladder, which it can throw out and draw in at pleasure. It places and presses this bladder against the substances on which it is walking, and seems to fix itself thereby to them. These insects are to be found in great plenty in the spring and summer, in the flowers of the dandelion, &c.

Fig. 9. *The Acarus, or Mite.* This insect has eight legs, two eyes, one on each side of the head, and two jointed tentacula. The female is oviparous. The sire, or cheese mite, is a very minute species. To the naked eye these mites appear like

No. 106. Vol. III.

moving particles of dust; but the microscope discovers them to be perfect animals, having as regular a figure of performing all the functions of life, as perfectly as creatures that exceed them in bulk. These little creatures may be kept alive many months between two concave glasses, and applied to the microscope at pleasure. They are thus often seen in coitu, conjoined tail to tail; and this is performed by an incredible swift motion. Their eggs are so small, that a regular computation shews, that ninety millions of them are not so large as a common pigeon's egg. They are very voracious animals, and have often been seen to eat one another. The mite is an animal very tenacious of life, and will live months without food. Mr. Leewenhoeck had one which lived eleven weeks in a situation he had fixed it for examining by his microscope. For its representation in a magnified state, see Plate II.

Fig. 10. *The Exulcerans, or Itch Animal.* Dr. Bononio discovered that the disease called the itch, owes its rise to little insects under the cuticula, whose continual bitings cause an ousing of the serum from the cutis, and produce these pustules whereby the disease is known. For, on observing people in this distemper pull out of the scabs little bladders of water with the point of a pin, and crack them like lice upon their nails from a place scabbed over, and where there was a grievous itching, he picked out a little pustule, and from thence squeezed a thin matter, in which he could but just discern a small white globe; but on applying it to his microscope, found it to be a minute animal of a whitish colour, in shape resembling a tortoise, but somewhat dark on its back. The animal has several long hairs, six legs, a sharp head, and two horns, and is very nimble. The doctor repeated this on persons of all ages and complexions, and at all seasons of the year, and found the same sorts of animals in most of the watery pustules. They begin to enter the furrows of the cuticula by knawing and working in their heads, till they are got quite under, where they cause a grievous itching, and force the infected person to scratch, which only heightens the malady. Hence follows the reason why this distemper is so very catching, since by simple contact these animals can readily pass from one person to another, not only from their swift motion, but by their clinging to every thing they touch, and crawling as well upon the surface of the body as under the skin. A few being once lodged, they multiply apace by their eggs; nor is it any wonder if this infection is propagated by the sheets, towels, handkerchiefs, or gloves, used by itchy people.

THE ORGANIZATION OR CONSTRUCTION OF TIMBER, AS VIEWED BY THE MICROSCOPE.

This subject opens an extensive field of observation to the naturalist, in which the labour of a life may be employed. It is a branch where the observer will find the microscope of continual use, and without which he will scarce be able to form any just idea of the organization of trees and plants, of the variations in the disposition, the number, nature, and offices of the several parts. If we consider the imperfection of the instruments used by some in those anatomical researches, and the little attention paid by the rest to the advantages their favourite pursuits might have derived from the use of the microscope and the dissecting knife, we have rather more to wonder at what has been done, than at what remains to be performed.

One reason that our knowledge of this subject is so circumscribed is the general inattention to the structure of plants. To this, among other causes, we may also ascribe the instability and fluctuation of the different theories on the principles of vegetation. We are, however, so little acquainted with the steps which Providence takes to lead intellectual, but free, agents, to the knowledge of truth, and the various difficulties, errors, and prejudices that must be removed before it can shine in its natives colours, that it is our duty to encourage every humble effort towards the advancement of science, that thus we may co-operate with our beneficent Creator in promoting that plan to which all things are now converging, the bringing all his creatures to a state of truth, goodness, and consequent happiness, an end worthy the best and wisest of beings.

As Dr. Hill is the first writer who has treated this part of Natural History in an orderly and scientific manner, we shall use the names he has adopted for characterizing the different parts of trees, &c. which are, the rind; the bark; the blea; the wood; the corona, or circle of propagation; and the pith. These are placed immediately within or under one another; they are the essential parts upon which the strength of the tree depends; in, among, and between these, the various vessels are placed which nourish the whole, and maintain and carry on the vegetation of the tree; and from which it obtains its peculiar qualities and virtues.

The exterior covering of all trees is a thin, dry, parched substance, which has been compared by many writers to the skin of animals, and called by names analogous thereto. Thus it is called the epidermis by Duhamel; the skin by Grew; the rind by Hill. The rind is a general covering to the young fruits of trees, to the branches, the roots, the leaves, and trunk, the flowers, &c.

Aided by the microscope, a number of luminous points may be discovered in the rind; these are so many minute holes for other purposes of transpiration. In the canes these holes are visible to the naked eye. A few oval holes may also be perceived in it; these are however no more than a separation of the parts, occasioned by the extension of the interior vessels.

The bulk lies next within the rind, and differs but little from it in construction; though it holds a more important office in the scale of vegetation, the growth and qualities of the tree being in a great measure connected with it. It is therefore found to differ considerably, in substance, quantity and quality in various kinds. It is originally the outer membrane covering the lobes of the seed. Even there, as in the branch of a tree, it appears in form of a kind of spung, or like a crust of bread composed of flatted bladders. By the bark the tree is fed with a continual supply of moisture, protected from external injuries, and defended from the excesses of heat and cold; for these purposes it is variously disposed in different trees.

The blea is that part of the tree which is forming into wood, and therefore lies between it and the bark, and may be separated from the bark by maceration. A longitudinal piece of the blea, when examined by the microscope, exhibits a number of vessels running parallel to each other, the interstitial spaces being filled with a floccose, white, formless substance, of which Dr. Hill suspects even the vessels themselves to be formed. The blea is a zone more or less perfect, which lies under the bark, and is principally distinguished from it by being less dense. In some species the difference between the blea and the wood is very remarkable, in others it is less so. The ancient botanists, struck with the difference between the wood and the blea, compared this substance to the fat in animals. It is organized in a manner similar to the wood, and possessing the same vessels disposed nearly in the same manner.

When the bark and blea are taken away, we come to the wood, which is a solid substance, on which the strength of the tree depends, and which has been considered by naturalists as being to the tree what bones are to the animal. It is more difficult to investigate the construction of the wood than that of the other parts, because the texture is in general much harder, and therefore not so easily separated, requiring very long macerations, and many subjects, before one may be found fit for maceration. A transverse section of wood generally appears formed of a number of rays proceeding from the corona to the bark, which are intersected at different distances by concentric circles interspersed with vessels of varying magnitude. The variations in this structure afford much pleasure to the curious observer, and throw considerable light upon the nature and properties of timber; for it is by means of a variety of strainers that different juices are prepared from the same mass. Matter considered as matter has no share in the qualities of bodies. It is from the arrangement of it, or the recipient forms given to it, that we have so many different substances. According to the modifications that these receive, we shall find the same light, air, water, and earth, manifesting themselves in one by a deadly poison, and in another by a most salubrious food. A lemon ingrafted upon an orange stock, is capable of changing the sap of the orange into its own nature, by a different arrangement of the nutritive juices. One mass of earth will give life and vigour to the bitter aloe, to the sweet cane, the cool house-leek, and the fiery mustard, the nourishing grain, and the deadly night shade. In a word, the life of the vegetable seems to reside in the wood; from it all the other parts are produced. It shoots a pith inwards, and a blea and a bark outwards.

Dr. Hill gives the name of Corona to that circle which surrounds the pith and separates it from the wood, although in his opinion it differs greatly from both, and in its composition has no resemblance to either. It is, according to him, the most important part in the whole vegetable fabric, by which the propagation and increase of the branches, buds, and shoots is carried on. The corona is not so uniform as the other parts, nor is it constituted exactly similar in all trees. It is placed between the pith and wood in all vegetables forming a ring, whose outline is more or less regulated. The general circle is cellular, composed of blebs and vessels, like the bark and the rind, and is perfectly similar to them, only that at different distances oblong clusters of different vessels are placed amongst it. These clusters are usually eight or ten in number, and give origin to the angles of the corona. Each cluster is composed of all the essential parts of the succeeding branch, and the intermediate parts of the circle are absolutely bark and rind. On the corona and its clusters depends that property of vegetables that can be produced entire from every piece. These clusters follow the course of the other portions of the tree, they are therefore every where; they are always capable of growing, and their growth, even in a cutting of the smallest twig, cannot produce a leaf or any other part of a vegetable alone, but must afford the whole; for they are complete bodies, and the whole is there waiting only for the opportunity of extension. For the knowledge we have of this part, we are altogether indebted to Dr. Hill. It remains for future observers to confirm or disprove his observations.

The pith is found in the centre of every young shoot of a tree; it is large in some, less in others, but present in all. It is placed close within the corona. It seems to be nothing more than a congeries of the cellular tissue; it is generally found near the centre of the tree, inclosed as it were within a tube: in general the cells of the pith are larger than those of the cellular tissue, with which according to some naturalists it communicates. The bark and the wood grow thicker every year, while the pith, on the contrary, grows more slender; so that in a branch of one year it is of a larger size than it is in the same branch when two years old, and so on. In very young branches, while in an herbaceous state, the pith forms the greatest part of the substance; but when the fibres are stronger, the pith becomes less succulent, and surrounded with a tube of wood. When the branch is arrived to a certain age, it is so compressed as to be almost annihilated. In examining different branches that proceed from others in their first state, a small communication between the pith of the one and the other will be found; but this communication is in general entirely closed up in the second or third year. The cells of which the pith is formed are at first entirely one connected body; but as the plant grows up, it is often so broke and ruptured as to remain no longer a fibrous substance.

This, as well as other remarks on the nature of pith, corroborates the opinion of Dr. Hill, who thinks it is formed for the purpose of moistening the clusters of the corona, and regulating its extension. It has been supposed coeval with, or primordial to, all other parts; but he thinks it posterior, and comes after them in the order of time as well as in its uses; and the thickness of the juices clothing the bubble gives it form and substance. The first season is the time of its greatest use, and immediately after it begins to decay.

To what has been said, we may add the following general ideas relative to the organization of trees. The most obvious and remarkable parts of a plant, or tree, are the root, the stem, the branches, the leaves, the flower, and the fruit. The component parts of these divisions are not complicated; they are simple when compared to those of an animal, and this because the offices of the vegetable are fewer than those of the animal. The principal source of the phenomena of vegetation is the simplicity and uniformity of their organization. For a representation of an instrument for cutting transverse sections in wood, see Plate of MICROSCOPICAL APPARATUS.

The figures in Plate III. are portions of transverse sections cut by Mr. Cusane, who first brought this art to perfection, and remains unrivalled as yet in these performances.

Fig. 1. represents a magnified view of a section of the sugar cane: fig. 2. a magnified view of a section of the common cane: fig. 3. a magnified view of a section of the hazel: fig. 4. a magnified view of a section of the althea frutex: fig. 5. a magnified view from a branch of the lime-tree: fig. 6. a magnified view of a section of the bamboo cane.

The exterior form, and even the internal structure, of the generality of vegetable seeds, have been supposed by some so much alike in the several kinds, and of so little curiosity and beauty in the whole, that they have scarcely been regarded by the curious; but when nearly examined by the help of microscopes, they are found to be worthy of greater attention; those which appear most like to one another when viewed by the naked eye, often proving as different when thus examined, in their several forms and characters, as the different genera of any other bodies of the creation. If their external forms carry all this variety and beauty about them, their internal structure, when laid open by different sections, appears yet more admirable. A number of beauties in this part of the creation are described at large by Dr. Parsons, in his work entitled, "A Microscopic Theatre of Seeds." Most kinds of seeds should be prepared for a microscopical examination by steeping them in warm water till their coats are separated, and their seminal leaves may then be opened without laceration. But seeds while dry, and without any preparation, are of an almost infinite variety of shape, and afford a number of pleasing objects for the microscope. Indeed, it may be truly said, that the whole of the animal, vegetable, and mineral kingdoms, with all their numerous subdivisions, furnish objects for the microscope; and there is not one of them, when properly examined, but will afford a pleasing fund of instruction and entertainment to the rational investigator of the works of creation.

Those who rightly consider natural things will find them a shadow of heavenly things, a school in which the parent of the universe is the teacher, and all the objects of sense in heaven and earth, and under the earth, are as the letters of an universal language, in which all the nations that inhabit the globe have a common interest. The Creator himself has made this use of it, revealing his will by it, and referring man to it for instruction.

MIDWIFERY. The art of assisting women in the birth of children. It comprehends the management of women both before and after the delivery, as well as the treatment of the child in its most early state.

Microscopic Objects of the Vegetable Kingdom, as they appear when magnified, exhibiting a view of the Organization of Timber.

Copied by permission from Mr. Adams's Essays on the Microscope.

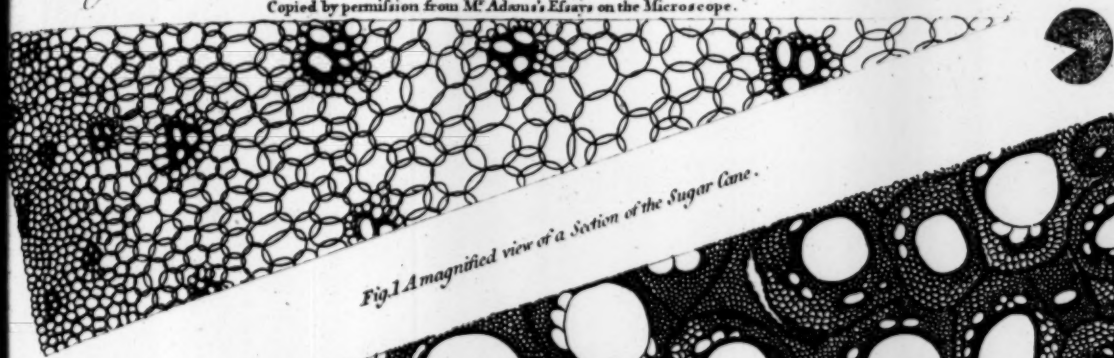


Fig. 1 A magnified view of a Section of the Sugar Cane.

Fig. 2

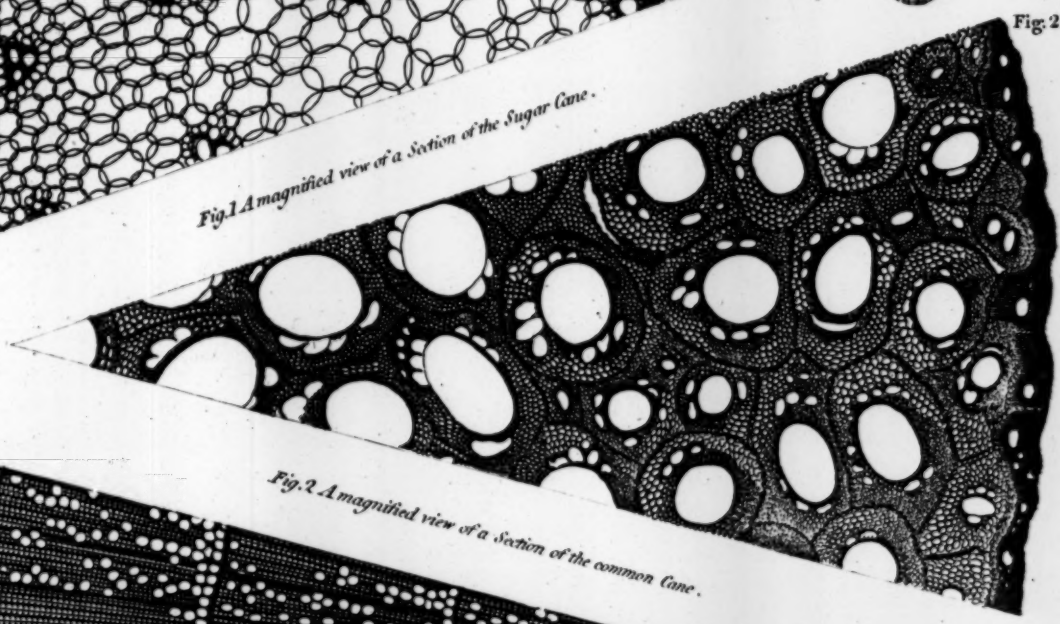


Fig. 2 A magnified view of a Section of the common Cane.

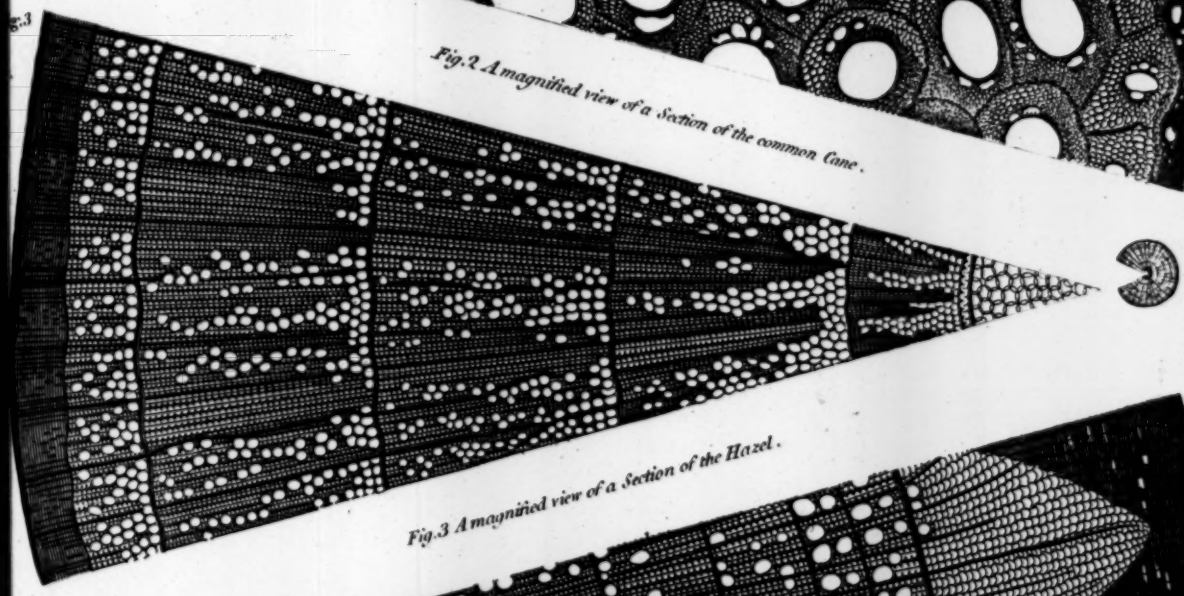


Fig. 3 A magnified view of a Section of the Hazel.

Fig. 4

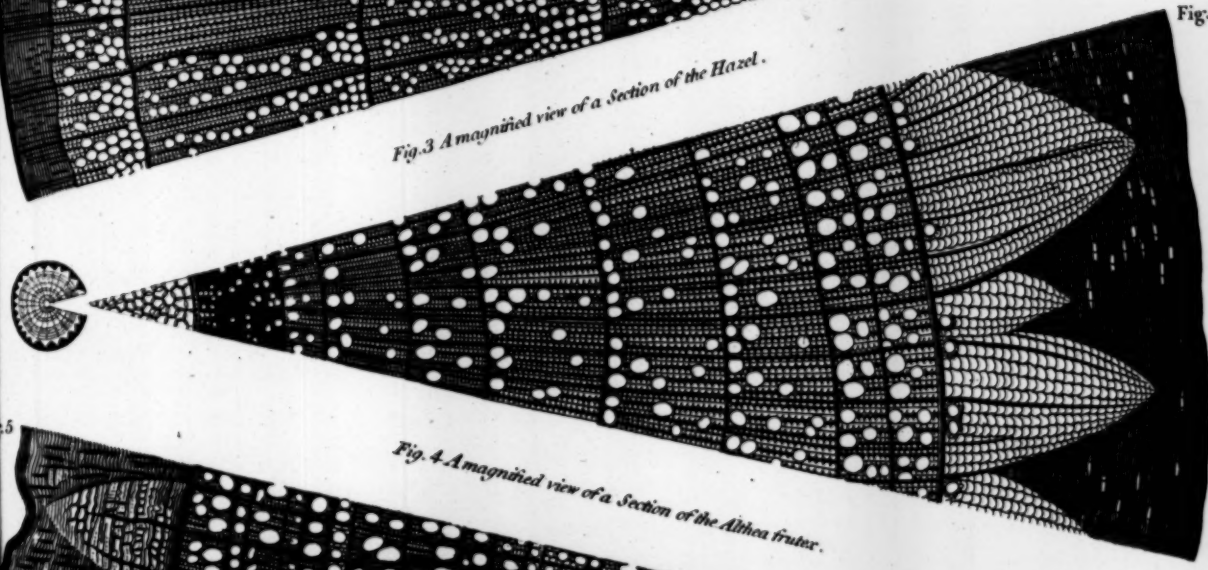


Fig. 4 A magnified view of a Section of the Althoea fruticosa.



Fig. 5 A magnified view from a branch of the Lime-tree.

Fig. 6



Fig. 6 A magnified view of a Section of the bamboo Cane.

Published as the Art directs by C. Cooke No. 7 Paternoster Row July 1826.

T
physi
peter
this
and f
adops
creat
its ul
a ged
sing
lowin
capac
and
This
of el
child
tion,
did
prod

T
sphe
serv
tog
opp
Alt
cess
not
in t
in t
we
selv
wa
for
U
gr
an
Fa
wi

w
an
ve
m
in
p
A
li
e
v
f

SYSTEM OF MIDWIFERY.

INTRODUCTION.

THE knowledge of midwifery seems not to have been improved so soon as that of physic. Hippocrates, and other physicians of eminence among the ancients, did not attain to a competent degree of knowledge either in the theory or practice of this art. Mauriceau was the first who brought it to a standard, and formed it upon principles that have ever since been generally adopted. The knowledge of midwifery has been so much increased within this century, that it seems to have nearly attained its ultimate perfection, and its operations are reduced almost to a geometrical certainty. And this, says Astruc, is not surprising; for, after all, the art of midwifery is reduced to the following mechanical problem: "An extensive cavity of a certain capacity being given, to pass a flexible body of a given length and thickness through an opening dilatate to a certain degree." This might be resolved geometrically, if the different degrees of elasticity of the womb, and strength and weakness of the child, the greater or less disposition of the blood to inflammation, and the greater or lesser degree of irritability of the nerves, did not occasion that uncertainty which physical facts constantly produce in all physico-mathematical questions.

PART I. THEORY.

SECTION I. CONCEPTION.

The minutiae or first principles of bodies being without the sphere of human comprehension, all that we know is by the observation of their effects; so that the *modus* of conception is altogether uncertain, especially in the human species, because opportunities of opening pregnant women so seldom occur. Although the knowledge of this operation is not absolutely necessary for the practice of midwifery, an investigation of it may not only gratify the curious, but also promote farther enquiries; in the course of which, many material discoveries may be made, in the same manner as many valuable compositions in chymistry were found out in the last century by those who exercise themselves in search of the philosopher's stone.

From the time of Hippocrates to the sixteenth century, it was generally believed that the Embryo and Secundines were formed by the mixture of the male and female semen in the Uterus; but during the last hundred years, anatomy received great improvements by the frequent dissection of human bodies; and in some female subjects, the Fœtus was found in one of the Fallopian tubes; in others, it was discovered in the abdomen, with the Placenta adhering to the surface of the Viscera.

Malpighius, and others, between the years 1650 and 1690, wrote expressly upon the incubation of eggs, their formation, and the gradual increase of oviparous animals. The great Harvey observed the progress of the viviparous kind, in a great number of different animals which he had opportunities of opening. De Graaf dissected near one hundred rabbits, and is very particular and accurate in the observations he had made. Ruysch, Aldes, Needham, Steno, Kerkringius, Swammerdam, Bartholine the son, and Drelincourt, employed themselves in the same enquiries; and, in consequence of their different remarks, a variety of theories have been erected: yet all of them have been subject to many objections.

When the parts in women, subservient to generation, attain their acme, or full growth, one or more of the Ova being brought to maturity, that part of the Peritonæum which covers the Ovarium begins to stretch; the nervous fibres are accordingly affected, and contract themselves so as to bring the Fimbria of the Fallopian tube in close contact with the ripe Ovum: by which mechanism, this last is squeezed out of its nidus or husk into the cavity of the tube, through which it is conveyed into the Uterus by a vermicular or peristaltic motion; and if it is not immediately impregnated with an Animalcule of the male semen, must be dissolved and lost, because it is now detached from the vessels of the Ovarium, and has no Vis Vitæ in itself. The external coat of the Ovum is the membrane Chorion; one fourth part of which is the Placenta, supposed to be the root by which it was formerly joined to the vessels of the Ovarium; and the navel-string is no other than a continuation of the vessels belonging to this cake. The Chorion is on the inside lined with another membrane called *Amnion*; and both are kept distended in a globular form by a clear serous fluid, or thin lymph.

As for the male semen, according to the observation of the celebrated Leeuwenhoek, it abounds with Animalcula, that swim about in it like so many tadpoles; and these are larger and more vigorous the longer the semen hath remained in the Vesiculæ Seminales. The parts of both male and female being thus brought to maturity, the following circumstances are supposed to happen in coition, especially in those embraces which immediately follow the evacuation of the Menfes. In the woman the frictions of the Penis in the contracted Vagina, the repeated pressure and shocks against the external parts, the alternate motion upwards and downwards of the Uterus, with its appendages, the Ovaria, Fallopian tubes, and round ligaments, produce a general titillation and turgency; in consequence of which, the nervous fibrils are convulsed, and a fluid ejected from the prostate, or analogous glands, as well as from those of the Uterus and Fallopian tubes. The Fimbria belonging to one of which, now firmly grasps the

ripened Ovum, which at the same instant is impregnated with the male seed that in the orgasm of coition had been thrown into the Uterus, and thence conveyed into the cavity of the tube by some absorbing or convulsive power. When the two matured principles are thus mingled, one of the Animalcula insinuates itself into the Ovum, and is joined with its belly to that ruptured part of it from which the navel-string is produced; or, entering one of the vessels, is protruded to the end of the Funis, by which a circulation is carried on from the embryo to the placenta and membranes. The ovum being impregnated is squeezed from its nidus or husk into the tube, by the contraction of the fimbria; and thus disengaged from its attachments to the ovarium, is endowed with a circulating force by the animalculum, which has a vis vitæ in itself: the vessels on the surface of the ovum being opened in consequence of its detachments from the ovarium, absorb the surrounding fluid which is secreted by the glands in the cavity of the tube and uterus, or forced into them by motion, heat, and rarefaction, and carried along the umbilical vein for the nourishment and increase of the impregnated mass.

Of the semen that is injected or absorbed into the uterus, part is mixed with the fluid secreted by the glands in the canal of the neck, which is blocked up with a sort of gluten formed by this mixture; so that the Ovum is thereby prevented from sinking too far down, and being discharged.

This theory of conception, though very ingenious, and of all others the best supported with corroborating considerations, such as, that Fœtuses and Embryos have been actually found in the cavity of the tube and abdomen, without any marks of exclusion from the Uterus; besides other presumptions that will be mentioned when we come to treat of the nutrition of the fœtus; we say, notwithstanding the plausibility of the scheme, it is attended with circumstances which are hitherto inexplicable; namely, the manner in which the Animalculum gains admission into the Ovum, either while it remains in the ovarium, sojourns in the tube, or is deposited in the Fundus Uteri; and the method by which the vessels of the navel-string are inoculated with those of the Animalculum. Indeed, these points are so intricate, that every different theorist has started different opinions concerning them, some of which are rather jocular than instructive.

SECT. II. External and internal Parts of Generation in Women.

The Mons Veneris is situated at the upper part of the Pubes, from which also begin the Labia Pudendi, stretching down as far as the lower edge, where the Frænum Labiorum or Fourchette is formed.

The Clitoris with its Præputium is found between the Labia, on the middle and fore-part of the Pubes; and from the lower part of the Clitoris, the Nymphæ rising, spread outwards and downwards to the sides of the Os Externum, forming a kind of sulcus or furrow, called the *Fossa Magna* or *Navicularis*, for the direction of the Penis in coition, or the finger in touching, into the Vagina.

The Meatus Urinarius is immediately below the under edge of the Symphysis of the Os Pubis, and at the upper part of the Os Externum, which is the orifice of the Vagina, situated immediately below the said bones of the Pubes; the lower edge of which bones is equal to the lower edge of the frænum or fourchette, which bounds the inferior part of the Fossa Magna and Os Externum, restraining it as if with a bridle.

The Perinæum extends from this border to the Anus, being about one inch or one and an half in length: the wrinkled part of the Anus is about three quarters of an inch in diameter; from thence to the Coccyx the distance is about two inches; so that the whole extent from the fourchette to this bone amounts to about four inches, or four and a quarter.

What remains of the lower part of the Pelvis is covered and filled up with the integuments, adipose membrane, and the muscles called *Levatores Ani*; while within these are contained the muscles belonging to the Clitoris, mouth of the bladder, Os Externum, and Anus. See fig. 12.

In young children, there is a thin membrane called the *Hymen*, extended over the lower part of the Os Externum, representing the figure of a crescent; the concave and open side being turned towards the Meatus Urinarius. In some, the middle of this concave is attached to the lower part of the Meatus, forming two small openings; nay, in some adults this membrane has entirely shut up the entrance of the Vagina, so that they have been altogether imperforated; but, when broke, it recedes, and forms the Carunculæ Myrtiformes.

On each side of the Meatus Urinarius are two small lacunæ or openings, the tubes of which, ending in a kind of sacculus, come from the prostate gland: from these a thin fluid is ejected in time of copulation, and that from some women with considerable force; and sometimes, though seldom, to the quantity of several drachms.

The Urethra; in women, is about one inch and an half in length. The Vagina is formed of a strong thick membrane, of a spongy texture, more contracted in virgins than in married women. When stretched to its full extent, it may be about five, six, or seven inches long, and two in width, according to the difference of stature in different women: but, when the Uterus hangs down in the Vagina, the length will not be more than two or three inches; and it may be stretched with the finger to the width of three or four

four

MIDWIFERY.

four. The inside of it, in young women, is full of rugæ, folds, or wrinkles, which are partly obliterated in those who have borne children. The upper end of the Vagina is joined to the circumference of the lips of the Os Uteri, which resemble the mouth of a puppy or tench; and a thin expansion of this membrane, being reflected inwards, covers the exterior part of these lips, which in virgins are smooth and of an oval form. It is also continued along the inside of the Uterus, constituting the internal membrane of the neck and Fundus, which is likewise full of plicæ, especially in young subjects. See fig. 4, 5, 6, 7, 8.

As to the different names of those parts, the book of Schurigius, published at Dresden, may be consulted. The entry of the Vagina is commonly called the *Spinder Vagina*, and the mouth of the womb is often distinguished by the appellation of *Os Tincæ*: but, as the mention of these parts will frequently occur in the course of this System, we shall, in order to avoid confusion or mistake, call the first Os Externum, and the other Os Internum, through the whole of it.

The Uterus is about three inches long from the Os Internum to the upper part of the Fundus, and one inch in thickness from the fore to the back part. It is divided into the Neck and Fundus; the length of the neck being an inch and three quarters, while that of the fundus is one inch and one quarter. The width of the Uterus at the neck is about one inch, but at the fundus twice as much. The uterus is smaller in young women.

The outside-shape of the Uterus in some measure resembles a flattened cucurbit, or that kind of spear which hath a long neck.

The canal or entrance from the Os Internum to the cavity of the Fundus Uteri will admit a common director; being a little wider in the middle, and more contracted at the upper end.

The cavity of the Fundus is in point of figure something between an oval and triangle: one of the angles commencing at the upper end of the aforesaid canal, and the other two expanding the sides of the Fundus, from which arise the Fallopian Tubes. These tubes are about three inches long; and so narrow at their entrance from the uterus, as scarcely to admit an hog's bristle; but the cavity of each turns gradually wider, and ends in an open mouth or sphincter, from the brim of which is expanded the Fimbria or *Morus Diaboli*, that generally bears the likeness of jagged leaves, and in some resembles an hand with membranous fingers, which is supposed to grasp the Ovum when ripe and ready to drop from the Ovarium.

The Uterus is formed first of the inside membrane that rises from the Vagina, and lines all the interior part of the womb: immediately above this coat is the thick substance of the uterus, composed of a plexus of arteries, lymphatic, veins and nerves; and the vessels on the surface, when injected, seem to run in contorted lines. It appears to be of the same glandular texture (tho' not so compact) as that of the breasts, without any muscular fibres, except such as compose the coats of the vessels. When this part is minutely injected, it seems to be almost nothing but a mass of vessels; a circumstance common to it with other parts of the body: And anatomists are agreed, that the greater number of vessels visible in such nice injections, are those through which the serum or lymph of the blood circulates in the living body; whence the *error loci* in an Ophthalmia is imitated by subtle injections of coloured matter into the arteries of the dead subject. See fig. 4, 5, 6.

When the Uterus stretches in the time of gestation, the vessels are proportionably dilated by an increase of the fluid they contain: so that, at the time of delivery, some of them are capacious enough to admit the end of the little finger. Yet the substance of the womb, for the most part, instead of growing thinner as Mauriceau alleges, or thicker, according to Daventer, continues of its natural thickness during the whole term of pregnancy; and this equality is maintained by the gradual distention of the vessels that enter into its composition. In time of labour, indeed, as the waters are discharged, the uterus contracts itself and grows thicker; and the resistance ceasing at the delivery of the child, and after-birth, it becomes smaller and smaller, until it has nearly resumed its natural dimensions. See fig. 14 and 16.

The Vagina on its outside is covered with a thick adipose membrane; by means of which, it is on the fore-part attached to the lower part of the bladder, and on the back-part to the lower end of the Rectum and Anus; and by the same means all these parts are connected with the Peritonæum, or internal surface of the Pelvis.

The Uterus is contained in a duplicature of the Peritonæum, which covers it every where about, and is connected with its substance by a very thin cellular membrane: as for the Peritonæum in itself, it is a smooth membranous expansion, that covers all the inside of the Abdomen, and gives external coats to all the Viscera contained in that cavity. On the fore-part it lines the muscles of the Abdomen and Diaphragm; backwards, it covers the abdominal Viscera in general, the Aorta and Vena Cava Descendens, the kidneys, ureters, and spermatic vessels, the external and internal Iliacs, the Psoas and muscles that cover the inside of the Ilium, whence it rises double, and forms the Ligamenta Lata, in which are contained the Ovaria and Fallopian tubes. This duplicature, where it meets in the middle, envelops all the Uterus, as before observed, and gives a covering to the round ligaments that rise from each side of the Fundus Uteri, and are inserted or lost about the upper

and external part of the pubes and groin. The Peritonæum is also reflected from the fore-part of the Uterus over the upper part of the bladder: and upon the back part of the Uterus it descends even upon the Vagina, from which it is again reflected upwards over the Rectum.

In coition, the Uterus yields three or four inches to the pressure of the Penis, having a free motion upwards and downwards; so that the reciprocal oscillation, which is permitted by this contrivance, increases the mutual titillation and pleasure: See fig. 5.

SECT. III. Of the OVARIA, Vessels, Ligaments, and Fallopian Tubes.

The Ovaria are two small oval bodies, one of which is placed behind each Fallopian tube; supposed to be little more than a cluster of Ova, whence they derive their present name: for, by ancient authors, they are mentioned by the appellation of the *female testicles*. Each Ovarium is about one inch in length, half as broad, and one quarter of an inch in thickness; more convex on the fore than on the back-part, of a smooth surface, covered with the Peritonæum. See fig. 5.

The blood vessels are, first, the Spermatic Arteries and Veins, which have nearly the same origin as those in men, are mostly distributed upon the ovaria and tubes, and at the upper part of the uterus communicate with the hypogastrics: from the branches of which the body of the womb is furnished. All these arteries anastomose, and are supposed to detach small ramifications that open into the cavity of the Uterus. The veins are large, communicate one with another with the Hæmorrhoidals and Vena Portarum, and have no valves. The Ligamenta Rotunda are two vascular ropes composed of veins and arteries inclosed in the duplicature of the Ligamenta Lata, seemingly arising from the crural artery and vein, from whence they are extended to the sides of the Fundus Uteri. The nerves come from the Intercostals, Lumbares, and Sacri, as described in Boerhaave's Institutes and Winslow's Anatomy.

SECT. IV. Of the Increase of the UTERUS after Conception.

It is supposed that the Ovum swims in a fluid, which it absorbs so as to increase gradually in magnitude till it comes in contact with all the inner surface of the Fundus; and this being distended in proportion to the augmentation of its contents, the upper part of the neck begins also to be stretched.

About the third month of gestation, the ovum in bigness equals a goose-egg; and then nearly one fourth of the neck at its upper part is distended equal with the fundus. At the fifth month, the fundus is increased to a much greater magnitude, and rises upwards to the middle space betwixt the upper part of the pubes and the navel; and at that period one half of the neck is extended. At the seventh month, the fundus reaches as high as the navel; at the eighth month, it is advanced midway between the navel and scrobiculus cordis; and in the ninth month is raised quite up to this last mentioned part, the neck of the womb being then altogether distended. See fig. 4, 5, 6, 7, 8, 9, 10.

Now that the whole substance of the uterus is stretched, the neck and os internum, which were at first the strongest, become the weakest part of the womb, and the stretching force being still continued by the increase of the fetus and secundines, which are extended by the inclosed waters in a globular form, the os uteri begins gradually to give way. In the beginning of its dilatation, the nervous fibres in this place being more sensible than any other part of the uterus, are irritated, and yield an uneasy sensation; to alleviate which the woman squeezes her uterus by contracting the abdominal muscles, and at the same time filling the lungs with air, by which the diaphragm is kept down; the pain being rather increased than abated by this straining, is communicated to all the neighbouring parts to which the ligaments and vessels are attached, such as the back, loins, and inside of the thighs; and by this compression of the uterus the waters and membranes are squeezed against the os uteri, which is of consequence a little more opened. See fig. 11, 14, 15, 16.

The woman being unable to continue this effort for any length of time, from the violence of the pain it occasions, and the strength of the muscles being thereby a little exhausted and impaired, the contracting force abates; the tension of the os tincæ being taken off, it becomes more soft, and contracts a little; so that the nervous fibres are relaxed. This remission of pain the patient enjoys for some time, until the same increasing force renews the stretching pains, irritation, and something like a tenesmus at the os uteri; the compression of the womb again takes place, and the internal mouth is a little more dilated, either by the pressure of the waters and membranes, or, when the fluid is in small quantity, by the child's head forced down by the contraction of the uterus, which in that case is in contact with the body of the fetus. See fig. 16, 17, 18.

In this manner the labour-pains begin, and continue to return periodically, growing stronger and more frequent until the os uteri is fully dilated, and the membranes are depressed and broke; so that the waters are discharged, the uterus contracts, and, with the assistance of the muscles, the child is forced along and delivered.

SECT. V. Of the Magnitude, Weight, and different Appellations given to the OVUM and CHILD.

When the ovum descends into the uterus, it is supposed to be about the size of a poppy-seed, and in the third month augmented

M I D W I F E R Y.

to the bigness of a goose egg. Ten days after conception, the child (according to some authors) weighs half a grain; at thirty days, is increased to the weight of twenty-two grains; at three months, weighs betwixt two and three ounces; and at nine months, from ten to twelve, and sometimes sixteen, pounds: by which calculation it would appear that the progress of the Fœtus is quickest in the beginning of its growth; for from the tenth to the thirteenth day (according to this supposition) it increases to three and forty times its weight. All these calculations are uncertain.

The conception is called an *Embryo*, until all the parts are distinctly formed, generally in the third month; and from that period to delivery, is distinguished by the appellation of Fœtus.

SECT. VI. Of the PLACENTA and Membranes.

We have already observed that the Ovum is formed of the Placenta with the Chorion and Amnion, which are globularly distended by the inclosed water that surrounds the child. The Placenta is commonly of a round figure, some what resembling an oat-cake, about six inches in diameter, and one inch thick in the middle, growing a little thinner towards the circumference; it is composed of veins and arteries, which are divided into an infinite number of small branches, the venous parts of which unite in one large tube, called the *umbilical vein*, which brings back the blood, and is supposed to carry along the nutritive fluid from the vessels of the Chorion and Placenta, to the child, whose belly it perforates at the navel; from thence passing into the liver, where it communicates with the *Vena Portarum* and *Cava*. It is furnished with two arteries, which arise from the internal iliacs to the child, and running upon each side of the bladder perforates the belly where the umbilical vein entered; then they proceed to the Placenta, in a spiral line, twining round the vein, in conjunction with which, they form the *Funiculus Umbilicalis*, which is commonly four or five hand breadths in length, sometimes only two or three, and sometimes it extends to the length of eight or ten. The two arteries, on their arrival at the inner surface of the Placenta, are divided and subdivided into minute branches, which at last end in small capillaries that inosculate with the veins of the same order. These arteries, together with the umbilical vein, are supposed to do the same office in the Placenta which is afterwards performed in the lungs by the pulmonary artery and vein, until the child is delivered and begins to breathe: and this opinion seems to be confirmed by the following experiments. If the child and Placenta are both delivered suddenly, or the last immediately after the first; and if the child, though alive, does not yet breathe, the blood may be felt circulating sometimes slowly, and at other times with great force, through the arteries of the Funis to the Placenta, and from thence back again to the child, along the umbilical vein. When the vessels are slightly pressed, the arteries swell between the preffure and the child, while the vein grows turgid between that and the Placenta, from the surface of which no blood is observed to flow, altho' it be lying in a basin among warm water. As the child begins to breathe, the circulation, though it was weak before, immediately grows stronger and stronger; and then in a few minutes the pulsation in the navel-string becomes more languid, and at last entirely stops. If, after the child is delivered, and the navel-string cut, provided the Placenta adheres firmly to the Uterus, which is thereby kept extended, or if the womb is still distended by another child, no more blood flows from the umbilical vessels than what seemed to be contained in them at the instant of cutting; and this, in common cases, does not exceed the quantity of two or three ounces: and finally, when, in consequence of violent floodings, the mother expires either in time of delivery or soon after it, the child is sometimes found alive and vigorous, especially if the Placenta is found; but if tore, then the child will lose blood as well as the mother.

The external surface of the Placenta is divided into several lobes, that it may yield and conform itself more commodiously to the inner surface of the Uterus, to which it adheres, so as to prevent its being separated by any shock or blows upon the abdomen, unless when violent. Those groups of veins and arteries which enter into the composition of the Placenta, receive external coats from the Chorion, which is the outward membrane of the Ovum, thick and strong, and forms three-fourths of the external globe that contains the waters and the child; the remaining part being covered by the Placenta; so that these two in conjunction constitute the whole external surface of the Ovum. Some indeed alledge, that these are enveloped with a cribriform or cellular substance, by which they seem to adhere by contact only to the Uterus; and that the inner membrane of the womb is full of little glands, whose excretory ducts, opening into the fundus and neck, secrete a soft thin mucus (as formerly observed) to lubricate the whole cavity of the Uterus, which beginning to stretch in time of gestation, the vessels that compose these glands are also distended; consequently a greater quantity of this mucus is separated and retained in this supposed cribriform and cellular substance, the absorbing vessels of which take it in and convey it along the veins for the nourishment of the child. The womb being therefore distended in proportion to the increase of the child, those glands are also proportionably enlarged; by which means a larger quantity of the fluid is separated, because the nutriment of the child must be augmented in proportion to the progress of its growth; and this liquor undergoes an altera-

No. 106. VOL. III.

tion in quality as well as in quantity, being changed from a clear thin fluid into the most viscous consistence of milk. In some cases, this mucus hath been discharged from the Uterus in time of pregnancy, and both mother and child weakened by the evacuation; which may be occasioned by the chorion's adhering too loosely, or being in one part actually separated from the womb.

Formerly it was taken for granted, by many, that the Placenta always adhered to the Fundus Uteri. But this notion is refuted by certain observations: in consequence of which we find it as often sticking to the sides, back, and fore-parts, and sometimes as far down as the infide of the os uteri. See fig. 4, 5, 6, 7, 8, 9, 11, 14, 15, 17.

When the Placenta is delivered, and no other part of the membrane tore except that through which the child passed, the opening is generally near the edge or side of the Placenta, and seldom in the middle of the membranes; and a hog's bladder being introduced at this opening, and inflated, when lying in water, will shew the shape and size of the inner surface of the womb, and plainly discover the part to which the Placenta adhered.

The Chorion is, on the infide, lined with the Amnion, which is a thin transparent membrane, without any vessels so large as to admit the red globules of blood: it adheres to the chorion by contact, and seems to form the external coat of the Funis Umbilicalis.

This membrane contains the serum in which the child swims; which fluid is supposed to be furnished by lymphatic vessels that open into the inner surface of the Amnion. If this liquid is neither absorbed into the body of the fœtus, nor taken into the stomach by suction at the mouth, there must be absorbing vessels in this membrane, in the same manner as in the abdomen and other cavities of the body, where there is a constant renovation of humidity.

From the foregoing observations upon nutrition, it seems probable, that the fœtus is rather nourished by the absorption of the nutritive fluid into the vessels of the Placenta and Chorion, than from the red blood circulated in full stream from the arteries of the Uterus to the veins of the Placenta, and returned by the arteries of the last to the veins of the first, in order to be renewed, refined, and made arterial blood in the lungs of the mother.

SECT. VII. Of the Child's Situation in the Uterus.

The embryo or fœtus, as it lies in the Uterus, is nearly of a circular or rather oval figure, which is calculated to take up as little space as possible. The chin rests upon the breast; the thighs are pressed along the belly; the heels applied to the breech; the face being placed between the knees; while the arms cross each other round the legs. The head for the most part is down to the lower part of the Uterus; and, the child being contracted into an oval form, the greatest length is from head to breech: but the distance from one side to the other is very much less than that from the fore to the back part; because the thighs and legs are doubled along the belly and stomach, and the head bended forwards on the breast.

In the first month, according to some writers, the embryo exhibits the figure of a tadpole, with a large head and small body or tail, which gradually increases in magnitude, till the arms and thighs begin to bud or strut out, like small nipples, from the shoulders and breech; two black specks appear on each side of the head, with a little hole or opening between them, which, in the second month, are easily distinguished to be the eyes and mouth. (See fig. 6.) The legs and arms are gradually formed, while the body turns larger; but the fingers are not separated or distinct, till the latter end of the second or beginning of the third month. (See fig. 7.) This is commonly the case, but sometimes the bulk and appearance differ considerably in different embryos of the same age. The younger the embryo, the larger and heavier is the head in proportion to the rest of the body; and this is the case in all the different gradations of the fœtus; so that, when dropt or suspended by the navel-string in water, the head must sink lowermost of course. Besides, when women miscarry, in the fourth, fifth, sixth, and seventh months, the head, for the most part, presents itself, and is first delivered. (See fig. 7, 8, and 9.) By the touch in the vagina, the head is frequently felt in the seventh, sometimes in the sixth, but more frequently in the eighth month; and if the same women are thus examined from time to time till the labour begins, the head will always be felt of a round firm substance at the fore-part of the brim of the pelvis, betwixt the os internum and pubes, through the substance of the Vagina and Uterus. (See fig. 9.) But all these opinions are liable to objections; yet as it lies as easy in one posture as in another till the birth, this dispute is of less consequence in the practice of Midwifery. It may be useful to suggest, that the wrong posture of the child in the Uterus may proceed from circulations of the Funis Umbilicalis. (See fig. 32.) Or when there is little or no water surrounding the child, it may move into a wrong position, and be confined there by the stricture of the Uterus. See fig. 33, 34, 35, 36. Or lastly, it may be the effect of a pendulous belly or narrow pelvis, when the head lies forward over the pubis. See fig. 16, 30, and 37.

SECT. VIII. The Pelvis.

It is necessary that all Practitioners in Midwifery should be acquainted with the structure and form of the Pelvis; of the component parts which we have treated in the System of Anatomy. And in order to afford a more perfect knowledge of the bones

MIDWIFERY.

which compose the Pelvis, we have given three views of it, that will be described at the end of the System. The first Figure represents the bones of a well formed Pelvis. The second Figure exhibits a front view of a distorted Pelvis. The third represents a lateral and internal view of the Pelvis, the same being divided longitudinally, in order more clearly to shew and describe the respective parts. As a distorted Pelvis sometimes occurs in the course of practice, it will be proper to attend to fig. 2. in the description of the Plates at the end of the System.

PART II.

Of the Diseases incident to pregnant Women; being either such as immediately proceed from Pregnancy, or such as may happen at any other Time; and, if not carefully prevented or removed, may be of dangerous Consequence both to Mother and Child.

SECT. I. Of NAUSEA and VOMITING.

The first complaint attending pregnancy is the nausea and vomiting, which in some women begins soon after conception, and frequently continues till the end of the fourth month. Most women are troubled with this symptom more or less, particularly vomiting in the morning: some who have no such complaint in one pregnancy, shall be violently attacked with it in another; and in a few it prevails during the whole time of uterine gestation.

The vomiting, if not very violent, is seldom of dangerous consequence: but, on the contrary, is supposed to be serviceable to the patient, by unloading the stomach of superfluous nourishment, thereby carrying off or preventing too great a turgency in the vessels of the viscera and uterus; and by creating a kind of straining or nifus in the parts, which will assist the fundus and neck of the womb in stretching. Nevertheless, if the straining is too great, it may endanger a miscarriage.

Perhaps this complaint is chiefly occasioned by a fulness of the vessels of the uterus, owing to obstructed catamenia, the whole quantity of which cannot as yet be employed in the nutrition of the embryo: over and above this cause, it has been supposed that the uterus being stretched by the increase of the ovum, a tension of that part ensues, affecting the nerves of that viscus, especially those that arise from the sympatheticæ maximi, and communicate with the plexus at the mouth of the stomach. Whatever be the cause, the complaint is best relieved by bleeding, more or less, according to the plethora and strength of the patient; and if she is costive, by emollient glysters and opening medicines, that will evacuate the hardened contents of the colon and rectum; so that the viscera will be rendered light and easy, and the stretching fulness of the vessels taken off. A light, nutritive, and spare diet, with moderate exercise, and a free open air, will conduce to the removal of this complaint.

SECT. II. Of the Difficulty in making Water; Costiveness; Swelling of the Hæmorrhoids, Legs, and Labia Pudendi; and the Dyspnœa and Vomiting at the latter End of Pregnancy.

Towards the end of the fourth month, or beginning of the fifth, the uterus is so much distended as to fill all the upper part of the pelvis, and then begins to rise upwards into the abdomen; about the same time the os internum is likewise raised and turned backward towards the sacrum, because the fundus is inclined forwards in its rise. The uterus, according to the different directions in which it extends, produces various complaints by its weight and pressure upon the adjacent parts, whether in the pelvis, or higher in the abdomen. In the fourth or fifth month, it presses against the sphincter of the bladder in the pelvis, and produces a difficulty in making water, and sometimes (though seldom) a total suppression. This complaint will happen if the womb is sunk too low in the vagina; or if the ovum, instead of adhering to the fundus, descends into the wide part in the middle of the neck, which accordingly first undergoes distention. This disposition of the ovum is frequently the cause of abortion, because the mouth and neck being in this case, from the stretching, the weakest parts of the uterus, the os internum begins to be opened too soon: yet sometimes this will continue strong and rigid; and after the neck is enlarged, the fundus will be, last of all, stretched till the end of gestation, and the woman be happily delivered. This is one probable reason to account for the Placenta's sometimes adhering over the inside of the mouth of the womb, and helps to support the theory of the neck's turning shorter and shorter, as the full time approaches.

But, as the stretching begins lower down in this than in a common case, the uterus must consequently press against all parts of the pelvis before it can rise above the brim; and this pressure sometimes produces an obstruction of urine, and difficulty in going to stool: the general compression of all these parts will be attended with a degree of inflammation in the substance of the uterus, the vagina, mouth of the bladder, and rectum; from whence violent pains and a fever will ensue. In order to remove or alleviate these symptoms, recourse must be had to bleeding and glysters, the urine must be drawn off by the catheter, fomentations and warm baths be used, and this method occasionally repeated until the complaints abate; and they commonly vanish in consequence of the womb's rising higher, so as to be supported on the brim of the pelvis. See fig. 7.

By the pressure of the uterus upon the upper part of the rectum and lower part of the colon, where it makes semicircular turns to the right and left, the fæces are hindered to pass, and by remaining too long in the guts are indurated, the fluid parts being absorbed. Hence arise violent straining at stool, and a compression of the womb, which threatens abortion. When the patient, therefore, has laboured under this symptom for several days, let emollient, laxative, and gently stimulating glysters be injected. But if the rectum be so obstructed as that the injection cannot pass, suppositories are first to be introduced: for frequently, when the colon and rectum are compressed by the uterus, the peristaltic motion is weakened and impeded, so that the guts cannot expel their contents; in which case, the suppository, by irritation, quickens this faculty, and in dissolving lubricates the parts, thereby facilitating the discharge of the hardened fæces. This previous measure being taken, a glyster ought to be injected, in order to dissolve the collected and indurate contents of the colon, as well as to lubricate and stimulate the inside of that intestine, so as to effect a general evacuation; and for this purpose, a syringe should be used instead of a bladder, that the injection may be thrown up with greater efficacy and force.

These glysters ought to be repeated until the hardened fæces are altogether brought away, and the last discharge appear to be of a soft consistence: neither ought the prescriber to trust to the reports of the patients or nurse, but to his own senses, in examining the effects of these injections; for, if the complaint hath continued several days, a large quantity of indurated fæces ought to be discharged. To avoid such inconvenience for the future, an emollient glyster must be injected every second night; or, if the patient will not submit to this method, which is certainly the easiest and best, recourse must be had to those lenients mentioned at the latter end of this section: for when the fæces are long retained, the air rarifies, expands, and stretches the colon, producing severe choleric pains; this being the method followed by nature, with a view to disburthen herself when she is thus encumbered. See fig. 7.

The pressure of the uterus upon the hæmorrhoidal and internal iliac veins, produces a turgency and tumefaction of all the parts below, such as the pudenda, vagina, anus, and even the os internum, and neck of the womb. This tumefaction of the hæmorrhoidal veins, appears in those swellings at the inside and outside of the anus, which are known by external and internal hæmorrhoids, or piles. This is a complaint to which women are naturally more subject than the other sex: but it is always more violent in time of pregnancy, when the same method of cure may be administered as recommended in the System of Medicine, Genus 31, though greater caution must be used in applying leeches to the parts; because, in this case, a great quantity of blood may be lost before the discharge can be restrained.

About the latter end of the 5th or in the beginning of the sixth month, the uterus being stretched above the brim, and the fundus raised to the middle space betwixt the os pubis and navel, is considerably increased in weight; and even then (though much more so near the full time) lies heavy upon the upper part of the brim, presses upon the vertebræ of the loins, and ossa ilia, and, rising still higher with an augmented force, gradually stretches the parietes of the abdomen, pushing the intestines upwards and to each side.

The weight and pressure on the external iliac veins are attended with a furchage or fulness in the returning vessels that come from the feet, legs, and thighs; and this tumefaction produces cedematous and inflammatory swellings in these parts, together with various tumours in the veins, that sometimes come to suppuration.

The same weight and pressure occasion pains in the back, belly, and loins, especially towards the end of the eighth or in the ninth month: if the uterus rises too high, a dyspnœa, or difficulty of breathing, and frequent vomitings ensue: the first proceeds from the confinement of the lungs and diaphragm in respiration, the liver and viscera of the abdomen being forced up into the thorax: and the last is occasioned by the extraordinary pressure upon the stomach.

All the complaints above described, namely, swelling of the legs, thighs, and labia pudendi, pains in the back, loins and belly, with dyspnœa and vomiting, are removed or palliated by the following method. The patient, if she can bear such evacuations, is generally relieved by bleeding at the arm or ankle, to the amount of eight or ten ounces; but the quantity must be proportioned to the emergency of the case: the belly must be kept open and easy with emollient glysters and laxative medicines, such as a spoonful or two of a mixture composed of equal parts of *Ol Amygd. d.* and *Syr Violar.* taken every night; or from two drachms to half an ounce of manna, or the same quantity of lenitive electuary; a small dose of rhubarb, or five grains of any opening pill; unless the patient be troubled with the hæmorrhoids, in which case all aloetic medicines ought to be avoided: the patient must not walk much, or undergo hard exercise; but frequently rest upon the bed, and lie longer than usual in the morning. When the swelling of the legs is moderate, and only returns at night, rollers or the laced stocking may be serviceable; but when it extends in a great degree to the thighs, labia pudendi, and lower part of the belly, in a woman of a full habit of body, venesection is necessary, because this

cedematous

M I D W I F E R Y.

edematous swelling proceeds from a compression of the returning veins, and not from laxity, as in the anasarca and leucophlegmatic constitutions: here moderate exercise, and (as we have already observed) frequent resting on a bed or couch, is beneficial; or if the skin of the legs and pudenda is excessively stretched, so as to be violently pained, the patient will be greatly relieved by puncturing the parts occasionally: but these complaints cannot be totally removed till delivery, after which they commonly vanish of themselves.

The bellies of those that are indolent, and use no exercise, ought to be moderately compressed, so that the uterus may not rise too high, and occasion difficulty in breathing, and vomiting, in the last months; but they must not be too straitly swathed, lest the womb should be determined, in stretching over the pubes, and produce a pendulous belly, which is often the cause of difficult labours. A medium ought, therefore, to be preserved in this article of compressing, and no woman lace her jumps or stays so as to make herself uneasy; while the diet, air, and exercise, ought to be regulated according to the constitution, custom, and complaints of the patient.

SECT. III. *Of Incontinence of Urine and Difficulty in making Water, at the latter End of Pregnancy, and in Time of Labour.*

The Vesica Urinaria, in women near their full time, is often so much pressed by the Uterus, that it will contain but a very small quantity of water; a circumstance, tho' not dangerous, extremely troublesome, especially when attended with a vomiting or cough; in which case, the straining forces out the water involuntarily, with great violence. The cough may be alleviated by proper remedies, but the vomiting can seldom be removed. Sometimes a bandage applied round the lower part of the belly, and supported with the scapular, is of singular service, particularly when the Uterus lies pendulous over the Os Pubis, thereby compressing the urinary bladder.

But this complaint is not of such dangerous consequence, as a difficulty in making water, or a total suppression, which happens, though very seldom, in the fourth or in the beginning of the fifth month of pregnancy; but most frequently occurs in the time of labour, and after delivery. In the beginning of labour, before the membranes are broke, and the head of the child sunk into the passage, the woman commonly labours under an incontinence of urine from the pressure upon the bladder: but the membranes being broken, and the waters discharged, the uterus contracts, and the child's head is forced down into the Pelvis, where, if it continues for any length of time, the Urethra and Sphincter Vesicæ are so compressed that the urine cannot pass: while the pressure on the other parts of the bladder being removed in consequence of the diminished size of the Uterus and the laxity of the parietes of the abdomen, the Vesica Urinaria is the more easily stretched by the increasing quantity of urine, which distends it to such a degree, that the fibres are over strained: and after delivery, when the pressure is removed from the Sphincter and Meatus Urinarius, it cannot contract so as to discharge its contents, especially if any swelling or inflammation remains from the pressure upon the neck and urethra; in which case the patient is afflicted with violent stretching pains in the loins, back, groin, and particularly above the Os Pubis.

This complaint is immediately removed by drawing off the urine with a catheter: and indeed this expedient ought to be tried before delivery, as it must infallibly promote labour, because one pain interferes with the other. If the inflammation continues or increases, and the obstruction of urine recurs after delivery, the external parts ought to be fomented with warm stupes; bladders half filled with warm water or emollient decoctions may be applied, as hot as the patient can bear them, to all the lower part of the belly; and the catheter be used twice a-day, or as often as necessity requires, until the bladder shall have recovered its tone, so as to perform its office without assistance.

PART III. MISCARRIAGES.

Most of the complaints above described, if violent and neglected, may occasion a miscarriage; and it would be almost an endless task to enumerate every accident from which this misfortune may proceed. We shall therefore content ourselves with describing in what manner abortion happens: first, in the death of the child; secondly, in the separation of the placenta; and lastly, in whatever may occasion too great extension of the neck and of the Os Internum.

SECT. I. *Of the CHILD'S Death.*

This may proceed from diseases peculiar to itself not to be accounted for, as well as from divers accidents that befall it in the womb. If, for example, the navel-string be long, and the quantity of surrounding waters great, the fœtus, while young, may in swimming form a noose of the funis; through which if the head only passes, a circumvolution will happen round the neck or body; but should the whole fœtus pass or thread this noose, a knot will be formed on the navel-string, which, if tight drawn, will absolutely obstruct the circulation. This may likewise be the case when the waters are in very small quantity, and the Funis Umbilicalis falls down before the head, by which it is violently compressed. In short, the death of the fœtus will be effected by all circumvolutions, knots, or pressure upon the navel-string, which destroy the circulation between placenta and the child.

The fœtus may suffer death from diseases and accidents that

happen to the mother; from violent passions of joy, fear, or anger, suddenly raised to such transports as occasion tremors, fainting, or convulsions: and from a plethora, and all acute distempers, in which the circulating force of the fluids is too violent.

The child being dead, and the circulation in the secundines consequently destroyed, the Uterus is no longer stretched; the Fœtus, if large, is no longer felt to move or stir; all the contained parts run gradually into a state of putrefaction; the resistance of the membranes becomes weaker than the contracting force of the Uterus, joined with the pressure of the contents and parietes of the Abdomen; the contained waters of consequence burst through their mortified inclosure; and the Uterus is contracted close to its contents, which are therefore pressed down lower and lower; the neck and mouth of the womb being gradually stretched, labour comes on, and a miscarriage ensues.

At other times, gripings, looseness, and labour-pains, even before the membranes break, are occasioned by obstruction or resistance of the vessels of the Uterus. In these cases, if no flooding happens, the woman is seldom in danger; and, though the child is known to be dead, the progress of nature is to be waited for with patience. If the woman is weak, exhausted, or timorous, she must be encouraged and fortified with nourishing diet; if plethoric, she must undergo evacuation by bleeding and laxative medicines; and when labour begins, be assisted according to the directions specified in the sequel.

SECT. II. *Of the Separation of the PLACENTA from the UTERUS.*

This separation may proceed from all the foregoing diseases and accidents that happen to the mother; from violent shocks, strains, over-reachings, falls, and bruises on the Abdomen; as also from vehement coughs, vomitings, or strainings at stool when the body is costive. The separation of the Placenta is always accompanied with a discharge of blood from the vessels of the Uterus, more or less, according to the term of pregnancy, or as the Placenta is more or less detached.

This discharge is distinguished from the menses by the irregularity of its period, by its flowing in a larger quantity, and, after a small intermission, its return upon the least motion of the patient.

The younger the woman is with child, the danger is the less; because, tho' a considerable quantity of blood be lost, it does not flow with such violence as to exhaust her immediately; and therefore she must be supported and her spirits kept up with proper cordials and nutritive diet. But when such an hæmorrhage happens in any of the three or four last months of pregnancy, the danger is much more imminent, especially towards the full time; because the vessels of the Uterus being then largely distended, a much greater quantity of blood is lost in a shorter time: yet, in both cases, the floodings will be more or less as there is more or less of the Placenta separated from the womb; and when this happens in a very small degree, the discharge may, by right management, be sometimes stopped, and every thing will happily proceed to the full time. But if this purpose cannot be effected in a woman young with child, the principal intention ought to be a mitigation of the hæmorrhage, leaving the rest to time and patience, as a miscarriage in the first five months is seldom attended with hazard. On the contrary, nothing can be more dangerous than such an effusion in any of the four last months, provided it cannot be immediately restrained. In this case we are often deceived by a short intermission, occasioned by coagulated blood that locks up the mouth of the womb, which being pushed off, the flooding returns: and hence we account for its returning so commonly upon motion, a fit of coughing, straining at stool, or any effort whatever.

It is happy for the woman in this case when she is so near the full time that she may be sustained till labour is brought on; and this may be promoted, if the head presents, by gently stretching the mouth of the womb, which being sufficiently opened, the membranes must be broke: so that the waters being evacuated, the Uterus contracts, the flooding is restrained, and the patient safely delivered: at any rate, if the hæmorrhage returns again with great violence, there is no other remedy than that of delivering with all expedition.

Although the great danger is from floodings when near the full time, yet, if labour can be brought on, the Os Uteri is easily dilated with the labour or the hand; but in the sixth or seventh month, it takes longer time, and is stretched with greater difficulty, which is sometimes the occasion of the danger at that period.

In all cases, and at all times, of pregnancy, if the woman receives any extraordinary shock either in mind or body; if she is attacked by a violent fever, or any complaints attending a plethora; bleeding ought always to be prescribed by way of prevention or precaution, unless a low, weak, lax habit of body renders such evacuation unadvisable; but these are not so subject to fevers from fulness.

On the first appearance of flooding she ought to be confined to her bed, and be rather cool than warm. If costive, an emollient glyster must be injected in order to dissolve the hardened fæces, that they may be expelled easily without straining: internally, emulsion with nitre must be used, and mixtures of the *Tinct. Rosar. Rub.* acidulated with spirits of vitrol, as the cooling or restraining method shall seem to be indicated; but above all things, opiates must be administered to procure rest, and quiet the uneasy apprehensions of the mind: for diet, let her use panada, weak broth, and rice-gruel; she may drink water in which a red-hot iron has been several

MIDWIFERY.

several times quenched, mixed with a small proportion of red burnt wine; she must abstain from all the high-seasoned foods, and even flesh-meat or strong broths, that will enrich the blood too fast, and quicken the circulation. But if, notwithstanding this regimen, the flooding shall continue and increase, so that the patient becomes faint and low with loss of blood, we must without farther delay attempt to deliver her, though this is seldom practicable, except in the last months of pregnancy, and then will be the easier performed the nearer she is to her full time; unless labour-pains shall have assisted or begun a dilatation of the Os Internum.

PART IV.

RULES TO BE OBSERVED PREVIOUS TO LABOUR

SECT. I. TOUCHING.

Touching is performed by introducing the fore-finger lubricated with pomatum into the Vagina, in order to feel the Os Internum and neck of the Uterus; and sometime into the Rectum, to discover the stretching of the Fundus. By some we are advised to touch with the middle finger, as being the longest; and by others, to employ both that and the first; but the middle is too much encumbered by that on each side, to answer the purpose fully; and when two are introduced together, the patient never fails to complain. The design of touching is to be informed whether the woman is or is not with child; to know how far she is advanced in her pregnancy; if she is in danger of a miscarriage; if the Os Uteri be dilated; and, in time of labour, to form a right judgment of the case from the opening of the Os Internum, and the pressing down of the membranes with their waters; and, lastly, to distinguish what of the child is presented.

It is generally impracticable to discover by a touch in the Vagina, whether or not the Uterus is impregnated, till after the fourth month: when the best time for examination is the morning, when the woman is fasting, after the contents of the bladder and Rectum have been discharged: and she ought, if necessary, to submit to the enquiry in a standing posture; because, in that case, the Uterus hangs lower down in the Vagina, and the weight is more sensible to the touch than when she lies reclined. One principal reason of our uncertainty is, when we try to feel the neck, the womb rises up on our pressing against the Vagina, at the side of the Os Internum, (see fig. 7.) and in some, the Vagina feels very tense: but when the Fundus Uteri is advanced near the navel, the pressure from above keeps down the Os Internum so much, that you can generally feel both the neck, and, above that, the stretching of the under part of the Uterus. See fig. 6, 7, 8, 9.

There is no considerable variation to be felt in the figure of the Os Internum, except in the latter end of pregnancy, when it sometimes grows larger and softer, (see fig. 14;) nor do the lips seem to be more closed in a woman with child than in another, especially in the beginning of pregnancy; but, in both cases, the Os Uteri is felt like the mouth of a young puppy or tench. In some, the lips are very small; in others, large; and sometimes, though seldom, smoothed over or pointed. In many women, who have formerly had children and difficult labours, the lips are large, and so much separated, as to admit the tip of an ordinary finger; but, a little higher up, the neck seems to be quite closed.

In the first four months, the neck of the womb may be felt hanging down in the Vagina, by pushing up the finger by the side of the Os Internum: but the stretching of the Uterus and upper part of the neck cannot be perceived till the fifth, and sometimes the sixth month; and even then the Uterus must be kept down by a strong pressure upon the belly. The stretching of the Fundus is sometimes felt by the finger introduced into the Rectum, before it can be perceived in the Vagina; because, in this last method, the Uterus recedes from the touch, and rises too high to be accurately distinguished; whereas the finger, being introduced into the Rectum, passes along the back of the womb almost to the upper part of the Fundus, which in an unimpregnated state, is felt flat on the back-part, and jetting out at the sides; but the impregnated Uterus is perceived like a large round tumour.

About the fifth or sixth month, the upper part of the Uterus is so much stretched, as to rise three or four inches above the Os Pubis, or to the middle space between that and the navel; so that, by pressing the hand on the belly, especially of lean women, it is frequently perceived: (see fig. 10.) and if, at the same time, the index of the other hand be introduced in the Vagina, the neck will seem shortened, particularly at the fore-part and sides; and, as we have already observed, the weight will be sensibly felt: but if the Parietes of the Abdomen are stretched after eating, we may be deceived by the pressure of the stomach, because weight and pressure are the same. But all these signs are more perceptible towards the latter end of pregnancy: and, in some women, the Os Internum is felt a little open some weeks before the full time, though generally it is not open till a few days before the labour begins.

From the fifth to the ninth month, the neck of the Uterus becomes shorter and shorter, and the stretching of the womb grows more and more perceptible. In the seventh month, the Fundus rises as high as the navel; in the eighth month, to the middle space between the navel and Scrobiculus Cordis; and in the ninth, even to the Scrobiculus, except in pendulous bellies: (see fig. 9, 10, 14.) But all these marks may vary in different women; for when the belly is pendulous, the parts below the navel are much

more stretched than those above, and hang over the Os Pubis: the Fundus will then be only equal to, or a little higher than, the navel; at other times, the Uterus will rise in the latter end of the seventh or eighth month to the Scrobiculus Cordis. The neck of the womb will, in some, be felt as long in the eighth, as in others in the sixth or seventh month. This variation sometimes makes the examination of the Abdomen more certain than the touch of the Vagina; and so vice versa. At other times we must judge by both. See fig. 16.

SECT. II. Of the Signs of CONCEPTION, and the equivocal Signs of pregnant and obstructed Women.

The signs of pregnancy are to be distinguished from those that belong to obstructions by the touch in the Vagina, and motion of the child, in the fifth or sixth month: sometimes, by the touch in the Rectum, before and after the fifth month, when the tumour of the Abdomen is plainly perceived.

The Fundus Uteri, in the obstructed patient, is not stretched, nor is the disorder in her stomach so violence as in a pregnant woman, and seldom accompanied with retchings; while the woman with child is afflicted with a retching every morning, and subject to longings besides. The first labours under a fullness of the vessels; the last, over and above this complaint, suffers an additional one from the distention of the Uterus by the impregnated Ovum. Obstructions and pregnancy are both accompanied by a stretching fullness of the breasts: but in the last only may be perceived the areola, or brown ring, round the nipples, from which, in the last months, a thin serum distils: but this circle is not always so discernible as in the first pregnancy, and even then is uncertain as well as the others.

About the fifth or sixth month, the circumscribed tumour, or stretching of the Uterus, is felt above the Os Pubis; and by this circumscription and consistence easily distinguished from the ascites or dropsy of the Abdomen: it is also rounder and firmer than those swellings that accompany obstructions which proceed from a general fullness of the vessels belonging to the ligaments and neighbouring Viscera. On the whole, the difficulty of distinguishing between obstruction and pregnancy, in the first months, is so great, that we ought to be cautious in giving our opinion; and never prescribe such remedies as may endanger the fruit of the womb, but rather endeavour to palliate the complaints until time shall discover the nature of the case; and always judge on the charitable side when life or reputation is at stake.

In the fifth or sixth month of uterine gestation, by the touch in the Vagina, we perceive the neck of the womb considerably shortened; and the stretching of the lower part of the Uterus is then sensibly felt between the mouth of the womb and the Pubes, and on each side of the neck. See fig. 7, 8, 9.

In the seventh month, the head of the child is frequently felt resting against the lower part of the Uterus, between the Pubes and Os Internum; and, being pushed upwards toward the Fundus, sinks down again by its own gravity. All these diagnostics are more plain and certain, the nearer the patient approaches to the time of delivery. Sometimes, the head is not felt till the eighth or ninth month; and in some few cases not till after the membranes are broke; when it is forced down by the contraction of the Uterus and strong labour-pains. This circumstance may be owing to the head's resting above the basin, especially in a narrow Pelvis; or to the distention of its belly with air after death, by which the Fœtus, being rendered specifically lighter than the surrounding waters, the body floats up to the Fundus, if there is a large quantity of fluid in the membranes: nor is the body always felt when the child lies across the Uterus.

SECT. III. How to distinguish the FALSE LABOUR from the TRUE, and the Means to be used on that Occasion.

If the Os Uteri remains close shut, it may be taken for granted that the woman is not yet in labour, notwithstanding the pains she may suffer. With regard to these, an accurate enquiry is to be made; and if her complaints proceed from an overstretching fullness of the Uterus, or vessels belonging to the neighbouring parts, bleeding in the arm or ankle, to the quantity of six or eight ounces, ought to be prescribed, and repeated occasionally. If the pains are occasioned by a looseness or diarrhoea, it must be immediately restrained with opiates. Cholick pains are distinguished from those of labour, by being chiefly confined to the belly, without going off and returning by distinct intervals: they are for the most part produced by feces too long retained in the colon, or by such ingesta as occasion a rarefaction or expansion of air in the intestines, by which they are violently stretched and vellicated. This complaint must be removed by opening glysters, to empty the guts of their noxious contents: and this evacuation being performed, opiates may be administered to alluage the pains; either to be injected by the Anus, taken by the mouth, or applied externally in the form of epithem or embrocation.

Sometimes the Os Internum may be a little dilated, and yet it may be difficult to judge whether or not the patient be in labour. The case, however, may be ascertained after some attendance by these considerations: if the woman is not arrived at her full time: if no soft or glary mucus hath been discharged from the Vagina: if the pains are limited to the region of the belly, without extending to the back and inside of the thighs: if they are slight, and continue without

M I D W I F E R Y.

without intermission or increase, nay, if they have long intervals, and recur without force sufficient to push down the waters and membranes, or child's head, to open the os internum: if this part be felt thick and rigid, instead of being soft, thin, and yielding, we may safely pronounce that labour is not yet begun; and those alarms are to be removed as we have directed in the case of false or colic pains. Besides, if the pulse be quick and strong, and the patient attacked by stitches in the sides, back, or head, bleeding will be likewise necessary. See Fig. 9, 14, 15.

PART V. NATURAL LABOURS.

In order to render this system as distinct as possible, for the sake of the reader's memory, as well as the dependence and connection of the different labours, they are divided in the following manner: That is accounted *natural* in which the head presents, and the woman is delivered without extraordinary help; those births are called *laborious* or *nonnatural*, when the head comes along with difficulty, and must be assisted either with the hand in opening the parts, or with a fillet or forceps, or even when there is a necessity for opening and extracting it with the crotchet; and those in which the child is brought by the breech or feet are denominated *preternatural*, because the delivery is performed in a preternatural way.

SECT. I. The different Positions of Women in Labour.

In almost all countries the woman is allowed either to sit, walk about, or rest upon a bed, until the os uteri is pretty much dilated by the gravitation of the waters, or (when they are in small quantity) by the head of the fœtus, so that delivery is soon expected; when she is put in such position as is judged more safe, easy, and convenient for that purpose: but the patient may be put upon labour too prematurely, and bad consequences will attend such mistakes. Among the Egyptians, Grecians, and Romans, the woman was placed upon a high stool; in Germany and Holland, they use the chair which is described by Daventer and Heister: and for hot climates the stool is perfectly well adapted; but in northern countries, and cold weather, such a position must endanger the patient's health. In the West Indies, and some parts of Britain, the woman is seated on a stool made in form of a semicircle; in other places, she is placed on a woman's lap, and some, kneeling on a large cushion, are delivered backwards. In France, the position is chiefly half-sitting, half-lying, on the side or end of a bed; or the woman, being naked in bed, is raised up with pillows or a bed-chair. The London method is very convenient in natural and easy labours; the patient lies in a bed upon one side, the knees being contracted to the belly, and a pillow put between them to keep them asunder. But the most commodious method is to prepare a bed and a couch in the same room: a piece of oiled cloth or dressed sheep-skin is laid across the middle of each, over the under-sheet; and above this are spread several folds of linen, pinned or tied with tape to each side of the bed and couch. These are designed to sponge up the moisture in time of labour and after delivery; while the oiled cloths or sheep-skins below preserve the feather-bed from being wetted or spoiled: for this purpose some people lay, besides, upon the bed, several under-sheets over one another, so that, by sliding out the uppermost every day, they can keep the bed dry and comfortable.

The couch must be no more than three feet wide, and provided with casters; and the woman, without any other dress than that of short or half-shift, a linen skirt or petticoat open before, and a gown, ought to lie down upon it, and be covered with clothes according to the season of the year. She is commonly laid on the left-side, but in this particular she is to consult her own ease; and large sheets being doubled four times, or more, one end must be spread in below her breech, while the other hangs over the side of the couch, to be spread on the knee of the accoucheur or midwife, who sits behind her, on a low seat. As soon as she is delivered, this sheet must be removed, a soft warm cloth applied to the os externum, and the pillow taken from betwixt her knees; she then must be shifted with a clean warm half-shift, linen skirt, and bedgown, and the belly kept firm with the broad headband of the skirt, the ends of which are to be pinned across each other. These measures being taken, the couch must be run close to the bed-side, and the patient gently moved from one to another; but if there is no couch, the bed must be furnished with some apparatus. Some, again, are laid across the foot of the bed, to the head of which the clothes are previously turned up till after delivery, when the woman's posture is adapted, and then they are rolled down again to cover and keep her warm. By this expedient the place of a couch is supplied, and the upper part of the bed preserved soft and clean: whereas those who are laid above the clothes must be taken up and shifted while the bed is put to rights, in which case they are subject to fainting; and to such as are very much enfeebled, this fatigue is often fatal.

Women are most easily touched, least fatigued, and kept warmest when they lie on one side. But if the labour should prove tedious, the Parian method seems most eligible; because, when the patient half sits, half lies, the brim of the pelvis is horizontal, a perpendicular line falling from the middle space between the scrobiculus cordis and navel would pass exactly through the middle of the basin. In this position, therefore, the weight of the waters, and, after the membranes are broken, that of the child's head, will gravitate downwards, and assist in opening the parts, while the

contracting force of the abdominal muscles and uterus is more free, strong, and equal, in this than in any other attitude. Wherefore, in all natural cases, when the labour is lingering or tedious, this, or any other position, such as standing or kneeling, ought to be tried, which, by an additional force, may help to push along the head, and alter its direction when it does not advance in the right way. Nevertheless, the patient must, by no means, be too much fatigued.

When the woman lies on the left side, the right-hand must be used in touching, and *vice versa*, unless she is laid across on the bed; in which case either hand will equally answer the same purpose: but if she lies athwart, with the breech towards the bed's foot, it will be most convenient to touch with the left-hand when she is upon the left side, and with the right when in the opposite position. And here it will not be amiss to observe, that, in the description of all the laborious and preternatural deliveries treated of in this System, the reader must suppose the woman lying on her back, as directed, except when another posture is prescribed; and that, in natural and laborious labours, whether she be upon her side or back, the head and shoulders are a little raised into a reclining posture, so that she may breathe easily, and assist the pains. But in preternatural labours, when there is a necessity for using great force in turning the child, the head and shoulders must lie lower than the breech, which being close to the side or foot of the bed, ought to be raised higher than either; because, when the pelvis is in this situation, the hand and arm are easily pushed up in a right-line along the back part of the uterus, even to its fundus. Sometimes, however, when the feet of the child are towards the belly of the mother, they are more easily felt and managed when she lies on her side. At other times, placing the woman on her knees and elbows, on a low couch, according to Daventer's method, will succeed better, by diminishing, in part, the strong resistance from the pressure and weight of the uterus and child, by which the feet will sometimes be easier found and delivered: but then it is safer to the child, and easier for the operator and mother, to turn her back before you deliver the body and head.

SECT. II. Of the Management of Women in a Natural Labour.

In a woman come to full time, labour commonly begins and proceeds in the following manner: The os uteri is felt soft and a little opened, the circumference being sometimes thick, but chiefly thin; from this aperture is discharged a thick mucus, which lubricates the parts, and prepares them for stretching. This discharge usually begins some days before; and is accounted the forerunner of real labour: at the same time the woman is seized at intervals with slight pains, that gradually stretch the os uteri, fitting it for a larger dilatation: and when labour actually begins, the pains become more frequent, strong, and lasting. At every pain the uterus is strongly compressed by the same effort which expels the contents of the rectum at stool; namely, the inflation of the lungs, and the contraction of the abdominal muscles.

If the child be surrounded with a large quantity of waters (see Fig. 11, 14, 15) the uterus cannot come in contact with the body of it; but at every pain the membranes are pushed down by the fluids they contain, and the mouth of the womb being sufficiently opened by this gradual and repeated distention, they are forced into the middle of the vagina; then the uterus contracts and comes in contact with the body of the child, and if it be small, the head is propelled with the waters. Here the membranes usually break; but if that is not the case, they are pushed along towards the os externum, which they also gradually open, and appear on the outside in the form of a large round bag: meanwhile the head advances, and the os externum being, by this time, fully dilated, is also protruded; when, if the membranes, instead of bursting in the middle of the protuberance, are torn all round at the os externum, the child's head is covered with some part of them, which goes under the name of the *caul*, or *king's hood*. If the placenta is, at the same time, separated from the uterus, and the membranes remain unbroken, the secundines, waters, and child, are delivered together; but if the placenta adheres, they must, of course, give way; and should they be torn all round from the placenta, the greatest part of the body, as well as the head of the child, will be enveloped by them, from which it must be immediately disengaged, that the air may have a free passage into the lungs.

When the head is large, so that it does not descend immediately into the pelvis, the membranes are forced down by themselves, and, being stretched thinner and thinner, give way; when all the waters which are further advanced than the head run out: then, the uterus coming in contact with the body of the child, the head is squeezed down into the mouth of the womb, which it plugs up so as to detain the rest of the waters. (See Fig. 16, 17.)

Sometimes, when the quantity of waters is very small, and the uterus embraces the body of the child, the head, covered with the membranes, is forced downwards, and gradually opens the os internum; but at its arrival in the middle of the pelvis and vagina, part of the waters will be pushed down before it, sometimes in a large, and sometimes in a small proportion, towards the back-part of the pelvis. At other times, when the waters are in small quantity, no part of them are to be distinguished farther than the head, which, descending lower and lower, the attenuated membranes are split upon it; while, at the same time, it fills up the mouth of the

M I D W I F E R Y.

womb and upper part of the vagina in such a manner as hinders the few remaining waters from being discharged at once; though in every pain a small quantity distils on each side of the head, for lubricating the parts, so that the child may slip along the more easily. See Fig. 17.

The uterus contracts; the pains become quicker and stronger; the crown of the head is pushed down to the lower part of the pelvis, against one of the ischia, at its lower extremity; the forehead, being at the upper part of the opposite ischium, is forced into the hollow of the under part of the sacrum, while the vertex and hind-head is pressed below the os pubis (Fig. 18) from whence it rises in a quarter-turn, gradually opening the os externum; the frænum labiorum, or fourchette, perinæum, fundament, and the parts that intervene betwixt that and the extremity of the sacrum, are all stretched outwards in form of a large tumour. The perinæum, which is commonly but one inch from the os externum to the anus, is now stretched to three, the anus to two, and the parts between that and the coccyx are stretched from two inches to about three or more. The broad sacro-sciatic ligaments, reaching from each side of the lower part of the sacrum, to the under part of each ischium, are also outwardly extended, and the coccyx is forced backward; while the crown of the head, where the lambdoidal crosses the end of the sagittal future, continues to be pushed along, and dilates the os externum more and more. See Fig. 19, 20.

When the head is so far advanced that the back part of the neck is come below the under part of the os pubis, the forehead forces the coccyx, fundament, and perinæum, backwards and downwards; then the hind part of the head rises about two or three inches from under the pubes, making a half-round turn in its ascent, by which the forehead is equally raised from the parts upon which it pressed, and the perinæum escapes without being split or torn (see Fig. 22); at the same time, the shoulders advance into the sides of the pelvis, at its brim, where it is widest, and, with the body, are forced along and delivered: meanwhile, by the contraction of the uterus, the placenta and chorion are loosened from the inner surface to which they adhered, and forced through the vagina, out of the os externum. When the head rests as first, above the brim of the pelvis, and is not far advanced, the fontanel may be plainly felt with the finger, commonly towards the side of the pelvis: this is the place where the coronal crosses the sagittal future, and the bones are a little separated from each other, yielding a softness to the touch, by which may be distinguished four futures, or rather, one crossing another. These may be plainly perceived, even before the membranes are broken: yet the examination must not be made during a pain, when the membranes are stretched down and filled with waters; but only when the pain begins to remit, and the membranes to be relaxed; otherwise they may be broken too soon, before the os internum be sufficiently dilated, and the head properly advanced.

When the vertex is come lower down, the sagittal future only is to be felt: because, as the hind-head descends in the pelvis, the fontanel is turned more backwards to the side, or towards the concavity of the sacrum: but, after it has arrived below the under part of the ossa pubis, the lambdoidal may be felt crossing the end of the sagittal future, the occiput making a more obtuse angle than that of the parietal bones, at the place where the three are joined together. But all these circumstances are more easily distinguished after the membranes are broken, or when the head is so compressed that the bones ride over one another, provided the hairy scalp be not excessively swelled. See Fig. 13, 17, 18, 20, 21.

SECT. III. *How and when to break the Membranes.*

We have already observed that if the child be surrounded with a large quantity of waters, the uterus cannot come in contact with the body, so as to press down the head, until the membranes are pushed a considerable way before it into the vagina: nor even then, until they are broken, and the fluid diminished in such a manner as will allow the womb to contract, and, with the assistance of the pains, force along the child. When the membranes, therefore, are strong, or advanced, and continue so long unbroken that the delivery is retarded, provided the os internum be sufficiently dilated, they ought to be broken without further delay, especially if the woman hath been much fatigued or exhausted with labour, or is seized with a violent flooding: in which case the rupture of the membranes hasten delivery, and the hæmorrhage is diminished by the contraction of the uterus, which lessens the mouth of the vessels that are also compressed by the body of the child.

The common method of breaking the membranes is by thrusting the fingers against them when they are protruded with the waters during the pain, or by pinching them with the finger and thumb; but if they are detained too high to be managed in either of these methods, the hand may be introduced into the vagina, if the os externum is so lax as to admit it easily; and if this cannot be done without giving much pain, the fore and middle fingers being pushed into the vagina, with the other hand, let a probe or pair of pointed scissors be directed along and between them, and thrust through the membranes when they are pushed with the waters below the head. This operation must be cautiously performed, lest the head should be wounded in the attempt; and as for the membranes, let the opening be ever so small, the waters are discharged with force sufficient to tear them asunder.

SECT. IV. *When little or no Waters are protruded.*

If the vertex, instead of resting at the side of the brim of the pelvis, or at the os pubis, is forced farther down to the os internum, and the waters happen to be in small quantity, the head is pushed forwards, and gradually opens the mouth of the womb, without any sensible interposition of the waters: then it advances by degrees into the vagina, and the membranes being split or torn, little or nothing is discharged until the body of the child be delivered: and, in this case, the hair of the head being plainly felt, will be a sufficient indication that the membranes are broken. If no hair is to be felt, but a smooth body presents itself to the touch, and the woman has undergone many strong pains, even after the mouth of the womb hath been largely dilated, and the head forced into the middle of the pelvis, you may conclude that delivery is retarded by the rigidity of the membranes; that there is but a small quantity of waters; and that, if the containing sacs were broken, the head would come along without farther hesitation.

Sometimes no waters can be felt while the head is no farther advanced than the upper part of the pelvis, because it plugs up the passage, and keeps them from descending; but as it advances downwards, the uterus contracts, and they are forced down in a small quantity towards the back part; from thence, as the head descends, or even though it should stick in that situation, they are pushed farther down, and the membranes may be easily broken; but the task is more difficult when no waters come down, and the membranes are contiguous to the head. In this case they must be scratched a little, during every pain, with the nail of a finger, which, though short and smooth, will, by degrees, wear them thinner and thinner, until they split upon the head by the force of labour. Yet this expedient ought never to be used until you are certain that delivery is retarded by their rigidity; for, if that be not the hindrance, the difficulty must proceed from the weakness of the woman, a large head, or narrow pelvis: in which case the delivery is a work of time, and will be obstructed by the premature discharge of the waters, which, by gradually passing by the head, ought to keep the parts moist and slippery, in order to facilitate the birth: for, when the membranes are not broken until the head is forced into the middle of the pelvis, the largest part of it being then past the upper part of the sacrum, is commonly squeezed along, opens the os externum, and is delivered before all the waters are discharged from the uterus; so that what remains, by moistening and lubricating the parts, helps the shoulders and body to pass with more ease. When the membranes are too soon broken, the under part of the uterus contracts sometimes so strongly before the shoulders, that it makes the resistance still greater.

SECT. V. *How to manage when the Head comes down into the PELVIS.*

In most natural labours, the space betwixt the fore and back fontanels, viz. the vertex, presents to the os internum, and the forehead is turned to the side of the pelvis; because the basin at the brim is widest from side to side; and frequently, before the head is pushed in and fast wedged among the bones, the child (after a pain) is felt to move and turn it to that side or situation in which it is least pressed and hurt, if it was not presenting in that position before. But this position of the head may alter, viz. in those where it is as wide, or wider, from the back part to the fore part of the brim, than from side to side, the forehead may be turned backwards or forwards. But this form of the pelvis seldom happens.

This posture is always observed in a narrow pelvis; when the upper part of the sacrum jets forward to the pubes; but as the child is forced lower down, the forehead turns into the hollow at the interior part of the sacrum, because the vertex and occiput find less resistance at the lower part of the ossa pubis than at the ischium, to which it was before turned, the pelvis being at the pubes no more than two inches in depth, whereas at the ischium it amounts to four. If, therefore, the forehead sticks in its former situation, without turning into the hollow, it may be assisted by introducing some fingers, or the whole hand, into the vagina, during a pain, and moving in the right position. See Part VI. Sect. IV. Case V.

When the head of the fœtus presents, and is forced along in any of those positions, the labour is accounted natural, and little else is to be done but to encourage the woman to bear down with all her strength in every pain, and to rest quietly during each interval: if the parts are rigid, dry, and inflamed, they ought to be lubricated with pomatum, hog's lard, butter, or ung. altheæ; the two first are most proper for the external parts, and the two last (as being harder and not so easily melted) ought to be put up into the vagina, to lubricate that and the os internum.

SECT. VI. *How to assist in LINGERING LABOURS when the Parts are rigid.*

The mouth of the womb and os externum, for the most part, open with greater difficulty in the first than in the succeeding labours, more especially in women turned of thirty. In these cases the os internum must be gradually dilated in every pain, by introducing the fingers in form of a cone, and turning them round, so as to stretch the parts by gentle degrees; and the whole hand being admitted into the vagina, it will be sometimes found necessary to insinuate the fingers, with the flat of the hand, between the head and os internum: for when this precaution is not taken in time, the os uteri is frequently pushed before the head (especially that part

M I D W I F E R Y.

part of it next the pubes) even through the os externum; or if the head passes the mouth of the womb, it will protrude the parts of the os externum, and will endanger a laceration in the perineum. This dilatation, however, ought to be cautiously performed, and never attempted except when it is absolutely necessary; even then it must be effected slowly, and in time of a pain, when the woman is least sensible of the dilating force.

When the labour happens to be lingering, though every thing be in a right posture, if the assistants are clamorous, and the woman herself too anxious and impatient to wait the requisite time without complaining, the labour will be actually retarded by her uneasiness, which we must endeavour to surmount by arguments and gentle persuasion: but if she is not to be satisfied, and strongly impressed with an opinion that certain medicines might be administered to hasten delivery, it will be convenient to prescribe some innocent medicine, that she may take between whiles, to beguile the time and please her imagination; but if she is actually weak and exhausted, it will be necessary to order something that will quicken the circulating fluids, such as preparations of amber, castor, myrrh, volatile spirits, the *pulv. myrrh. compos.* of the London, or *pulv. et partum* of the Edinburgh Pharmacopœia, with every thing in point of diet and drink that nourishes and strengthens the body. If the patient is of a plethoric habit, with a quick strong pulse, the contrary method is to be used, such as venæsection, antiphlogistic medicines, and plentiful draughts of weak diluting fluids.

SECT. VII. *How to manage when the Birth is obstructed by the Navel-string of the Child, or a narrow PELVIS.*

Although the head is pushed down into the pelvis, and the vertex employed in opening the os externum, the forehead being lodged in the concavity formed by the coccyx and lower part of the sacrum; yet frequently, after the labour-pain is abated, the head is again withdrawn, by the navel-string happening to be twisted round the neck; or when the shoulders, instead of advancing, are regarded at the brim of the pelvis, one resting over the ossa pubis, while the other is fixed at the sacrum; or when (the waters having been long evacuated) the under part of the uterus contracts round the neck and before the shoulders, keeping up the body of the child.

When the head is therefore drawn back by any of these obstacles, and the delivery hath been retarded during several pains, one or two fingers being introduced into the rectum, before the pain goes off, ought to press upon the forehead of the child at the root of the nose, great care being taken to avoid the eyes; this pressure detains the head till the return of another pain, which will squeeze it further down, while the fingers pushing slowly and gradually turn the forehead half round outwards and half round upwards. By this assistance, and the help of strong pains, the child will be forced along, although the neck be entangled in the navel-string: for as the child advances the uterus contracts, and consequently the placenta is moved lower; the funis umbilicalis will also stretch a little, without obstructing the circulation. The head being thus kept down, the shoulders too are pressed in every succeeding pain until they are forced into the pelvis, when the whole comes along, without further difficulty. And this expedient will, moreover, answer the purpose, when the under part of the uterus or the os internum is contracted round the neck of the child, and before the shoulders: also, when the head is very low, pressing a finger on each side of the coccyx externally, will frequently assist in the same manner; also, in lingering cases, when the woman is weak, the head large, or the pelvis narrow, you may assist the delivery by gently stretching both the os externum and internum with your fingers, in time of the pains, which will increase the same, as well as dilate; but this is only to be done when absolutely necessary, and with caution and at intervals, for fear of inflaming or lacerating the parts. Over and above these obstacles, the head may be actually delivered, and the body retained by the contraction of the os externum round the neck, even after the face appears externally. In this case it was generally alleged that the neck was close embraced by the os internum: but this seldom happens when the head is delivered, because then the os internum is kept dilated on the back part and sides by the breast and arms of the fetus, unless it be forced low down with or before the head.

When the head is delivered, and the rest of the body retained from the largeness or wrong presenting of the shoulders, or by the navel-string being twisted round the body or neck of the child, the head must be grasped on each side, the thumbs being applied to the occiput, the fore and middle fingers extended along each side of the neck, while the third and fourth of each hand support each side of the upper jaw: thus embraced, the head must be pulled straight forwards; and if it will not move easily along, the force must be increased, and the direction varied from side to side, or rather from shoulder to shoulder, not by sudden jerks, but with a slow, firm, and equal motion. If the body cannot be moved in this manner, though you have exerted as much force as possible without running the risk of over-straining the neck, you must endeavour to slip the turns of the navel-string over the head. But should this be found impracticable, you ought not to trifle in tying the string at two places, and cutting betwixt the ligatures, as some people have advised: such an operation would engross too much time; besides, the child is in no danger of suffocation from the

stricture of the funis, because it seldom or never breathes before the breast is delivered.

The better method is, immediately to slide along one or two fingers, either above or below, to one of the arm-pits, by which you try to bring along the body, while with the other hand you pull the neck at the same time: if it still continues unmoved, shift hands, and let the other arm-pit sustain the force; but if this fail, cut the navel-string, and tie it afterwards. If the shoulders lie so high the fingers cannot reach far enough to cut or to take sufficient hold, let the flat of the hand be run along the back of the child: or should the os externum be strongly contracted round the neck, push up your hand along the breast, and pull as before; and should this method fail, you must have recourse to the blunt hook introduced and fixed in the arm-pit: but this expedient must be used with caution, lest the child should be injured or the parts lacerated. The child being born, the funis umbilicalis must be divided, and the placenta delivered, according to the direction that will occur in the sequel.

PART VI. LABORIOUS LABOURS.

SECT. I. *How LABORIOUS LABOURS are occasioned.*

A general outcry hath been raised against gentlemen of the profession, as if they delighted in using instruments and violent methods in the course of their practice; and this clamour hath proceeded from the ignorance of such as do not know that instruments are sometimes absolutely necessary, or from the interested views of some low, obscure, and illiterate practitioners, both male and female, who think they find their account in decrying the practice of their neighbours. It is not to be denied, that mischief has been done by instruments in the hands of the unskilful and unwary; but we are persuaded that a judicious practitioner will do every thing for the safety of his patients before he has recourse to any violent method, either with the hand or instrument, though cases will occur in which gentle methods will absolutely fail. It is therefore necessary to explain those reinforcements which must be used in dangerous labours; though they ought by no means to be called in, except when the life of the mother or child, or both, is evidently at stake; and even then managed with the utmost caution.

All those cases in which the head of the child presents, and cannot be delivered in the natural way, are accounted more or less laborious, according to the different circumstances from which the difficulty arises: and these commonly are, first, great weakness, proceeding from a loss of appetite and bad digestion; frequent vomitings, diarrhœas or dysenteries, floodings, or any other disease that may exhaust the patient; as also the fatigue she may have undergone by unskilful treatment in the beginning of labour. Secondly, from excessive grief and anxiety of mind, occasioned by the unseasonable news of sudden misfortune in time of labour; which often affect her so as to carry off the pains, and endanger her sinking under the shock. Thirdly, from the rigidity of the os uteri, vagina, and external parts, which commonly happens to women in the first birth, especially to those who are about the age of forty: though it may be also owing to large callosities, produced from laceration or ulceration of the parts; or to glands and scirrhous tumours that block up the vagina. Fourthly, when the under part of the uterus is contracted before the shoulders, or the body entangled in the navel-string. Fifthly, from the wrong presentation of the child's head: that is, when the forehead is towards the groin or middle of the os pubis; when the face presents with the chin to the os pubis, ischium, or sacrum; when the crown of the head rests above the os pubis, and the forehead or face is pressed into the hollow of the sacrum; and lastly, when one of the ears presents. Sixthly, from the extraordinary ossification of the child's head, by which the bones of the skull are hindered from yielding as they are forced into the pelvis; and from a hydrocephalus or dropsy, distending the head to such a degree that it cannot pass along until the water is discharged. Seventhly, from a too small or distorted pelvis, which often occurs in very little women, or such as have been rickety in their childhood. See Fig. 31.

In all these cases, except when the pelvis is too narrow and the head too large, provided the head lies at the upper part of the brim, or (though pressed into the pelvis) can be easily pushed back into the uterus, the best method is to turn the child, and deliver by the feet, according to the directions which shall be given in the sequel: but if the head is pressed into the middle or lower part of the pelvis, and the uterus strongly contracted round the child, delivery ought to be performed with the forceps; and in all these seven cases, if the woman is in danger, and if you can neither turn nor deliver with the forceps, the head must be opened and delivered with the crotchets. Laborious cases, from some of the above recited causes, happen much oftener than those we call preternatural; but those which proceed from a narrow pelvis or a large head are of the worst consequence. These cases demand greater judgment in the operation than those in which the child's head does not present; because in these last we know that the best and safest method is to deliver by the feet; whereas, in laborious births, we must maturely consider the cause that retards the head from coming along, together with the necessary assistance required; we must determine when we ought to wait patiently for the efforts of nature, and when it is absolutely necessary to come to her aid. If we attempt

M I D W I F E R Y.

tempt to succour her too soon, and use much force in the operation, so that the child and mother, or one of the two, are lost, we shall be apt to reproach ourselves for having acted prematurely, upon the supposition that if we had waited a little longer the pains might have by degrees delivered the child, or at least forced the head so low that we might have extracted it with more safety by the assistance of the forceps. On the other hand, when we leave it to nature, perhaps, by the strong pressure upon the head and brain, the child is dead when delivered, and the woman so exhausted with tedious labour, that her life is in imminent danger; in this case we blame ourselves for delaying our help so long, reflecting, that had we delivered the patient sooner, without paying such scrupulous regard to the life of the child, the woman might have recovered, without having run such a dangerous risk. Doubtless it is our duty to save both mother and child if possible; but, if that is impracticable, to pay our chief regard to the patient; and in all dubious cases, to act cautiously and circumspectly to the best of our judgment and skill.

If the head is advanced into the pelvis, and the uterus strongly contracted round the child, great force is required to push it back into the womb, because the effort must be sufficient to stretch the uterus, so as to readmit the head, together with your hand and arm; and even then the child will be turned with great difficulty. Should you turn when the head is too large, you may bring down the body of the child, but the head will stick fast above, and cannot be extracted without the help of the forceps or crochets; see Fig. 38, 39: yet the case is still worse in a narrow pelvis, even though the head be of an ordinary size. When things are so situated, you should not attempt to turn, because in so doing you may give the woman a great deal of pain, and yourself much unnecessary fatigue: you ought, therefore, to try the forceps; and if they do not succeed, diminish the size of the head, and extract it, as shall be afterwards shown.

SECT. II. Of the FILLETS and FORCEPS.

We have already observed, that the greatest number of difficult and lingering labours proceed from the head sticking fast in the pelvis, which situation is occasioned by one of the seven causes recited before. When formerly this was the case, the child was generally lost, unless it could be turned and delivered by the feet; or if it could be extracted alive, either died soon after delivery, or recovered with difficulty from the long and severe compression of the head, while the life of the mother was endangered from the same cause as above described: for the pressure being reciprocal, the fibres and vessels of the soft part contained in the pelvis are bruised by the child's head, and the circulation of the fluids obstructed; so that a violent inflammation, and sometimes a sudden mortification, ensues. If the child could not be turned, the method practised in these cases was to open the head and extract with the crotchet; and this expedient produced a general clamour among the women, who observed, that when recourse was had to the assistance of a man-midwife, either the mother or child, or both, were lost. This censure, which could not fail of being a great discouragement to male practitioners, stimulated the ingenuity of several gentlemen of the profession, in order to contrive some gentler method of bringing along the head, so as to save the child, without any prejudice to the mother.

Their endeavours have not been without success: a more safe and certain expedient for this purpose hath been invented, and of late brought to greater perfection in this than in any other kingdom; so that if we are called in before the child is dead, or the parts of a woman in danger of mortification, both the fetus and mother may frequently be happily saved. This fortunate contrivance is no other than the forceps, which was, as is alleged, first used here by the Chamberlains, by which it was kept as a nostrum, and after their decease so imperfectly known as to be seldom applied with success: so that different practitioners had recourse to various kinds of fillets or lacks. Blunt hooks also, of various make, were invented in England, France, and other parts. The forceps, since the time of Dr. Chamberlain, have undergone several alterations, particularly in the joining, handles, form, and composition.

The common way of using them formerly was by introducing each blade at random, taking hold of the head any how, pulling it straight along, and delivering with downright force and violence: by which means both the os internum and externum were often torn, and the child's head much bruised. On account of these bad consequences, they had been altogether disused by many practitioners, some of whom endeavoured, in lieu of them, to introduce divers kinds of fillets over the child's head: but none of them can be so easily used, or have near so many advantages, as the forceps, when rightly applied and conducted, according to the directions that shall be laid down in the next section.

The lacks or fillets are of different kinds, of which the most simple is a noose made on the end of a fillet of limber-garter; but this can only be applied before the head is fast jammed in the pelvis, or when it can be pushed up and raised about the brim. The os externum and internum having been gradually dilated, this noose must be conveyed on the ends of the fingers, and slipped over the fore and hind-head. There are also other kinds differently introduced upon various blunt instruments, too tedious either to describe

or use; but the most useful of all these contrivances is a fillet, made in form of a sheath, mounted upon a piece of slender whalebone, about two feet in length, which is easier applied than any other expedient of the same kind. See the Plate of Instruments, Fig. 4.

When the head is high up in the pelvis, if the woman has been long in labour, and the waters discharged for a considerable time, the uterus being strongly contracted so as that the head and shoulders cannot be raised, or the child turned to be delivered by the feet, while the mother is enfeebled, and the pains so weak that, unless assisted, she is in danger of her life; also when the os internum, vagina, and labia pudendi, are inflamed and tumefied; or when there is a violent discharge of blood from the uterus, provided the pelvis is not too narrow, or the head too large, this fillet may be successfully used; in which case, if the os externum and internum are not already sufficiently open, they must be gradually dilated as much as possible by the hand, which at the same time must be introduced, and passed along the side of the head, in order to ascertain the position thereof. This being known, let the other hand introduce the double of the whalebone and fillet over the face and chin, where you can have the best purchase and where it will be least apt to slip and lose its hold. This application being effected, let the hand be brought down, and the whalebone drawn from the sheath of the fillet, which (after the ends of it are tied together) must be pulled during every pain, pressing at the same time with the other hand upon the opposite part of the head, and using more or less force according to the resistance.

The disadvantage attending the fillets is the difficulty in introducing and fixing them: and though this last is easier applied than the others, yet when the vertex presents, the child's chin is so pressed to the breast, that it is often impracticable to insinuate the fillet between them, and if fixed upon the face or hind-head it frequently slips off in pulling. But, granting it commodiously fixed, when the head is large, or the pelvis narrow, so that we are obliged to pull with great force, the fillet will gall and even cut the soft parts of the very bone: and if the child comes out of a sudden in consequence of violent pulling, the external parts of the woman are in great danger of sudden laceration: but if the head is small, and comes along with a moderate force, the child may be delivered by this contrivance, without any bad consequences; though in this case, we find by experience, that unless the woman has some very dangerous symptom, the head will in time slide gradually down into the pelvis even when it is too large to be extracted with the fillet or forceps, and the child be safely delivered by the labour-pains, although slow and lingering, and the mother seems weak and exhausted, provided she be supported with nourishing and strengthening cordials.

From what we have said, the reader ought not to imagine that we are more bigotted to any one contrivance than to another. As our chief study hath been to improve the art of Midwifery, we have considered a great many different methods, with a view of fixing upon that which should best succeed in practice: we have tried several kinds of lacks, which have been from time to time recommended to us; and in particular the last-mentioned fillet, which was communicated by an eminent professor. As this fillet could, in all appearance, be more easily introduced than any other, we generally found the fixing of this, as well as all other lacks, so uncertain, that we have had recourse to the forceps, which being introduced with greater ease, and fixed with more certainty, seldom fail to answer the purpose better than any other method hitherto found out. Dr. Smellie reprobates the use of this fillet; but let not this assertion prevent people of ingenuity from employing their talents in improving these or any other methods that may be safe and useful; for daily experience proves that we are still imperfect, and very far from the *ne plus ultra* of discovery in arts and sciences; though we hope every gentleman will despise and avoid the character of a selfish secretmonger.

As the head in the 6th and 7th cases, recited in Sect. I. is forced along the pelvis, commonly in these laborious cases the bones of the cranium are so compressed that they ride over one another, so that the bulk of the whole is diminished, and the head, as it is pushed forward, is, from a round, altered into an oblong figure: when therefore it is advanced into the pelvis, where it sticks fast for a considerable time, and cannot be delivered by the labour-pains, the forceps may be introduced with great ease and safety, like a pair of artificial hands, by which the head is very little (if at all) marked, and the woman very seldom torn. But if the head is detained above the brim of the pelvis, or a small portion of it only farther advanced, and it appears that the one being too narrow, or the other too large, the woman cannot be delivered by the strongest labour-pains; in that case, the child cannot be saved, either by turning and bringing it by the feet, or delivered by the application of fillet or forceps; but the operator must unavoidably use the disagreeable method of extracting with the crotchet. Nevertheless, in all these cases, the forceps ought first to be tried; and sometimes they will succeed beyond expectation, provided the birth is retarded by the weakness of the woman, and the second, third, fourth, or fifth obstructions, mentioned in Sect. I. But they cannot be depended upon, even when the vertex presents, with the forehead to the side or back part of the pelvis, and though the woman has had strong pains for many hours after the membranes are broken, the head

M I D W I F E R Y.

head is not forced down into the pelvis, or at least but an incon- siderable part of it, resembling the small end of a sugar-loaf, as in Fig. 19 and 22. For, from these circumstances, you may con- clude that the largest part of it is still above the brim, and that either the head is too large or the pelvis too narrow. Even in these cases, indeed, the last fillet, or a long pair of forceps, may take such firm hold, that with great force, and the strong purchase, the head will be delivered: but such violence is commonly fatal to the woman, by causing such an inflammation, and perhaps laceration, of the parts, as is attended with mortification. In order to disable young practitioners from running such risks, and using so great a force, Dr. Smellie recommends the forceps so short in the handle that they cannot be used with such violence as will endanger the woman's life; though the purchase of them is suffi- cient to extract the head when one-half or two-thirds of it are equal to, or past, the upper or narrow part of the pelvis.

When the head is high, the forceps may be locked in the mid- dle of the pelvis; but in that case great care must be taken in feel- ing with the fingers all round, that no part of the vagina be in- cluded in locking. Sometimes when the head rests, or is pressed too much on the forehead or side of the pelvis, either at the brim or lower down, by introducing one blade, it may be removed far- ther down, provided the labour-pains are strong, and the opera- tion assisted by the fingers of the other hand, applied to the oppo- site side of the head; but if the fingers cannot reach high enough, the best method is to turn or move the blade towards the ear of the child, and introduce the other along the opposite side.

In a narrow pelvis we have sometimes found the head of the child thrown so much forward over the os pubis, by the jetting-in of the sacrum and lower vertebra of the loins, that we could not push the handles of the forceps far enough back to include within the blades the bulky part of the head which lay over the pubes. To remedy this inconvenience, Dr. Smellie contrived a longer pair, curved one side, and convex on the other; but these ought never to be used except when the head is small: for, as we have already observed, when the head is large, and the greatest part of it remains above the brim, the parts of the woman may be inflamed and confused by the exertion of too much force. Ne- vertheless, this kind of forceps may be advantageously used when the face presents and is low down, and the chin turned to the sacrum; because, in that case, the occiput is towards the pubes, so that the ends of the blades can take firmer hold of the head; but then the chin cannot be turned below the pubes so easily with these as with the other kind, nor the hind-head be brought below these last bones. See Fig. 29.

SECT. III. General Rules for using the FORCEPS.

The farther the head is advanced in the pelvis, the easier it is delivered with the forceps; because then, as in the 6th or 7th Case, in Sect. I. it is changed from a round to an oblong figure, by being forced along by the labour-pains; on the contrary, when the head remains high up, resting upon the brim of the pelvis, the forceps are used with greater difficulty and uncertainty.

The os externum must be gradually opened by introducing the fingers, one after another, in form of a cone, after they have been lubricated with pomatum, moving and turning them in a semi- circular motion, as they are pushed up. If the head is so low down that the hand cannot be introduced high up in this form, let the parts be dilated by the fingers turned in the direction of the coccyx, the back of the hand being upwards, next to the child's head; the external parts being sufficiently opened to admit all the fingers, let the back of the hand be turned to the perineum, while the fingers and thumb being flattened, will slide along betwixt the head and the os sacrum. If the right-hand be used, let it be turned a little to the left side of the pelvis, because the broad ligament and mem- brane that fill up the space between the sacrum and ischia will yield and allow more room for the fingers to advance; for the same reason, when the left-hand is introduced, it must be turned a little to the right side. Having gained your point so far, continue to push up, until your fingers pass the os internum; at the same time, with the palm of your hand, raise or scoop up the head, by which means you will be more at liberty to reach higher; dilate the internal parts, and distinguish the situation and size of the head, together with the dimensions of the pelvis: from which in- vestigation you will be able to judge whether the child ought to be turned and brought by the feet, or delivered with the forceps; or, if the labour-pains are strong, and the head presents tolerably fair, without being jammed in the pelvis, you will resolve to wait for some time, in hope of seeing the child delivered by the labour- pains, especially when the woman is in no immediate danger, and the chief obstacle is the rigidity of the parts.

The position of the head is distinguished by feeling for one of the ears, the fore or smooth part of which is towards the face of the child; if it cannot be ascertained by this mark, the hand and fingers must be pushed farther up, to feel for the face or back part of the neck; but if the head cannot be traced, the observation must be taken from the fontanel or that part of the cranium where the lambdoidal crosses the end of the sagittal suture. When the ears of the child are towards the side of the pelvis, or diagonal, the forehead being either to the sacrum or pubes, the patient must

lie on her back, with her breech a little over the bed, her legs and thighs being supported as directed. If one ear is to the sacrum, and the other to the pubes, she must be laid on her side, with her breech over the bed, as before, her knees being pulled up to her belly, and a pillow placed between them; except when the upper part of the sacrum jets too much forward, in which case she must lie upon her back, as before described.

The blades of the forceps ought always, if possible, to be intro- duced along the ears; by which means they approach nearer to each other, gain a firmer hold, and hurt the head less than in any other direction: frequently, indeed, not the least mark of their application is to be perceived; whereas, if the blades are applied along the forehead and occiput, they are at a great distance from each other, require more room, frequently at their points press in the bones of the skull, and endanger a laceration in the os ex- ternum of the woman. See Fig. 19.

The woman being laid in a right position for the application of the forceps, the blades ought to be privately conveyed between the feather-bed and the clothes, at a small distance from one another, or on each side of the patient; that this conveyance may be the more easily effected, the legs of the instrument ought to be kept in the operator's side-pockets. Thus provided, when he sits down to deliver, let him spread the sheet that hangs over the bed, upon his lap, and, under the cover, take out and dispose the blades on each side of the patient; by which means he will often be able to deliver with the forceps, without their being perceived by the wo- man herself or any other of the assistants. Some people pin a sheet to each shoulder, and throw the other end over the bed, that they may be more effectually concealed from the view of those who are present: but this method is apt to confine and embarrass the operator. At any rate, as women are commonly frightened at the very name of an instrument, it is advisable to conceal them as much as possible, until the character of the operator is fully established.

The sum of all that has been said on this head, may be com- prehended in the following general maxims: Young practitioners are often at a loss to know and judge by the touch of the vagina, when the head is far enough down in the basin for using the for- ceps. If we are to take our observations from what we feel of the head at the os pubis, we should be frequently deceived, be- cause in that place the pelvis is only two inches in depth, and the head will seem lower down than it really is: but if, in examining backwards, we find little or no part of it towards the sacrum, we may be certain that all the head is above the brim: if we find it down as far as the middle of the sacrum, one-third of it is ad- vanced; if as far down as the lower part, one-half; and in this case, the largest part is equal with the brim. When it is in this situa- tion, we may be almost certain of succeeding with the forceps; and when the head is so low as to protrude the external parts, they never fail. But these things will differ according to different circumstances, that may occasion a tedious delivery.

Let the operator acquire an accurate knowledge of the figure, shape, and dimensions of the pelvis, together with the shape, size, and position of the child's head. Let the breech of the woman be always brought forwards a little over the bed, and her thighs pull- ed up to her belly, whether she lies on her side or back, to give room to apply and move the forceps up or down, or from side to side. Let the parts be opened and the fingers pass the os inter- num; in order to which, if it cannot be otherwise accomplished, let the head be raised two or three inches, that the fingers may have more room: if the head can be raised above the brim, your hand is not confined by the bones; for, as we have already observed, the pelvis is wider from side to side at the brim than at the lower part, if the fingers are not past the os uteri, it is in danger of being in- cluded betwixt the forceps and the child's head.

The forceps, if possible, should pass along the ears, because in that case they seldom or never hurt or mark the head. They ought to be pushed up in any imaginary line, towards the middle space between the navel and scrobiculus cordis, otherwise the ends will run against the sacrum. The forehead ought always to be turned into the hollow of the sacrum, when it is not already in that situation. When the face presents, the chin must be turned to below the os pubis, and the hind-head into the hollow of the sacrum. When the shoulders rest at the pubes, where they are de- tained, the head must be turned a large quarter to the opposite side, so as they may lie towards the sides of the pelvis. The head must be always brought up with an half-round turn, over the outside of the os pubis, for the preservation of the perineum, which must at the same time be supported with the flat of the other hand, and slide gently backwards over the head.

When the head is so low as to protrude the parts in form of a large tumour, and the vertex hath begun to dilate the os externum, but, instead of advancing, is long detained in that situation, from any of the formentioned causes of laborious cases, and the op- erator cannot exactly distinguish the position of the head, let him introduce a finger between the os pubis and the head, and he will frequently find the back-part of the neck, or one ear, at the fore- part or towards the side of the pelvis. When the situation is known, he needs not stretch the os externum, and raise the head, as formerly directed; but he may introduce the forceps, and, they being

MIDWIFERY.

being properly joined and their handles tied, pull gently during every pain, or, if the pains are gone, at the interval of four or five minutes, that the parts may be slowly dilated, as they are in the natural labour: but when the situation cannot be known, the head ought to be raised. The same method may also be taken when the face presents, and is low in the pelvis, except when the chin is toward the back part: in this case the head ought to be raised likewise. Almost all these directions are to be followed, except when the head is small; in which case it may be brought along by the force of pulling: but this only happens when the woman is reduced, and the labour-pains are not sufficient to deliver the child; for the lower part of the uterus may be so strongly contracted before the shoulders, and so close to the neck of the child, as to prevent its advancing, even when the head is so loose in the pelvis, that we can sometimes push our fingers all round it; and this is oftentimes the occasion of preventing the head being delivered when low in the pelvis. This difficulty, when high up, is from the restraint at the brim; and when it passes that, the head is seldom retained in the lower part, unless the patient is weak. In this case we need not wait, because we are commonly certain of relieving the woman immediately with the forceps, by which you prevent the danger that may happen, both to the mother and child, by the head continuing to lodge there too long. This case should be a caution against the breaking the membranes too soon, because the uterus may contract too forcibly and too long before the shoulders: when the head, in this case, is advanced one-third or half way on the os externum, if the pains are strong, this last inconvenience is frequently remedied by introducing your two fingers into the rectum, as formerly directed. By these rules, delivery may, for the most part, be performed with ease and safety. Nevertheless, the head is sometimes squeezed and locked in the pelvis, and the hairy scalp so much swelled, that it is impracticable to raise up the head so as to come at the ears or os internum, or to distinguish the sutures of the skull so as to know how the head presents. In this case the forceps must be introduced at random, and the uncertainty of the position generally removed by remembering that in those cases where the head is squeezed down with great difficulty, the ears are, for the most part, towards the os pubis and sacrum; and that the forehead seldom turns into the hollow of the sacrum, before the occiput is come down to the lower part of the ischium; and then rises gradually towards the under part of the os pubis, and the perinæum and anus are forced down before it in form of a large tumour.

On such occasions, the woman being laid on her side, if one ear is to the sacrum and the other to the os pubis, the blades of the forceps are to be introduced; and if they meet with any resistance at the points, they must not be forcibly thrust up, lest they pass on the outside of the os uteri and tear the vagina, which together with the womb would be included in the instrument and pulled along with the head: for this reason, if the blade does not easily pass, let it be withdrawn a little downwards, as before directed, and pushed up again, moving the point close to the head; if the ear obstructs its passage, let the point be brought a little outwards: and by these cautious essays it will at length pass without further resistance, and ought to be advanced a considerable way, in order to certify the operator that he is not on the outside of the os internum.

When the forceps are fixed, and the operator uncertain which way the forehead lies, let him pull slowly, and move the head with a quarter-turn, first to one side and then to the other, until he shall have found the direction in which it comes most easily along. If at any time we find the forceps begin to slip, we must rest and push them up again gently: but if they are like to slide off at a side, untie the handles, and move them so as to take a firmer hold, fix as before, and deliver. If we are obliged to hold with both hands, the parts may be supported by the firm application of an assistant's hand; for without such cautious management they will run a great risk of being lacerated; a misfortune which rarely happens when the perinæum is properly pressed back, and the head leisurely delivered. Sometimes, when the head is brought low down, you may take off the forceps, and help along with your fingers on each side of the coccyx, or in the rectum, as directed in the natural labour.

If the head is low down, the ears are commonly diagonal, or to the sides; and when the head is brought down one-third, or one-half through the os externum, the operator can then certify himself whether the forehead is turned to the coccyx or os pubis, by feeling with his finger for the back part of the neck or ear, betwixt the os pubis and the head; and then move the head as above directed. Let him try to alter with his hand every bad position of the head; and if it be detained high in the pelvis, in consequence of the woman's weakness, the rigidity of the parts, the convulsions or shortness of the funis, or the contraction of the uterus over the shoulders of the child, the forceps will frequently succeed when the fœtus cannot be turned; but if the head is large, or the pelvis narrow, the child is seldom saved, either by turning or using the forceps, until the head shall be farther advanced.

And here it will not be amiss to observe, that the blades of the forceps ought to be new-covered with stripes of washed leather after they shall have been used, especially in delivering a woman suspected of having an infectious distemper.

SECT. IV. The Signs of a dead Child.

When the head presents, and cannot be delivered by the labour-pains; when all the common methods have been used without success, the woman being exhausted, and all her efforts vain; and when the child cannot be delivered without such force as will endanger the life of the mother, because the head is too large, or the pelvis too narrow; it then becomes absolutely necessary to open the head and extract with the hand, forceps, or crotchet. Indeed, this last method formerly was the common practice when the child could not be easily turned, and is still in use with those who do not know how to save the child by delivering with the forceps: for this reason their chief care and study was to distinguish whether the fœtus was dead or alive; and as the signs were uncertain, the operation was often delayed until the woman was in imminent danger; or when it was performed sooner, the operator was frequently accused of rashness, on the supposition that the child might in time have been delivered alive by the labour-pains. Perhaps he was sometimes conscious to himself of the justice of this imputation, although what he had done was with an upright intention.

The signs of a dead fœtus are, first, the child's ceasing to move and stir in the uterus. Secondly, the evacuation of meconium, though the breech is not pressed into the pelvis. Thirdly, no perceivable pulsation at the fontanel and temporal arteries. Fourthly, a large swelling or tumour of the hairy scalp. Fifthly, an uncommon laxity of the bones of the cranium. Sixthly, the discharge of a fetid ichor from the vagina, the effluvia of which surrounding the woman, gave rise to the opinion that her breath conveyed a mortified smell. Seventhly, want of motion in the tongue when the face presents. Eighthly, no perceivable pulsation in the arteries of the funis umbilicalis, when it falls down below the head; nor at the wrist, when the arm presents; and no motion of the fingers. Ninthly, the pale and livid countenance of the woman. Tenthly, a collapsing and flaccidity of the breasts. Eleventhly, A coldness felt in the abdomen, and weight, from the child falling, like a heavy ball, to the side on which she lies. Twelfthly, a separation of the hairy scalp on the slightest touch, and a distinct perception of the bare bones. All or most of these signs are dubious and uncertain, except the last, which can only be observed after the fœtus hath been dead several days. One may also certainly pronounce the child's death, if no pulsation hath been felt in the navel-string for the space of twenty or thirty minutes; but the same certainty is not to be acquired from the arm, unless the skin can be stripped off with ease.

SECT. V. When the CROTCHET is to be used.

MIDWIFERY is now so much improved, that the necessity of destroying the child does not occur so often as formerly. Indeed it never should be done, except when it is impossible to turn or to deliver with the forceps; and this is seldom the case but when the pelvis is too narrow, or the head too large to pass, and therefore rests above the brim. For this reason, it is not necessary for the operator to puzzle himself about dubious signs; because, in these two cases there is no room for hesitation: for if the woman cannot possibly be delivered in any other way, and is in imminent danger of her life, the best practice is undoubtedly to have recourse to that method which alone can be used for her preservation, namely, to diminish the bulk of the head. In this case, instead of destroying, you are really saving a life; for, if the operation be delayed, both mother and child are lost.

SECT. VI. Method of extracting the Head.

Various have been the contrivances intended for this purpose. Some practitioners, when the head did not advance in the pelvis, introduced the *speculum matricis*, in order to stretch the bones asunder, and thereby increase the capacity of the basin: if, after this operation, the woman could not be delivered with her pains, they fixed a large screw in the head, by which they pulled with great force. Others opened the head with a large bistoury, or a short broad-bladed knife in form of a myrtle-leaf, or with a crooked bistoury with a long handle: then a small pair of forceps with teeth were introduced; and one blade being insinuated into the opening they laid hold on the skull, and pulled the head along: they likewise made use of different kinds of crotchets, both sharp and blunt: and when the head was lower down, they practised the same expedient. Albucasis has also given the draught of an instrument, which is both for opening and extracting the head; the point and wings are forced through the cranium, and when turned the contrary way, the two wings are forced to take hold of the inside.

There are other later contrivances used and recommended by different gentlemen of the profession, such as Mauriceau's *tire-tête*, Simpson's scalp-ring, and Old's *terebra occulta* with the improvement made in it by Dr. Burton of York: and all these instruments may be used with success, if cautiously managed, so as not to injure the woman; except the *speculum matricis*, which so far from answering the supposed intention of it, namely, to extend the bones of the pelvis, can serve no other purpose than that of bruising or inflaming the parts of the woman.

The following method, if exactly followed according to the circumstances of the case, seems, of all others hitherto invented, the easiest, safest, and most certain, especially when it requires great force to extract the head.

SECT.

M I D W I F E R Y.

SECT. VII. *The Method of using the SCISSARS, Blunt Hook, and CROTCHET.*

When the head presents, and such is the case that the child can neither be delivered by turning, nor extracted with the forceps, and it is absolutely necessary to deliver the woman to save her life; this operation must then be performed in the following manner: The operator must be provided with a pair of curved crotchets, made according to the improvements upon those proposed by Mesnard, together with a pair of scissars about nine inches long, with rests near the middle of the blades, and the blunt hook.

Of the Woman's Posture.

The patient ought to be laid on her back or side, in the same position directed in the use of the forceps; the operator must be seated on a low chair, and the instruments concealed and disposed in the same manner and for the same reason mentioned in treating of the forceps. The parts of the woman have already, in all likelihood, been sufficiently dilated by his endeavours to turn or deliver with the forceps: or, if no efforts of that kind have been used, because, by the touch, he had learned that no such endeavours would succeed, as in the case of a large hydrocephalus, when the bones of the cranium are often separated at a great distance from each other, or upon perceiving that the pelvis was extremely narrow; if, upon these considerations, he hath made no trials in which the parts were opened, let him gradually dilate the os externum and internum, as formerly directed.

The head is commonly kept down pretty firm, by the strong contraction of the uterus round the child; but, should it yield to one side, let it be kept steady by the hand of an assistant, pressing upon the belly of the woman: let him introduce his hand, and press two fingers against one of the sutures of the cranium; then take out his scissars from the place in which they were deposited, and guiding them by the hand and fingers till they reach the hairy scalp, push them gradually into it, until their progress is stopped by the rests.

If the head slips aside, in such a manner as that they cannot be pushed into the skull at the future, they will make their way through the solid bones, if they are moved in a semicircular turn, like the motion of boring, and this method continued till you find the point firmly fixed; for, if this is not observed, the points slide along the bones.

The scissars ought to be so sharp at the points, as to penetrate the integuments and bones when pushed with a moderate force; but not so keen as to cut the operator's fingers, or the vagina, in introducing them.

The scissars being thus forced into the brain, as far as the rests at the middle of the blades, let them be kept firm in that situation; and the hand that was in the vagina being withdrawn, the operator must take hold of the handles with each hand, and pull them asunder, that the blades may dilate and make a large opening in the skull; then they must be shut, turned, and again pulled asunder, so as to make the incision crucial; by which means the opening will be enlarged, and sufficient room made for the introduction of the fingers; let them afterwards be closed, and introduced even beyond the rests, when they must again be opened, and turned half-round from side to side, until the structure of the brain is so effectually destroyed, that it can be evacuated with ease. This operation being performed, let the scissars be shut and withdrawn; but if this instrument will not answer the last purpose, the business may be done by introducing the crotchet within the opening of the skull. The brain being thus destroyed, and the instrument withdrawn, let him introduce his right-hand into the vagina, and two fingers into the opening which hath been made, that, if any sharp splinters of the bones remain, they may be broken off and taken out, lest they should injure the woman's vagina, or the operator's own fingers.

If the case be an hydrocephalus, let him fix his fingers on the inside, and his thumb on the outside, of the opening, and endeavour to pull along the skull in time of a pain: but if the labour is weak, he must desire the woman to assist his endeavours by forcing down: and thus the child is frequently delivered: because, the water being evacuated, the head collapses of course.

But when the pelvis is narrow, the head requires much greater force to be brought along; unless the labour-pains are strong enough to press it down, and diminish it, by squeezing out the cerebrum: in this case let the operator withdraw his fingers from the opening, and, sliding them along the head, pass the os uteri; then, with his left-hand, taking one of the crotchets from the place of its concealment, introduce it along his right-hand, with the point towards the child's head, and fix it above the chin, in the mouth, back part of the neck, or above the ears, or in any place where it will take firm hold; having fixed the instrument, let him withdraw his right-hand, and with it take hold of the end or handle of the crotchet, then introduce his left to seize the bones at the opening of the skull (as above-directed) that the head may be kept steady, and pull along with both hands.

If the head is still retained by the uncommon narrowness of the pelvis, let him introduce his left-hand along the opposite side, in order to guide the other crotchet; which being also applied, and locked or joined with its fellow in the manner of the forceps, he must pull with sufficient force, moving from side to side, and as it advances: turn the forehead into the hollow of the sacrum, and extract it with the forceps, humouring the shape of the head and

pelvis during the operation, which ought to be performed slowly, with great judgment and caution: and from hence it appears absolutely necessary to know how the head presents, in order to judge how the crotchet must be fixed, and the head brought along to the best advantage. Sometimes, in these cases, when we find that we cannot succeed by pulling at the opening with the fingers, and if the woman has not had strong pains, we introduce the small end of the blunt-hook into the opening, and placing the fingers against the point on the outside of the skull, pull with greater and greater force: but, as we can seldom take a firm hold in this manner, if it does not answer the purpose, we introduce the fingers, as above, farther, and slide the point up along the outside, above the under-jaw; and have succeeded several times with this instrument, except when the pelvis was so narrow as to require a greater force; when we must use others: no doubt it is better first to try the blunt-hook; because the managing the point gives less trouble, and it can be easier introduced with the point to one side. When the instrument is far enough advanced, this point may be turned to the head; and as a very narrow pelvis seldom occurs, the blunt-hook will commonly succeed.

Dr. Smellie mentions, in his last treatise, a sheath to cover the sharp point of the curved crotchets, which may be introduced and used in the same manner as the blunt-hook: the sheath may be taken off or kept on as there is occasion.

If, when the head is delivered in this manner, the body cannot be extracted, on account of its being much swelled, of a monstrous size, or (which is most commonly the case) the narrowness of the pelvis; let the operator desist from pulling, lest the head should be separated from the body, and, introducing one hand, so as to reach with his fingers to the shoulder-blades or breast, conduct along it one of the crotchets, with the point towards the foetus, and fix it with a firm application; then withdrawing his hand, employ it in pulling the crotchet, while the other is exerted in the same manner upon the head and neck of the child; if the instrument begins to lose its hold, he must push it further up, and fixing it again, repeat his efforts, applying it still higher and higher, until the body is extracted.

Some writers direct us to introduce the crotchet within the skull, and, pressing one hand against the point on the outside, pull along. But this is a trifling expedient; and if a good deal of force is used, the instrument tears through the thin bones, and hurts the operator's hand, or the woman's vagina, if not both: whereas, in the other method, there is much more certainty, and a better purchase to force along the head, which collapses and is diminished as the brain is discharged, and never comes down in a broad flattened form, according to the allegations of some people, whose ideas of these things are imperfect and confused: for, if this were the case, the same would happen when the head is forced down from behind with labour-pains into a narrow pelvis, because the pressure in both cases acts in the same direction; whereas we always find, both in the one and the other, that the vertex is protruded in a narrow point, and the whole head squeezed into a longish form. Dr. Smellie observes, in his Treatise, that though many people have exclaimed against the crotchets, as dangerous instruments, from ignorance, want of experience, or a worse principle, as formerly observed; yet, Dr. Smellie again observes, that they either tore or hurt the parts of a woman with that instrument. He has, indeed, several times hurt the inside of his hand by their giving way; till he had recourse to the curve kind, which, in many respects, have the advantage of the straight; and, he is persuaded, if managed as above-directed, will never injure the patient.

Indeed, young practitioners, till they are better informed by custom and practice, may, after the head is opened, try to extract it with the small or large forceps; and if it is not very large, or the pelvis very narrow, they may deliver by squeezing and lessening the head; but, in his course of practice, he has been concerned in many cases, where the pelvis was so distorted and narrow, that, even after opening the head largely, he has pulled at the bones in time of strong pains, but all to no purpose, although some of them actually came away. Nay, after fixing a crotchet firmly above or near the chin or basis of the skull, and using a good deal of force, he had not been able to move the head lower, till at last he was obliged to introduce the other, and by intervals increase the force of pulling to the utmost of his strength; and before he had the curve crotchet, he had been so fatigued from the straight kind slipping their small hold so often, that he had scarcely been able to move his fingers or arms for many hours after; and if this force had not been used, the mother must have been lost as well as the child. See Fig. 31, 32.

PART VII.

PRETERNATURAL LABOURS.

Preternatural labour happens when, instead of the head, some other part of the body presents to the os uteri. It has been thought by some, that all labours in which the forceps and crotchets are used ought to be ranked in this class, because the head is certainly delivered by preternatural means; and that, when the feet or breech present, and the woman is delivered without any other assistance than that of labour-pains, the case ought to be accounted natural. However, this division would embarrass and confuse young beginners more than the other, which we have chosen to follow, namely,

MIDWIFERY.

namely, that of reckoning by the manner in which the child is delivered, and calling all those births *preternatural* in which the body is delivered before the head. Preternatural labours are more or less difficult according to the presentation of the child, and the contraction of the uterus round its body. The nearer the head and shoulders are to the os internum, or lower part of the uterus, the more difficult is the case; whereas, when the head is towards the fundus, and the feet or breech near the os internum, it is more easy to turn and deliver.

To begin with the easiest of these, it may be proper to divide them into three divisions: First, how to manage when the feet, breech, or lower parts present. Secondly, how to behave in violent floodings; and, when the child presents wrong before the membranes are broke; how to save the waters in the uterus, that the fœtus may be the more easily turned; and what method to follow even after the membranes are broke, when all the waters are not evacuated. Thirdly, how to deliver when the uterus is strongly contracted, and the child presenting either with the fore or back parts, and lying in a circular form; or with the shoulders, breast, neck, face, ear, or vertex, and lying in a longish form, with the feet and breech towards the fundus of the womb, which is contracted like a long theath, close to the body of the fœtus; and when the fore-parts of the child lie towards the side, fundus, fore or back part of the uterus.

We sometimes meet with pendulous bellies, in which the os uteri is farther back than usual; but even in these cases, when the head is not very large, nor the pelvis narrow, and the patient is vigorous, and the labour-pains strong, the woman, with a little patience, is, for the most part, safely delivered, without any other than common assistance: or, should the case prove tedious, she may be assisted in time of a pain by introducing one or two fingers into the os uteri, and gradually bringing it more forwards. When the belly is very pendulous, change of position from time to time is of service, especially lying upon her back, with the shoulders low, and the breech raised. In women that are distorted, when one ilium is much lower than the other, the fundus uteri will be turned to the low side; but there the chief difficulty will proceed from the narrowness of the pelvis.

SECT. I. First Division of PRETERNATURAL LABOURS. When the Feet, Breech, or lower Parts of the Fœtus present, and the Head, Shoulders, and upper Parts are towards the Fundus Uteri.

These, for the most part, are accounted the easiest, even although the uterus should be strongly contracted round the body of the child, and all the waters discharged. If the knees or feet of the child present to the os internum, which is not yet sufficiently dilated to allow them and the body to come farther down; or, if the woman is weak, worn out with long labour, or endangered by a flooding; let the operator introduce his hand into the vagina, push up and stretch the os uteri, and bring along the feet; which being extracted, let him wrap a linen cloth round them, and pull until the breech appears on the outside of the os internum. If the face or fore part is already towards the back of the uterus, let him persist in pulling in the same direction: but if they are towards the os pubis, or one side, they must be turned to the back part of the uterus; and as the head does not move round equal with the body, he must make allowance for the difference in turning, by bringing the last quarter farther than the place at which the head is to be placed; so that the face or forehead, which was towards one of the groins, will be formed to the side of the sacrum, where it joins with the ischium. This quarter-turn of the body must be again undone, without affecting the position of the head; a cloth may be wrapped round the breech, for the convenience of holding it more firmly; then placing a thumb along each side of the spine, and with his fingers grasping the belly, let him pull along the body from side to side, with more or less force, according to the resistance. When the child is delivered as far as the shoulders, let him slide his hand, flattened (suppose the right, if he lies on her back) between its breast and the perinæum, coccyx, and sacrum, of the woman, and introduce the fore and middle finger (or both, if necessary) into the mouth of the fœtus; by which means the chin will be pulled to the breast, and the forehead into the hollow of the sacrum: and this expedient will also raise upwards the hind-head, which rests at the os pubis.

When the forehead is come so low as to protrude the perinæum, if the woman lies on her back, let the operator stand up and pull the body and head of the child upwards, bringing the forehead with a half-round turn from the under part of the os externum, which will thus be defended from laceration. The application of the fingers in the child's mouth will contribute to bring the head out in this manner, prevent the os externum from hitching on the chin, help along the head, and guard the neck from being overstrained; a misfortune which would infallibly happen, if the forehead should be detained at the upper part of the sacrum: nor is there any great force required to obviate this inconvenience, or the least danger of hurting the mouth, if the head is not large: for if the head cannot be brought along with moderate force, and the operator is afraid of injuring or overstraining the lower jaw, let him push his fingers farther up, and press on each side of the nose, or on the inferior edges of the sockets of the eyes. If the legs are come out, and the breech pulled into the vagina, there is no occasion for pulling up so open, but only to pull along and manage as before-directed: still

remembering to raise the forehead slowly from the perinæum which may be pressed back with the fingers of the other hand.

In the case of a narrow pelvis or large head, which cannot be brought along without the risk of overstraining the neck, let him slide up his fingers and hand into the vagina, and bring down one of the child's arms, at the same time pulling the body to the contrary side, by which means the shoulders will be brought lower down: let him run his fingers along the arm, until they reach the elbow, which must be pulled downwards with a half-round turn to the other side, below the breast. This must not be done with a jerk, but slowly and cautiously, in order to prevent the dislocation, behind, or breaking, of the child's arm.

Let him again guide his fingers into the child's mouth, and try if the head will come along; if this will not succeed, let the body be pulled to the other side, so as to bring down the other shoulder; then slide up his left-hand, and extracting the other arm, endeavour to deliver the head. If one finger of his right-hand be fixed in the child's mouth, let the body rest on that arm; let him place the left-hand above the shoulders, and put a finger on each side of the neck: if the forehead is towards one side at the upper part of the pelvis, let him pull it lower down, and gradually turn it into the hollow of the sacrum; then stand up, and in pulling raise the body so as to bring out the head in a half-round turn, as above directed.

Daventer and others, from a mistaken notion that the chief resistance is at the coccyx or lower part of the pelvis, have directed us to press the shoulders of the child downwards, so as to bring the hindhead first from below the os pubis: not considering that the resistance is occasioned by the thickest part of the head being detained at the upper part of the pelvis, where the lowest vertebra of the loins and the upper part of the sacrum jet inwards; and that until the forehead hath passed into the hollow of the sacrum, this method cannot succeed. The business, therefore, is to pull upwards at the back part of the neck which rests against the under-part of the os pubis: and by this exertion, the forehead, which is high up, will be brought down with a circular turn; after which the head seldom stops, and the same circular motion is still the most proper, though now we can bring out the head the other way, but not before. Sometimes, indeed, we have found Daventer's method succeed better than any other, when the head is low down, and the chief resistance is in the lower parts; but this is very seldom the case: however, when the forehead is hindered from coming down into the lower part of the sacrum by an uncommon shape of the head or pelvis, and we cannot extract it by bringing it out with a half-round turn at the os pubis, we must try to make this turn in the contrary direction; and instead of introducing our fingers into the child's mouth, let the breast of it rest on the palm of your left-hand (the woman being on her back) and placing the right on its shoulders, with the fingers on each side of the neck, press it downwards to the perinæum. In consequence of this pressure, the face and chin being within the perinæum, will move more upwards, and the head come out with a half-round turn from below the os pubis: for the centre of motion is now where the forepart of the neck presses at the perinæum; whereas, in the other method, the back-part of the neck is against the lower part of the os pubis, on which the head turns.

If the forehead is not turned to one side, but sticks at the upper part of the sacrum, especially when the pelvis is narrow; let him endeavour, with his finger in the mouth, to turn if one side of the jetting-in of the sacrum, because the pelvis is wider at the sides of the brim, and bring it along as before.

If one of the child's arms, instead of being placed along the side of the head, is turned in between the face and sacrum, or between the hindhead and os pubis, the same difficulty of extracting occurs as in a large head or narrow pelvis; and this position frequently ensues when the fore-parts of the child's body are turned from the os pubis down to the sacrum. If they are turned to the left side of the woman, the left-hand and arm are commonly brought in before the face, and *vice versa*; but in these cases the elbow is for the most part easily come at, because it is low down in the vagina, and there is a necessity for bringing down one or both arms before the head can be delivered: from whence we may conclude that those authors are sometimes in the wrong who expressly forbid us to pull down the arms. Indeed, if the pelvis is not narrow, nor the head very large, and the arms lie along the sides of the head, there is seldom occasion to pull them down, because the pelvis is widest at the sides, and the membranes and ligaments that fill up the space betwixt the sacrum and ischia yield to the pressure, and make room for the passage of the head: but when they are squeezed between the head and the sacrum, ischia, or ossa pubis, and the head sticks in the pelvis, they certainly ought to be brought down; or even when the head comes along with difficulty. Neither is the alleged contraction of the os internum round the neck of the child so frequent as hath been imagined; because, for the most part, the contraction embraces the head and not the neck: but should the neck alone suffer, that inconvenience may be removed by introducing the hand into the vagina, and a finger or two into the child's mouth or on each side of the nose; by which means also a sufficient dilatation will be preserved in the os externum, which frequently contracts on the neck as soon as the arms are brought out.

The diameter from the face or forehead to the vertex, being greater

M I D W I F E R Y.

greater than that from the forehead to the back-part of the hind-head or neck, when the hind-head rests at the os pubis, and the forehead at the upper part of the sacrum, the head can seldom be brought down until the operator, by introducing a finger into the mouth, moves the same to the side, brings the chin to the breast, and the forehead into the hollow of the sacrum: by which means the hind-head is raised and allowed to come along with greater ease; and in pulling, half the force only is applied to the neck, the other half being exerted upon the head, by the finger which is fixed in the mouth; so that the forehead is more easily brought out, by pulling upwards with the half-round turn from the perineum. When the operator, with his fingers in the child's mouth, cannot pull down the forehead into the hollow of the sacrum, let him push the fore-finger of his left hand betwixt the neck and the os pubis, in order to raise the hind-head upwards; which being done, the forehead will come down with less difficulty, especially if he pushes up and pulls down at the same time, or alternately.

If it be discovered, by the touch, that the breech presents, that the membranes are not yet broke, the woman is in no danger, the os internum not yet sufficiently dilated, and the labour-pains strong; the midwife ought to wait until the membranes, with the waters, are pushed farther down, as in the natural labour; for as they come down through the os uteri into the vagina, they stretch open the parts contained in the pelvis; and the bulk within the uterus being diminished, it contracts and comes in contact with the body of the child; so that the breech is pushed along by the mechanical force of the abdominal muscles operating upon the womb. The same consequences will follow even although the membranes are broke; for the waters lubricate the parts as they flow off, and the breech, if not too large, or the pelvis narrow, is pushed down: in this case, when the nates present equal and fair to the os uteri, and one side of the fœtus lies towards the fore-part, the other to the back-part of the uterus; and when the breech presents, it lies in the same manner, only that the fore-parts of the child are rather turned backwards to one side of the vertebræ of the loins; in this position, one hip will present, and the other rest on the os pubis; but when forced along with pains, the last will be gradually moved more and more to the groin of that side, and from thence slip down at the side of the basin: the lower at the same time will be forced to the other, and the hollow betwixt the thighs will rest upon the jetting-in of the os sacrum, and come down in that manner; the thighs on each side, and the back and round part of the breech passing in below the arch of the os pubis, which is the best position: but if the back of the child is tilted backwards, then it will be forced down in the contrary direction, and come along with more difficulty, viz. the thighs to the os pubis, and back to the sacrum. When it is come down to the middle or lower part of the pelvis, let the operator introduce the fore-finger of each hand along the outside, to the groin; and taking hold, pull gently along during a strong pain.

If the os externum is so contracted that he cannot take sufficient hold, let it be opened slowly, so as to allow his hand to be pushed up with ease: when he has insinuated a finger or two in each groin, let him place his thumbs on the thighs, if they are towards the os pubis, so as to obtain a full hold; then pull along from side to side, and, if the back of the child is to the os pubis, continue to assist in this manner until the body and head are delivered. The legs being commonly stretched up along the belly and breast, when the child is extracted as far as the shoulders, they come out themselves, or are easily brought down: if the belly of the child is turned to one side, or to the os pubis, in that case, when the breech is delivered, he ought to turn the belly down to the sacrum and the back to the os pubis; and that the face may be also turned to the back of the mother, let him remember the quarter extraordinary, which must be again reversed, and then he may pull along and deliver.

If the body cannot be turned until the thighs and legs are brought down, either on account of the bulk, or because the hold on the breech is not sufficient, let him continue to pull along until the hams appear on the outside of the os externum; then seize one of the knees with his finger and thumb, and extract that leg; and let the other be brought down in the same manner. If he attempts to pull out the legs before the hams arrive at this place, the thighs are always in danger of being bent or broken. When the legs are delivered, let him wrap a cloth round the breech of the child: and as the body was pulled down almost as far as the breast, before the legs could be brought out, it must be pushed up again to the navel or above it; because, without this precaution, the shoulders would be so much engaged in the pelvis, that it would be impracticable to make the motions formerly directed, so as to turn the face to the back of the mother: whereas, when the body is pushed up, those turns can be effected with greater ease, because the belly being in the pelvis, it yields easier to the form of the basin. When the face is turned properly down, let him proceed to deliver as above directed.

If the breech is detained above the pelvis, either by its uncommon magnitude or the narrowness of the basin; or if one of the nates is pushed in, while the other rests above the os pubis, sacrum, or to either side; if the woman is low and weak, the pains lingering, and in sufficient to force the child along; or if she is in danger

from a violent flooding; in any of these cases, let him (during every pain) gradually open first the os externum, and then the os internum, with his fingers and hand. Having thus gained admision, let him push up the breech to the fore or back part, or to one side of the uterus that his hand and arm may have room to slide along the fore-parts or belly of the child, so as to feel the thighs, that will direct him to the legs, which must be brought down with his fingers, while at the same time he pushes up the arms with his thumb, that in case the legs lie straight up they may be extracted with more ease by the flexion of the knee, and run the less risk of being bent, broken, or overstrained; if they are folded downward, they are more easily brought out.

If the breech be strongly pressed into the upper part of the pelvis, let him also push it upwards and to one side, that his hand and arm may have free passage; for the higher the breech is raised out of his way, he will be at more freedom to extract the legs. If both legs cannot be easily brought down, he may safely deliver with one, of which taking hold with a linen cloth wrapped round it, let him slide up his other hand into the vagina, and a finger or two into the outside of the groin which is bent: by these means the hip will come down the easier, and the leg which is already extracted, will not be overstrained by sustaining the whole force of pulling the body along.

If the legs lie towards the left side of the woman, who is laid on her back, the right-hand must be introduced into the uterus; if they lie to her right side, the left-hand will better answer the purpose; and if they are towards her back or belly, either hand may be indifferently used. In all cases where the breech presents, the safest practice is always to push up and bring down the legs, provided the os uteri is sufficiently dilated, and the waters not wholly discharged. If the waters are evacuated, the uterus strongly contracted around the child, the breech so low as that it cannot be returned, or so small as to come easily along, we ought then to deliver it accordingly: but if so large as neither to be pushed up nor brought along with the assistance of the fingers, let the operator introduce the curved handle of the blunt crotchet into one of the groins, his fingers into the other, and pull very cautiously in order to prevent a fracture or dislocation of the thigh-bone, which might otherwise happen from the use of this instrument, the blunt point of which must be sufficiently past the groin. A fillet may be also used for the same purpose.

We have, in the foregoing cases of this section, supposed the woman laid on her back, her legs supported, and breech to the bedside: this being generally the best position for delivering the body and head. Indeed, when the child is small, she may lie on her side, and the same methods be used in delivering, provided the operator still remembers that in this position the ilium and ischium of one side are down, and the others up. Besides, when the breech is pushed up, in order to bring down the legs, if they lie forwards towards the fore-part of the uterus, and the belly is pendulous, he can reach them with the greatest ease when she lies on one side; or if the resistance is very great, turn her to her knees and elbows, according to Daventer's method: but, when the legs are delivered, if the child is large or the pelvis narrow, she ought to be turned upon her back, because the body and head can be better and more safely delivered by pulling up and down; and in that posture she is also kept more firm, and her thighs less in the operator's way, than when she lies upon her side. See Fig. 32, 33, 35, and 37.

SECT. III. The Second Division of PRETERNATURAL LABOURS.

First case. When the membranes are broke, but the face, shoulder, or some other part of the child, being pushed into the pelvis, locks up the os internum, so as that a small quantity of the waters hath been discharged, the uterus is kept from contracting strongly round the child, which is therefore more easily turned than it possibly can be when they are all gone.

Second case. When, before the membranes are broke, the child is felt through them, presenting wrong; and at the same time the pains push them down so as to dilate the os internum, more or less.

Third case. When the woman at any time in the four last months is seized with a violent flooding that cannot be restrained, and unless speedily delivered must lose her life: if labour-pains cannot be brought on by stretching the parts, delivery must be forced: but if she is in labour, and the membranes have been pushed down with the waters, they may be broke; by which means the flooding is frequently diminished, and the child delivered by the labour-pains. In these three different cases, if we can prevent the strong contraction of the uterus, by keeping up the waters, we can also for the most part, turn the child with great ease, even in the very worst positions.

C A S E I.

In the first case, let the operator slowly introduce his hand into the vagina, and his fingers between that part of the child which is pushed down and the os internum; if in so doing, he perceives some of the waters coming along, he must run up his hand as quick as possible into the uterus, betwixt the inside of the membranes and the child's body; the lower part of his arm will then fill up the os externum, like a plug, so that no more of the waters can pass: let him turn the child with its head and shoulders up to the fundus,

M I D W I F E R Y.

the breech down to the lower part of the uterus, and the fore-parts towards the mother's back: let the hand be pushed no farther up than the middle of the child's body; because if it is advanced as high as the fundus, it must be withdrawn lower, before the child can be turned; and by these means the waters will be discharged, and the uterus, of consequence, contract, so as to render the turning more difficult.

C A S E II.

In the second case, when the membranes are not broke, and we are certain that the child does not present fair, if the os internum is not sufficiently dilated, and the woman is in no danger, we may let the labour go on until the parts are more stretched; lubricating and extending the os internum, by degrees, during every pain. Then introducing one hand into the vagina, we insinuate it in a flattened form, within the os internum, and push up between the membranes and the uterus, as far as the middle of the womb. Having thus obtained admission, we break the membranes, by grasping and squeezing them with our fingers; slide our hand within them, without moving the arm lower down; then turn and deliver as before directed: but if in any one of these cases you find the head is large, or the pelvis narrow, bring down the head into the natural position, and assist as directed in lingering or laborious cases.

C A S E III.

In the third case, if the woman is attacked with a violent flooding, occasioned by a separation of all or any part of the placenta from the uterus during the last four months of pregnancy, and every method has in vain been tried to lessen and restrain the discharge, the operator ought to pronounce the case dangerous, and prudently declare to the relations of the patient, that unless she is speedily delivered, both she and the child must perish; observing, at the same time, that by immediate delivery they may both be saved: let him also desire the assistance and advice of some person eminent in the profession, for the satisfaction of her friends, and the support of his own reputation. When there are no labour-pains, and the mouth of the womb is not dilated, it is sometimes very difficult to deliver, more especially if the os internum is not a little lax, but feels rigid.

If the os uteri is so much contracted that the finger cannot be introduced, some authors have recommended a dilator, by which it may be gradually opened so as to admit a finger or two. Doubtless, some cases may happen in which this may be necessary; though in all those we know of in which there was a necessity for forcing delivery, the mouth of the womb was open enough to receive the tip of a finger, so that by gradual efforts we could effect a sufficient dilatation; and it is certainly a safer method to dilate with the fingers and hand than with an instrument. If in the stretching the os internum labour-pains are brought on, let the operator slowly proceed and encourage them: when the mouth of the womb is opened, if the head presents and the pains are strong, by breaking the membranes the flooding will be diminished: but if the floods to such a degree as to be in danger of her life, and the dilatation does not bring on labour, at least not enough for the occasion, the must be immediately delivered in the following manner. But in the first place let her friends be apprised of the danger, and the operator beware of promising to save either mother or child: for we have known the woman die in a few minutes after delivery, although to all appearance she seemed able to undergo the operation, and the child lost from the head sticking in the pelvis; others, again, who were apparently much more weak and exhausted, have recovered, and the child hath been saved.

The operator having performed his duty in making the friends acquainted with the situation of the case, must gently open the os externum, by introducing his fingers gradually, turning them half-round, and pushing upward; then forming them, with the thumb, into the figure of a wedge or cone, continue to dilate slowly and by intervals, until his hand is admitted in the vagina: having thus far gained his point, let him insinuate, in the same slow cautious manner, first one, then two fingers into the os internum, which may be dilated so as to admit the other two and the thumb, in the same conical form, which will gradually make way for sliding the hand along between the outside of the membranes and inside of the uterus, then he must manage as directed in the second case. If upon sliding up his hand upon the outside of the membranes, he feels the placenta adhering to that side of the womb, he must either withdraw the hand and introduce the other on the opposite side, or break through the membranes at the lower edge of the placenta. The greatest danger in this case frequently proceeds from the sudden emptying of the uterus and belly: for when labour comes on of itself, or is brought on in a regular manner, and the membranes are broke, the flooding is gradually diminished; and first the child, then the placenta, is delivered by the pains; so that the pressure or resistance is not all at once removed from the belly and uterus of the woman, which have time to contract by degrees; consequently, those fainting-fits and convulsions are prevented which often proceed from a sudden removal of that compression under which the circulation was performed.

In order to anticipate these fatal symptoms, Dr. Smellie (sometimes successfully) ordered an assistant to press upon the woman's belly while the uterus was emptying: or, after having broken the membranes, turned up the head to the fundus, and brought down the legs and breech, he withdrew his arm a little to let the waters

come off, and kept his hand in the uterus for a few minutes; he did not extract the legs until he felt the womb close contracted to the child; nay, if the flooding was stopped, or diminished, he let the child remain in the uterus perhaps ten or fifteen minutes longer, then delivered; and, if the hæmorrhage was stayed, he left the placenta to be expelled by nature. In all these stages, however, when the flooding is violent, we must deliver without loss of time, remembering still the pressure upon the abdomen; for the woman is frequently so very weak, that although labour could be brought on, she would not have strength sufficient to undergo it. The younger the woman is with child, the greater is the difficulty in opening the os internum; and more so in the first child, especially if past the age thirty-five.

We should never refuse to deliver in these dangerous cases, even although the patient seems expiring; for immediately after delivery the uterus contracts, the mouth of the vessels are shut up, so that the flooding ceases, and if she lives five or six hours after the operation, and can be supported by frequent draughts of broth, jelly, caudle, weak cordial, and anodyne medicines, which maintain the circulation and gradually fill the empty vessels, she may recover.

If, in time of flooding, she is seized with labour-pains, or if, by every now and then stretching with your fingers the os internum, you bring on labour, by which either the membranes or head of the child is pushed down and opens the os internum, the membranes ought to be broken; so that, some of the waters being discharged, the uterus may contract and squeeze down the fœtus. This may be done sooner in those women who have had children formerly, than in such as have not been in labour before. If, notwithstanding this expedient, the flooding still continues, and the child is not like to be soon delivered, it must be turned immediately: or, if the head is in the pelvis, delivered with the forceps: but, if neither of these two methods will succeed, on account of the narrowness of the pelvis or the bigness of the head, this last must be opened and delivered with the crotchet. In all these cases let the parts be dilated slowly and by intervals, in order to prevent laceration. See Fig. 11, 14, 15, 16, 17.

SECT. IV. Third Division of PRETERNATURAL LABOURS.

We have already observed that the principal difficulties in turning children and bringing them by the feet, proceeded from the contraction of the uterus and bad position of the fœtus. If the child is in a round form, whether the fore-parts are towards the os internum, or up to the fundus uteri, we can for the most part move it with the hand, so as to turn the head and shoulders to the upper part, and the breech and legs downwards; but if the child lies lengthwise, the womb being contracted around it like a long sheath, the task is more difficult; especially if the head and shoulders of the child are down at the lowest part of the uterus, with the breech and feet turned up to the fundus.

Before we proceed to the method of delivery in the following cases, it will not be improper to premise, that the woman ought to be laid on her back, her breech upon the side or foot of the bed, a bolster or pillows being laid below the feather-bed or mattress, in order to raise it so as that the breech may be higher than the shoulders: while an assistant sits on each side, to support her legs and thighs, and one or two more assistants ought to sit behind, or on each side of her shoulders, to keep her firm in that position. The operator ought to avoid all formality in point of dress, and never walk about the room with sleeves and apron; for although such apparatus may be necessary in the hospitals, in private practice it conveys a frightful idea to the patient and female spectators: the more genteel and commodious dress is a loose washing night-gown, which he may always have in readiness to put on when he is going to deliver; his waistcoat ought to be without sleeves, that his arms may have more freedom to slide up and down under cover of the wrapper; and the sleeves of his shirt may be rolled up and pinned to the breast of his waistcoat. In natural labours, the sheet that hangs over the bed-side is sufficient to keep him clean and dry, by being laid in his lap; but in those cases where he is obliged to alter his position, a sheet ought to be tucked round him, or an apron put on, but not before he is about to begin his work. If the patient is laid on a low bed, and he intends to introduce his right-hand, his best and firmest position is to kneel with his left knee on a cushion, keeping up the right to support his arm; if the left-hand is introduced, the reverse of this disposition must take place: if the bed or couch is high, he ought to stand, but still remember to support the elbow on the knee. These directions, howsoever trivial they may seem to old practitioners, may be serviceable to young beginners, and give our readers a better idea of the operation.

The hand of the accoucher or operator being introduced into the uterus, if he finds the breech below the head and shoulders, let him search for the legs, and bring them down: but if the breech be higher than the upper parts of the child, or equal with them, he must try to turn the head and shoulders to the fundus, and the breech downwards, by pushing up the first and pulling down the last; then proceed with delivery as before directed. This is commonly executed with ease, provided some part of the waters still remain in the uterus: but, if the woman has been long in labour, and the waters discharged, the contraction of the womb is so strong, that the child cannot be turned without the exertion of great force frequently repeated. In this case, the easiest method, both for the

M I D W I F E R Y.

patient and operator, is to push up the hand gradually on that side to which the legs and thighs are turned; and even after he has reached them, if they are not very high up, let him advance his hand as far as the fundus uteri; he will thus remove the greatest obstacle, by enlarging the cavity of the womb, so as more easily to feel and bring down the legs; then he may push up and pull down, as we have prescribed before. But if the head and shoulders still continue to hinder the breech and body from coming along, and the feet cannot be brought so low as the outside of the os externum, while they are yet in the vagina, he may apply a noose upon one, or both: for, unless the child is so small that he can turn it round by grasping the body when the head and shoulders are pushed up, and he endeavours to bring down the other parts, they will again return to the same place, and retard delivery; whereas, if he gains a firm hold of the feet, either without the os externum, or in the vagina, by means of the noose fixed upon the ankles, he can with the other hand push up the head and shoulders, and be able, in that manner, to bring down the breech. He must continue this method of pushing and pulling down, until the head and shoulders are raised to the fundus uteri: for, should he leave off too soon, and withdraw his hand, although the child is extracted as far as the breech, the head is sometimes so pressed down and engaged with the body, in the passage, that it cannot be brought farther down without being torn along with the crotchets; for the breech and part of the body may block up the passage in such a manner as that the hand cannot be introduced to raise the head.

In all cases where the accoucheur foresees that great force will be requisite, he ought to save his strength as much as possible, beginning slowly, and resting his hands between whiles during the operation of pushing and turning the child in the uterus: for if he begins to work in a hurry, and exerts his utmost strength at first, his hand will be so cramped and enervated, that he will be obliged to desist, and give them some respite; so that it may be a long time before he recovers the use of them, and even then they will be so much weakened as to be scarce able to effect delivery, which is thus impeded and delayed.

Those cases are commonly the easiest in which the fore parts present, and the child lies in a round oval form across the uterus, or diagonally, when the head or breech is above and over the os pubis, with the legs, arms, and navel-string, or one or all of them, at the upper or lower part of the vagina, or on the outside of the os externum. Those are most difficult in which, though the child lies in the same round or contracted form, the back, shoulders, belly, or breast, are over the os internum; because, if we cannot move the child round, so as to place the head to the fundus, the legs are brought down with much more difficulty than in the other case: but if the shoulder, breast, neck, ear, face, or crown of the head presents, and the legs and breech are up to the fundus uteri, the case is still more difficult; because, in the other two, the uterus is contracted in a round form, so that the wrong position of the child is more easily altered than this, when the womb is contracted in a long shape, and sometimes requires vast force to stretch it, so as that the head may be raised to the fundus, and the legs and breech brought down.

C A S E I.

When the fore parts of the child present, if the feet, hands, and navel-string are not detained above the os uteri, some, or all of them, descend into the vagina, or appear on the outside of the os externum. If one or more of them come down, and the child, at the same time, lies in a round form across the uterus, let the accoucheur introduce his hand between them and the os sacrum, as directed in Part VII. Sect. 3. When it is past the os internum, let it rest a little, while he feels with his fingers the position of the fœtus: if the head and shoulders lie higher than the breech, he must take hold of the legs and bring them down without the os internum: if the breech is detained above the brim of the pelvis, let him slide up the flat of his hand along the buttocks, and pull down the legs with the other hand; by which method the breech is disengaged and forced into the middle of the pelvis. See Fig. 34.

In most of those cases where the child is pressed in an oval form, if neither the head nor breech present, the head is to one side of the uterus, and the breech to the other; because, as was formerly observed, it is wider from side to side, than from the back to the fore part; and if either the head or breech is over the os pubis, the other is turned off to the side: in moving the head or shoulders to the fundus, they are raised with greater ease along the sides than at the back or fore parts, for the same reasons.

If the head and shoulders lie lower down, so as to hinder the breech from coming along, and the legs from being extracted, let him push up the head and shoulders to the fundus, and pull out the legs; then try, as above-directed, to bring in the breech; and if it still sticks above, because the head and shoulders are again forced down by the contraction of the uterus, he must, with one hand, take hold of the legs, that are now without the os externum, and, sliding the other into the uterus, push the head and shoulders again up to the fundus, while, at the same time, he pulls the legs and breech along with the feet. If the legs cannot be brought farther down than the vagina, because the breech is higher up, let him slip a noose over the feet round the ankles, as before observed; by which he may pull down the lower parts with one hand, while

the other is employed in pushing it up, as before. By this double purchase, the child may be turned even in the most difficult cases; but the operator, in pulling, must beware of overtraining the ligaments of the joints.

If the legs can be extracted through the os externum, let a single cloth, warmed, be wrapped round them, in order to yield a firmer hold to the accoucheur; but when they can be brought no lower than the neck of the uterus and vagina, he may use one of these following nooses. Let him take a strong limber-fillet, or soft garter, half worn, about one yard and a half in length, and moderately broad and thick; if thick, an eye may be made at one end of it, by doubling about two inches and sewing it strongly, and the other end passing through this doubling in order to make the noose, which, being mounted upon the thumb and fingers of his hand, must be introduced, and gently slipped over the toes and feet of the child, so as to embrace the ankles, and, thus applied, it must be drawn tight with his other hand.

If the foot or feet should be so slippery that his fingers cannot hold them, and work over the noose at the same time, it must be withdrawn and mounted round his hand or wrist; with which hand, when introduced, he may take firm hold of both feet, if they are as far down as the vagina; then, with the fingers of his other hand, he may slide the noose along the hand and fingers that hold the feet, and fix it round the ankle. But if one foot remains within the uterus, the fingers of his other hand cannot push up the noose far enough to slide it over the ankle; so that he must have recourse to a director, like that for polyposes, mounted with the noose, which will push it along the hand and fingers that hold the foot. The noose being thus slipped over the fingers upon the ankle, he must pull the extremity of the fillet, which hath passed the eye at the upper end of the director: and after it is close drawn, bring down the instrument. Some use a small slender pair of forceps to grasp the ankles, and slide the noose along them; others make use of a fillet with a noose upon the end of it, fixed on a hollow tube that carries it up to be slipped over the ankles; and this being done, it is drawn close by pulling the other end of the fillet down through the cavity of the tube: but there is seldom occasion for any of these instruments, because we can, for the most part, bring the feet down into the vagina.

C A S E II.

When the belly presents, and the head, shoulders, breech, thighs, and legs, are turned up, over the back, to the fundus uteri; when the back presents, and all these parts are upwards; when the side presents, with the head, shoulders, breech, thighs, and legs turned to the side, back, or fore part of the uterus: in all these cases, when the child is pressed into a round or (more properly) an oval figure, it may be, for the most part, moved round, with one hand introduced into the uterus, the head and shoulders pushed to the fundus, and the legs and breech to the os internum; which being effected, the legs are easily brought down. See Fig. 35, 36. But these cases are more or less difficult as the feet are farther up or lower down, because the business is to bring them downwards.

When the breast, shoulders, neck, ear, or face, presents to the os internum, the breech, thighs, and legs being towards the fundus, with the fore parts of the fœtus turned either to the side, back, or fore part of the woman's belly, and the whole lying in a longish form, the uterus being closely contracted around its body like a sheath (see Fig. 37) let the accoucheur introduce his hand into the vagina, and open the os internum, by pushing up the fingers and hand, flattened, between the parts that present and the inside of the membranes; and rest his hand in that situation, until he can distinguish how the child lies, and form a right judgment how to turn and deliver; for if these circumstances are not maturely considered, he will begin to work in a confused manner, fatigue himself and the patient, and find great difficulty in turning and extracting the child.

If the feet and legs of the fœtus lie towards the back, sides, or fundus uteri, the woman ought to be laid on her back, with her breech raised and brought a little over the bed, as formerly observed; because, in that position, he can more easily reach the feet than in any other.

If they lie towards the fore part of the uterus, especially when the belly is pendulous, she ought to lie upon her side, because, in the other posture, it is often difficult to turn the hand up to the fore part of the womb: whereas, if she is laid on the left side, the right hand may be introduced at the upper part and left side of the brim of the pelvis, where it is widest, and then along the fore part of the uterus; by which means the feet are more easily come at. If it is more convenient for the accoucheur to use his left hand, the patient may be turned on her right side. The only inconvenience attending these positions is, that the woman cannot be kept so firm and steady, but will be apt to toss about and shrink from the operator; and, besides, there may be a necessity for turning her upon her back, after the body is delivered, before he can extract the head, especially if it be large, or the pelvis narrow.

The situation of the child being known, and the position of the mother adjusted, let the proper hand be introduced, and the first effort always made in pushing the presenting part up towards the fundus, either along the sides, back, or fore part of the uterus, as is most convenient. If this endeavour succeeds, and the breech, thighs,

M I D W I F E R Y.

thighs, or legs come down, the body may be delivered with ease: but if the head, shoulder, breast, or neck present, the other parts of the body being stretched up lengthwise, and the uterus so strongly contracted around the child that the presenting part cannot be raised up, or, though pushed upwards, immediately returns before the legs can be properly seized or brought down; the operator ought, in that case, to force up his hand slowly and gradually between the uterus and the child. If the resistance is great, let him rest a little between whiles, in order to save the strength of his hand and arm, as formerly directed; and then proceed with his efforts until he shall advance his hand as far as the feet: for the higher his hand is pushed, the more will the uterus be stretched, and the more room granted for bringing the legs along; and if, in pushing up his hand, the fingers should be entangled in the navel-string, or one of the arms, let him bring it a little lower, and pass it up again on the outside of such incumbrance.

If one leg can be brought down, the child being turned, and that member extracted through the os externum, let the accoucheur slide his hand up to fetch the other; but if this cannot be done, he must fix a finger on the outside of the groin of that thigh which is folded up along the belly, and bring along that buttock, as in the breech case, while he pulls with his other hand at the other leg; and, the body being thus advanced, deliver as before-directed.

When the shoulder presents, and the arm lies double in the vagina, let him push them both up: but if this cannot be done, and the hand is prevented from passing along, he must bring down the arm, and hold it with one hand, while the other is introduced; then let go and push up the shoulder; and, as the child is turned, and the feet brought down, the arm will, for the most part, return into the uterus; but if the arm that is come down be so much swelled that it is impracticable to introduce the hand so as to turn and deliver the child, he must separate it at the joint of the shoulder, if it be so low down; or at the elbow, if he cannot reach the shoulder. If the limb be much mortified, it may be twisted off; otherwise it may be snipped and separated with the scissors.

If the shoulder, by the imprudence and ignorance of the unskilful, who pull, in expectation of delivering in that way, is forced into the vagina, and part of it appears on the outside of the os externum, a vast force is required to return it into the uterus; because, in this case, the shoulder, part of the ribs, breast, and side, are already pulled out of the uterus, which must be extended so, as not only to receive them again, but also the hand and arm of the accoucheur. If this distention cannot possibly be effected, he must fix a crotchet above the sternum, and turn the child by pushing up the shoulder and pulling down with the crotchet; or slide his fingers to the neck of the child, and with the scissors divide the head from the body; then deliver, first, the separated head, or bring along the body by pulling at the arm, or, if need be, with the assistance of the crotchet: after the body is delivered, the head must be extracted according to the rules that will be laid down in Case 6.

When the forehead, face, or ear presents, and cannot be altered with the hand into the natural position; or is not advanced to the os externum, so that we can assist with the forceps; the head must be returned, and the child delivered by the feet: but if this cannot be done, and the woman is in imminent danger, recourse must be had to the crotchet.

C A S E I V.

If the navel-string comes down by the child's head, and the pulsation is felt in the arteries, there is a necessity for turning without loss of time: for, unless the head advances fast, and the delivery is quick, the circulation in the vessels will be entirely obstructed, and the child consequently perish. If the head is low in the pelvis, the forceps may be successfully used.

No doubt, if the pelvis is very narrow, or the head too large, it would be wrong to turn: in that case we ought to try if we can possibly raise the head, so as to reduce the funis above it, and after that let the labour go on. But if the waters are all gone, and a large portion of the funis falls down, it is impossible to raise it, so as to keep it up, even although we could easily raise the head: because, as one part of the funis is pushed up with the fingers, another part falls down, and evades the reduction; and to raise it up to the side, and not above the head, will be to no purpose: when a little jets down at the side of the head, our endeavours will, for the most part, be successful.

C A S E V.

The ancients, as well as some of the moderns, advise, in all cases when the upper parts, such as the shoulders, breast, neck, face, or ear of the child, present, to push them upwards, and bring in the head as in its natural way; observing, that the fetus ought never to be delivered by the feet, except in the presentation of the lower parts, such as the small of the back, belly, side, breech, or legs. Were it practicable at all times to bring the head into the right position, a great deal of fatigue would be saved to the operator, much pain to the woman, and imminent danger to the child: he therefore ought to attempt this method, and may succeed when he is called before the membranes are broken, and feels, by the touch, that the face, ear, or any of the upper parts, presents. In that case, let him open the os externum slowly during every pain;

and when the os internum is sufficiently dilated by the descent of the waters and membranes, let him introduce his hand into the uterus as directed, in Part II. Sect. 3. betwixt the womb and the membranes, which must be broke: and if he finds the head so large, or the pelvis so narrow, that it will be difficult to save the child, provided the woman is vigorous and has strong pains, he may with little difficulty bring in the crown of the head, then withdraw his hand; and, if the pains return and continue, the child has a good chance to be delivered alive. See Part II. Sect. 3. Even after the membranes are broke, if the presenting part has so locked up the os internum as to detain some portion of the waters (a circumstance easily known in pushing up the part that presents) he may easily run up his hand speedily to keep them from being discharged, and act in the same manner: but if the child is not large, nor the pelvis narrow, it were pity, while his hand is in the uterus, to desist from turning the child and bringing it by the feet; because in that case, we may be pretty certain of it. Besides, after the head is brought into the right position, should the pains go off entirely (and this frequently happens, or a flooding comes on, in consequence of the force which hath been exerted) he will find great difficulty in turning after the waters have been discharged; for it is harder to turn when the vertex presents, than in any other position; whereas, in the case of a large head or narrow pelvis, when the head is forced down by the labour-pains, and will not farther advance, the child may be saved by the forceps; nay, though pains do not act so as to force it down to be delivered either by the forceps or in the natural way, the head may be opened and extracted with the crotchet, which is the last resource.

But this necessity seldom occurs, because the cases in which we are most commonly called are after the membranes have been long broken, the waters discharged, and the uterus strongly contracted around the body of the child, which it confines, as it were, in a mould: so that we have frequently tried in vain to bring the head into a natural position; for this cannot be effected without first pushing up the part that presents, for which purpose great force is required and as one hand only can be introduced, when the operator endeavours to bring in the head, the pushing force is abated, to allow the pulling force to act: and the parts that hindered the head from presenting are again forced down; besides, the head is so large and slippery that they can obtain no firm hold. He might, indeed, by introducing a finger into the mouth, lay hold of the under-jaw, and bring in the face, provided the shoulder presents; but instead of amending, this would make the case worse, unless the child be very small: yet, granting the head could be brought into the same natural position, the force necessarily exerted for this purpose would produce a flooding, which commonly weakens the patient and carries off the pains; and after all, he must turn with less advantage; and if that cannot be performed when the head is brought in, he must have recourse to the last and most disagreeable method; whereas, when any other part presents, we can always turn the child, and deliver it by the feet. This we cannot promise, after the head is brought in; and when once the operator's hand is in the uterus, he ought not to run such risks.

When Dr. Smellie first began to practise, he frequently endeavoured to adjust the position of the head in this manner; but meeting with those inseparable difficulties above-mentioned, he adhered to that method which he always found certain and safe. He likewise used the *impellens* of Albucasis, in order to keep up the shoulders or body until he could bring in the head: but the contrivance was always so great that the instrument slipped, and was in danger of hurting the uterus. Indeed, when the ear, forehead, or the fontanel presented, he has, by pushing up, found the head come into the right position: he has likewise, when the forehead was towards the groin or side of the pelvis, moved it more backwards, by which means the forceps were fixed with more ease; but he has much oftener failed, by the head returning to its former situation.

The child is often in danger, and sometimes lost, when the breech presents and is low down in the pelvis, provided the thighs are so strongly pressed against the funis and belly as to stop the circulation in the former; as also when the child is detained by the head after the body is delivered: in both cases, the danger must be obviated by an expeditious delivery; and if the body is entangled in the navel-string, it must be disengaged as well as possible, especially when the funis happens to be between the thighs. As we have before observed, many of these minute directions in laborious and preternatural cases, may be thought idle and trifling by those practitioners who, without minding any stated rules, introduced the forceps, and taking hold of the hand at random, deliver with force and violence; and who, in preternatural deliveries, thrust up their hands into the uterus, and, without considering the position, search for the feet, pull them down, and deliver in a hurry. Such practice may sometimes succeed; but will often destroy the child, and bruise and injure the parts of the mother, even to the hazard of her life.

C A S E VI.

The legs and breech of the child being brought down, and the body properly turned with the fore-parts to the mother's back, let the accoucheur endeavour to bring it along: but if it is detained by the size of the belly, distended with air or water (a case that frequently happens when the child has been dead for several days,

M I D W I F E R Y.

let the belly be opened, by forcing into it the points of his scissars; or he may tear it open with the sharp crotchet.

The body of the child being delivered, the arms brought down, and every method hitherto directed unsuccessfully used for the extraction of the head, which is detained by being naturally too large, over-ossified, or dropical, or from narrowness and distortion of the pelvis; if the belly was not opened, and the child is found to be alive by the motion of the heart, or pulsation of the arteries in the funis, the forceps ought to be tried (see Fig. 38); but if he finds it impracticable to deliver the head so as to save the life of the child, he must, according to some, force the points of the scissars through the lower part of the occipital bone, or through the foramen magnum; then dilate the blades so as to enlarge the opening, and introduce a sharp or blunt hook. This operation rarely succeeds when the head is over-ossified: but may answer the purpose when the bones are soft and yielding, or in the case of an hydrocephalus; because in the first the aperture may sometimes be enlarged, and in the other the water will be evacuated so as to diminish the bulk of the head, which will of consequence come along with more ease. Some recommend an instrument to perforate the skull, with double points curved and joined together; which, when pushed into the foramen, are separated, and take hold on the inside; but as the opening with the scissars and introducing the blunt hook as above, will answer the same end, it is needless to multiply instruments, especially as this method is not so certain as the following.

If, notwithstanding these endeavours, the head cannot be extracted, let the operator introduce his hand along the head, and his fingers through the os uteri; then slide up one of the curved crotchets along the ear, betwixt his hand and the child's head, upon the upper part of which it must be fixed: this being done, let him withdraw his hand, take hold of the instrument with one hand, turning the curve of it over the forehead, and with the other grasp the head and shoulder, then pull along. The crotchet being thus fixed on the upper part, where the bones are thin and yielding, makes a large opening, through which the contents of the skull are emptied; the head collapsing, is with more certainty extracted, and the instrument hath a firm hold to the last, at the forehead, os petrosum, and basis of the skull.

In introducing the crotchet, let the operator observe the greatest degree of caution possible. He must not begin to pull until he is certain that the point of the instrument is properly fixed near the vertex; and he must keep the handle back to the perinaeum. The excellency of Mefnard's contrivance is more conspicuous here than when the head presents; because the curvature of the crotchet allows the point to be fixed on the upper part of the skull, which is to be torn open; and in pulling the contents are evacuated, and the head is lessened. By these means the principal obstruction is removed; whereas the straight crotchet takes so slight a hold, and slips so often, that several times we have been very much fatigued before we could effect the delivery; but have always succeeded to our satisfaction since we adopted the other kind. See the plate of Instruments, Fig. 10, 11, 12, 13.

If one crotchet is found sufficient, let him introduce the other in the same manner along the opposite side, lock and join them together, and pull along, moving and turning the head so as to humour the shape of the pelvis. This method seldom fails to accomplish his aim, though sometimes very great force is required; in which case he must pull with leisure and caution.

C A S E VII.

But if all the expedients should fail, by reason of the extraordinary ossification or size of the head, or the narrowness and distortion of the pelvis, after having used the crotchet without success, he must separate the body from the head with a billory, or pair of scissars; then pushing up the head into the uterus, turn the face to the fundus, and the vertex down to the os internum and brim of the pelvis, let him direct an assistant to press upon the woman's belly with both hands, in order to keep the uterus and head firm in that position; then open the skull with the scissars, destroy the structure of the brain, and extract with the crotchet, as directed above.

The head is sometimes left in the uterus by those practitioners who, not knowing how to turn the fore-parts of the face of the child towards the back-part of the uterus, or how to bring it along, although it presented in that position, pull at random with all their strength, so that the neck is stretched and separated, and the head left behind. This may also happen to an expert accoucheur, when the child hath been dead for many days, and the body is much mortified, even though he hath used all the necessary precautions. In such a case, provided the head is not very large, nor the pelvis narrow, and the forehead is towards the sacrum, let him slide up his hand along the back-part of the pelvis, and, introducing two fingers into the mouth with the thumb below the chin, try to pull the forehead into the hollow of the sacrum: if it sticks at the jutting-in of that bone, he must endeavour to move it first to one side and then to the other. If the head is small, it will come along; if any fragment of the neck remains, or any part of the loose skin, he may lay hold on it, and assist delivery by pulling at it with his other hand; if the head is low down, it may be extracted with the forceps.

Should all these methods fail, let him push up his hand along

the side of the head, until it shall have passed the os internum; with the other hand let him introduce one of the curved crotchets, and fix it upon the upper part of the head; then withdrawing the hand which was introduced, take hold on the instrument, and sliding the fingers of the other hand into the mouth, he must pull down with both, as above directed. If the head is not over-ossified, the crotchet will tear open the skull; and the bulk being of consequence diminished, the whole may be brought along, even in a narrow pelvis; but if it cannot be moved even by this expedient, he must introduce the other crotchet along the other side of the head, and fixing it upon the skull, lock them together; then, in pulling, turn the forehead down into the hollow of the sacrum, and extract with a half-round turn upwards, as when delivering with the forceps.

If the forehead is towards the os pubis, and cannot be brought into the right position, let him, with his hand, push up the head into the uterus, turn the forehead from the interior to the side or back-part of it, and try to extract as before. If the child hath been dead some time, and is much mortified, he must pull cautiously at the under jaw, because, should that give way, he will have no other hold for pulling or keeping the head steady, when he attempts to extract with one crotchet.

As great difficulties may occur from inflammations of the puerpera, contraction of the uterus, slipperiness or largeness of the head, and the narrowness of the pelvis, it will not be improper to inform the reader of other methods that appear to us useful, particularly when the parts are much contracted and swelled. Let the hand be introduced into the vagina; and if it cannot be admitted within the uterus, the fingers being infirmated, may move the head so as to raise the face and chin to the fundus, the vertex being turned to the os internum, and the forehead towards the side of the sacrum. This being effected, let the operator slide up along one ear a blade of the long forceps, which are much curved to the side (see Fig. 20, 38) then change hands, and send up the other blade along the opposite ear; when they are locked, and the handles secured by a fillet, he must pull the head as low as it will come, then putting them into the hands of an assistant, who will keep them in that position, let him make a large opening with the scissars, squeeze the head with great force, and extract slowly and by degrees.

There is an old instrument, with two sides, which turn on a pivot, formerly recommended in this case, and since improved, with the addition of another side, by Mr. Leveret, who gives it the denomination of *tire-tête*; but as Dr. Smellie thought the contrivance was too complex, and the blades too much confined to a circular motion, he altered the form of it in a manner that renders it more simple, convenient, and less expensive. Having turned down the vertex as above directed, let this instrument, with the three sides joined together, be introduced along the accoucheur's hand to the upper part of the head; then let the sides or blades be opened with the other hand so as to inclose the head, moving them circularly and lengthwise in a light and easy manner, that they may pass over the inequalities of the scalp, and avoid the resistance of the head and uterus: when they are exactly placed at equal distances from one another, let him join the handles, withdraw his hand, and, tying them together with a fillet, pull down, open, and extract, as above directed; and let it be remembered, that the farther the hand can be introduced into the uterus, the more easily will both instruments be managed.

When the pelvis is large, or the head small (in which cases this misfortune seldom happens) without doubt we might succeed with Mauriceau's broad fillet or sling, provided it could be properly applied: but, upon trial, Dr. Smellie found his hand so much cramped by the contraction of the uterus, and was so much incommoded by the slipperiness of the head, that he could not fix it so as to have sufficient hold, and that after many fruitless efforts he was obliged to have recourse to the scissars and crotchets.

Amand's net is attended with the same difficulties; and rather more troublesome, as it is more compounded: for, when it is mounted on the operator's hand, it will be found scarcely practicable to bring over the head a narrow fillet by which it is pulled along, because it commonly slides off from one side to the other. If the placenta adheres to the uterus, let him first extract the head; if the cake is separated and in his way, let him deliver it before he begins to deliver the head. When the head is small, or the pelvis large, dilating the foramen magnum with the scissars, and introducing the blunt hook, may be of use either to pull the head along or keep it down, until we can fix the forceps, curve-crotchet, or Leveret's *tire-tête*.

SECT. V. The CÆSARIAN OPERATION.

When the woman cannot be delivered by any of the methods hitherto described and recommended in laborious and preternatural labours, on account of the narrowness or distortion of the pelvis, into which it is sometimes impossible to introduce the hand; or from large excrescences and glandular swellings, that fill up the vagina, and cannot be removed; or from large cicatrices and adhesions in that part, and at the os uteri, which cannot be separated; in such emergencies, if the woman is strong, and of a good habit of body, the Cæsarian operation is certainly advisable, and ought to be performed; because the mother and child have no other chance to be saved, and it is better to have recourse to an operation which

M I D W I F E R Y.

hath sometimes succeeded, than leave them both to inevitable death. Nevertheless, if the woman is weak, exhausted with fruitless labour, violent floodings, or any other evacuation, which renders her recovery doubtful, even if she were delivered in the natural way; in these circumstances it would be rashness and presumption to attempt an operation of this kind, which ought to be delayed until the woman expires, and then immediately performed, with a view to save the child.

The operation has been performed both in this and the last century, and sometimes with such success that the mother has recovered, and the child survived. The previous steps to be taken are to strengthen the patient, if weak, with nourishing broths and cordials; and if the bladder is distended with urine, to draw it off with a catheter. These precautions being taken, she must be laid on her back, on a couch or bed, her side on which the incision is to be made being raised up by pillows placed below the opposite side: the operation may be performed on either side; though the left is commonly preferred to the right, because in this last the liver extends lower. The apparatus consists of a bistory, probe-scissors, large needles threaded, sponges, warm-water, pledgets, a large tent of dofsil, compresses, and a bandage for the belly.

If the weather is cold, the patient must be kept warm, and no part of the belly uncovered except that on which the incision is to be made; if the operator be a young practitioner, the place may be marked by drawing a line along the middle-space between the navel and the os ilium, about six or seven inches in length, slanting forwards towards the left groin, and beginning as high as the navel. According to this direction, let him hold the skin of the abdomen tense between the finger and the thumb of one hand, and with the bistory in the other make a longitudinal incision through the cutis to the membrana adiposa, which, with the muscles, must be slowly dissected and separated, until he reaches the peritonæum, which must be divided very cautiously, for fear of wounding the intestines that frequently start up at the sides, especially if the membranes are broken, the waters discharged, and the uterus contracted.

The peritonæum being laid bare, it may be either pinched up by the fingers, or slowly dissected with the bistory, until an opening is made sufficient to admit the fore-finger, which must be introduced as a director for the bistory, or scissors, in making an effectual dilatation. If the intestines push out, let them be pressed downwards, so as that the uterus may come in contact with the opening. If the womb is still distended with the waters, and at some distance from the child, the operator may make upon it a longitudinal incision at once; but if it is contracted close round the body of the fœtus, he must pinch it up, and dilate in the same cautious manner practised upon the peritonæum, taking care to avoid wounding the Fallopian tubes, ligaments, and bladder; then introducing his hand he may take out the child and secundines. If the woman is strong, the uterus immediately contracts, so as that the opening, which at first extended to about six or seven inches, is reduced to two, or less; and in consequence of this contraction, the vessels being shrunk up, a great effusion of blood is prevented. The coagulated blood being removed, and what is still fluid sponged up, the incision in the abdomen must be stitched with the interrupted suture, and sufficient room left between the last sitch and the lower end of the opening, for the discharge of the moisture and extravasated fluid. The wound may be dressed with dry pledgets or dofsils dipped in some liquid balsam, covered with compresses, moistened with wine, and a bandage to keep on the dressings and sustain the belly. Some authors observe that the cutis and muscles only should be taken up in the suture, lest bad symptoms should arise from stitching the peritonæum.

The woman must be kept in bed, as quiet as possible, and every thing administered to promote the lochia, perspiration, and sleep; which will prevent a fever and other dangerous symptoms. If she hath lost a great quantity of blood from the wounds in the uterus and abdomen, so as to be in danger from inanition, broths, caudles, and wine, ought to be given in small quantities, and frequently repeated; and the *Cort. Peruvian.* administered in powder, decoction, or extract, may be of great service in this case. For farther information on this subject, the reader may consult Ruffetus, the Memoirs of the Academy of Surgeons at Paris, and Heister's Surgery.

PART VIII. TWINS, MONSTERS, AND METHOD OF DELIVERING THE PLACENTA.

SECT. I. TWINS.

Twins are supposed to be the effect of a double conception in one coition, when two or more ova are impregnated with as many animalcula; which descending from the ovarium, through the Fallopian tube, into the fundus uteri, as they increase, come in contact with that part, and with one another, and are so pressed as to form a globular figure, and stretch the womb into the same form which it assumes when distended by one ovum only; and that, during the whole term of uterine gestation, it is impossible to distinguish twins, either by the figure or magnitude of the uterus, or by the motion of the different fœtuses: for one child, when it is large, and surrounded with a great quantity of waters, will sometimes produce as large a prominence (or even larger) in the woman's belly, than is commonly observed when she is big with

twins. One child will also, by moving its legs, arms, and other parts of its body, against different parts of the uterus, at the same instant or by intervals, yield the same sensation to the mother as may be observed in two or more children; for part of the motion in twins is employed on each other, as well as upon the uterus.

There is therefore no certain method of distinguishing in these cases, until the first child is delivered, and the accoucheur has examined if the placenta is coming along. If this comes of itself, and after its extraction the mouth of the womb be left contracted, and the operator is unwilling to give unnecessary pain by introducing his hand into the uterus; let him lay his hand upon the woman's abdomen, and if nothing is left in the womb, he will generally feel it, just above the os pubis, contracted into a firm round ball, of the size of a child's head, or less; whereas, if there is another child left, the size will be found much larger. If the placenta does not come down before the second child, which is frequently the case, upon examining, he will commonly feel the membranes, with the waters, pushed down through the os uteri; or, if they are broken, the head or some part of the body will be felt. If, therefore, the woman has strong pains, and is in no danger from floodings or weakness, provided the head presents fair, and seems to come along, she will be delivered of this also in the natural way. If the membranes are not broken, if the head does not immediately follow, or if the child present wrong, he ought to turn and bring it immediately by the feet, in order to save the patient the fatigue of a second labour, that may prove tedious and even dangerous by enfeebling her too much. Besides, as the parts are fully opened by the first delivery, he can introduce his hand with ease; and as the membranes are for the most part whole, the waters may be stopped up, and the fœtus easily turned, as in Part VI. Sect. II. but if the pelvis is narrow, the woman strong, and the head presents, he ought to leave it to the efforts of nature.

If the first child presents wrong, and in turning that he feels another, he must beware of breaking the membranes of one while he is at work upon the other: but should they chance to be broke, and the legs of both entangled together (though this is seldom the case, because they are commonly divided by two sets of membranes) let the operator, when he has got hold of two legs, run up his fingers to the breech, and feel if they belong to the same body; and, one child being delivered, let the other be turned and brought out in the same manner. If there are more than two, the same method must take place, in extracting one after another.

In case of twins, the placenta of the first seldom comes along until the second child is delivered: but as this does not always happen, he ought, as formerly directed, to certify himself that there is nothing left in the uterus, when the cake comes of itself. Both children being delivered, let him extract both placentas, if they come not of themselves; and if they are joined together, forming but one mass, they may be delivered at once, as in Part V. Sect. VII. Twins, for the most part, lie diagonally in the uterus, one below the other; so that they seldom obstruct one another at the os internum. See Fig. 15.

SECT. II. MONSTERS.

Two children joined together by their bellies (which is the most common case of monstrous births) or by the sides, or when the belly of the one adheres to the back of the other, having commonly but one funis, are comprehended in this class, and supposed to be the effect of two animalcula impregnated by the same ovum, in which they grow together, and are nourished by one navel-string, originally belonging to the secundines; because the vessels pertaining to the coats of the veins and arteries do not anastomose with the vessels belonging to the fœtus.

In such a case, where the children were small, the adhesion hath been known to stretch in pulling at the feet of one, so as to be delivered; and the other hath been afterwards brought along in the same manner, without the necessity of separation. When the accoucheur is called in a case of this kind, if the children are large, and the woman come to her full time, let him first attempt to deliver them by that method: but if, after the legs and part of the body of the first are brought down, the rest will not follow, let him slide up his hand, and with his fingers examine the adhesion; then introducing the scissors between his hand and the body of the fœtus, endeavour to separate them by snipping through the juncture. Should this attempt fail, he must diminish the bulk in the best manner he can think of, and bring the body of the first, in different pieces, by pulling or cutting them asunder, as he extracts with the help of the crotchet.

No certain rules can be laid down in these cases, which seldom happen; and therefore a great deal must be left to the judgment and sagacity of the operator, who must regulate his conduct according to the circumstances of the case, and according to the directions given for delivering when the pelvis is narrow and the children extraordinarily large. Formerly, practitioners used straight and crooked knives, with long handles, which were introduced into the uterus along the hand, in order to cut and divide the bodies of children, that they might be extracted piecemeal: and this cruel practice obtained even in some cases which we can now manage with ease and safety by turning and delivering the fœtus by the feet. But, no doubt, some will happen in which it is impossible to preserve or deliver the children without the help of instruments: and

M I D W I F E R Y.

and, in such an emergency, the scissars are much safer than knives; with which the operator runs the risk of cutting the uterus or himself; whereas he is exposed to no such hazard from the other, which cut only betwixt the points.

SECT. III. *Delivering the PLACENTA.*

The funis being separated, and the child committed to the nurse, the next care is to deliver the placenta and membranes, if they are not forced down by the labour-pains. We have already observed, that, if there is no danger from a flooding, the woman may be allowed to rest a little, in order to recover from the fatigue she has undergone; and that the uterus may, in contracting, have time to squeeze and separate the placenta from its inner surface: during which pause also, about one, two, or three cupfuls of blood are discharged through the funis from the vessels of the placenta, which is thus diminished in bulk, so that the womb may be more contracted; and this is the reason for applying one ligature only upon the cord. In order to deliver the placenta, take hold of the navel-string with the left-hand, turning it round the fore and middle fingers, or wrapping it in a cloth, that it may not slip from your grasp; then pull gently from side to side, and desire the woman to assist your endeavour, by straining as if she were at stool, blowing forcibly into her hand, or provoking herself to retch, by thrusting her finger into her throat. If, by these methods, the placenta cannot be brought away, introduce your hand slowly into the vagina, and feel for the edge of the cake, which, when you have found, pull it gradually along; as it comes out at the os externum, take hold of it with both hands and deliver it, bringing away, at the same time, all the membranes, which, if they adhere, must be pulled along with leisure and caution.

When the funis takes its origin towards the edge of the placenta, which is frequently the case, the cake comes easier off by pulling, than when the navel-string is inserted in the middle, unless it be uncommonly retained by its adhesion to the womb, or by the strong contraction of the os internum. If the funis is attached to the middle of the placenta, and that part presents to the os internum or externum, the whole mass will be too bulky to come along in that position: in this case you must introduce two fingers within the os externum, and bring it down with its edge foremost.

If, instead of finding the edge or middle of the placenta presenting to the os externum or internum, you feel the mouth of the womb closely contracted, you must take hold of the navel-string as before-directed, and slide your other hand along the funis into the vagina; then slowly push your fingers and thumb, joined in form of a cone, through the os uteri, along the same cord, to the place of its insertion in the placenta: here let your hand rest, and feel with your fingers to what part of the uterus the cake adheres; if it be loose at the lower edge, try to bring it along; but if it adheres, begin and separate it slowly, the back of your hand being turned to the uterus, and the fore part of your fingers towards the placenta; and, for this operation, the nails ought to be cut short and smooth. In separating, press the ends of your fingers more against the placenta than the uterus; and if you cannot distinguish which is which, because both feel soft (though the uterus is firmer than the placenta, and this last more solid than coagulated blood) in this case slide down your fingers to its edge, and conduct them by the separated part, pressing it gently from the uterus, until the whole is disengaged. Sometimes, when part of it is separated, the rest will loosen and come along, if you pull gently at the detached portion; but if this is not effected with ease, let the whole of it be separated in the most cautious manner: sometimes, also, by grasping the inside of the placenta with your hand, the whole will be loosened without further trouble. As the placenta comes along, slide down your hand and take hold of the lower edge, by which it must be extracted, because it is too bulky to be brought away altogether in a heap; and let it be delivered as whole as possible, keeping your thumb or fingers fixed upon the navel-string, by which means laceration is often prevented.

When the woman lies on her back, and the placenta adheres to the left side of the uterus, it will be most commodious to separate the cake with the right-hand; whereas the left-hand is most conveniently used when the placenta adheres to the right-side of the womb; but when it is attached to the fore part, back, or fundus, either hand will answer the purpose.

When, therefore, the placenta adheres to the fundus, and all the lower part of the womb is strongly contracted, the hand must be forced up, in form of a cone, into the vagina, and then gradually dilate the os internum and inferior part of the uterus. If great force is required, exert it slowly, resting between whiles, that the hand may not be cramped, nor the vagina in danger of being torn from the womb; for, in this case, the vagina will lengthen considerably upwards.

While you are thus employed, let an assistant press with both hands on the woman's belly, or, while you push with one hand, press with the other, in order to keep down the uterus, else it will rise high up, and roll about like a large ball, below the lax parietes of the abdomen, so as to hinder you from effecting the necessary dilatation.

When you have overcome this contraction, and introduced your hand into the fundus, separate and bring the placenta along, as above-directed; and should the uterus be contracted in the middle

like an hour-glass, a circumstance that sometimes, though rarely, happens, the same method must be practised. In every case, and especially when the placenta hath been delivered with difficulty, introduce your hand after its extraction, in order to examine if any part of the uterus be pulled down and inverted; and if that be the case, push it up and reduce it without loss of time; then clear it of the coagulated blood, which otherwise may occasion violent after-pains.

For the most part, in ten, fifteen, or twenty minutes, more or less, the placenta will come away of itself; and though some portion of it, or of the membranes, be left in the uterus, provided no great flooding ensues, it is commonly discharged in a day or two, without any detriment to the woman; but, at any rate, if possible, all the secundines ought to be extracted at once, and before you leave your patient, in order to avoid reflections.

We find that, both amongst the ancients and moderns, there have been different opinions and directions about delivering the placenta: some alleging, that it should be delivered slowly, or left to come of itself; others, that the hand should be immediately introduced into the uterus, to separate and bring it away. Before we run into extremes on either side, it should be considered how nature of herself acts in these cases. We find, in the common course of labours, that, not once in fifty or a hundred times there is any thing more to be done than to receive the child. Some of the ancients have alleged, that no danger happens, on this account, oftener than once in one thousand labours: and as nature is, for the most part, sufficient of itself in such cases, it is very rare, perhaps not once in twenty or thirty times, that we have occasion to separate, as it generally comes down by the common assistance of pulling gently at the funis, and the efforts of the woman. We also find that the mouth of the womb is as easily dilated some hours after delivery, as at any other time: so, in our opinion, we ought to go in the middle way, never to assist but when we find it necessary; on the one hand, not to torture nature, when it is self-sufficient; nor delay it too long, because it is possible that the placenta may sometimes, though seldom, be retained several days; for if the uterus should be inflamed, from any accident, and the woman be lost, the operator will be blamed for leaving the after-birth behind.

PART IX.

MANAGEMENT OF NEW-BORN CHILDREN, WITH THE DISEASES TO WHICH THEY ARE SUBJECT.

SECT. I. *How to tie the FUNIS UMBILICALIS, or NAVEL-STRING.*

If the air does not immediately rush into the lungs, and the circulation continues between it and the placenta, the operation of tying and cutting must be delayed, and every thing tried to stimulate, and sometimes to give pain. If the circulation is languid, respiration begins with difficulty, and proceeds with long intervals; and if it be entirely stopped in the funis, the child, if alive, is not easily recovered: sometimes many minutes are elapsed before it begins to breathe. Whatever augments the circulating force, promotes respiration; and as this increases, the circulation grows stronger; so that they mutually assist each other. In order to promote the one and the other, the child is kept warm, moved, shaken, whipped; the head, temples, and breast rubbed with spirits; garlic, onion, or mustard, applied to the mouth and nose; and the child has been sometimes recovered by blowing into the mouth with a silver canula, so as to expand the lungs.

When the placenta is itself delivered, immediately or soon after the child, by the continuance of the labour-pains, or hath been extracted by the operator, that the uterus may contract so as to restrain too great a flooding; in this case, if the child has not yet breathed, and a pulsation is felt in the vessels, some people (with good reason) order the placenta, and as much as possible of the navel-string, to be thrown into a basin of warm wine or water, in order to promote the circulation between them and the child; others advise us to lay the placenta on the child's belly, covered with a warm cloth; and a third set order it to be thrown upon hot ashes; but of these, the warm water seems the most innocent and effectual expedient. Nevertheless, if the placenta is still retained in the uterus, and no dangerous flooding ensues, it cannot be in a place of more equal warmth while the operator endeavours, by the methods before described, to bring the child to life.

Different practitioners have used different methods of performing this operation: some proposing to tie and separate the funis before the placenta is delivered; to apply one ligature close to the belly of the child, with a view to prevent a rupture of the navel; and making another two inches above the former, to divide the rope between the two tyings: by the second ligature they mean to prevent a dangerous hæmorrhage from the woman, provided the placenta adheres to the uterus. But all these precautions are founded upon mistaken notions; and the following is that which is easiest and best: If the placenta is not immediately delivered by the pains, and no flooding obliges you to hasten the extraction, the woman may be allowed to rest a little, and the child to recover. If the child does not breathe, or the respiration is weak, let the methods before-prescribed be put in practice, with a view to stimulate the circulation; but if the child is lively, and cries with vigour, the funis may be immediately tied in this manner: having provided a ligature or two, composed of sundry threads waxed together,

M I D W I F E R Y.

gether, so as to equal the diameter of a packthread; being seven inches in length, and knotted at each end, tie the navel-string about two fingers' breadth from the belly of the child, by making, at first, one turn, if the funis be small, securing it with two knots; but if the cord be thick, make two more turns, and another double knot: then cut the funis, with a pair of sharp scissars, one finger's breadth from the ligature towards the placenta; and, in cutting, run the scissars as near as possible to the root of the blades, else the funis will be apt to slip from the edge, and you will be obliged to make several snips before you can effect a separation: at the same time, guard the point of the scissars with your other hand. The child being washed, a linen rag is wrapped round the tied funis; which being doubled up along the belly, a square compress is laid over it, and kept firm, or moderately tight, with what the nurses call a *belly-band* or *roller* round the body.

This portion of the funis soon shrinks, turns first livid, then black, and about the fifth day falls off close to the belly: it will always drop off at the same place: so that ruptures in the navel seldom or never depend upon the tying of the funis, but may happen when the compress and belly-band are not kept sufficiently firm, and continued some time after the separation of the withered portion, especially in those children that cry much: the bandage ought always to be applied so slight as not to affect respiration. The ligature upon the funis must always be drawn so tight as to shut up the mouths of the vessels; therefore, if they continue to pour out their contents, another ligature must be applied below the former; for if this precaution be neglected, the child will soon bleed to death: yet if the navel-string is cut or torn asunder at two or three hand-breadths from the belly, and exposed to the cold without any ligature, the arteries will contract themselves, so that little or no blood shall be lost; nay, sometimes, if the funis hath been tied and cut at the distance of three finger-breadths from the child's belly, so that it hath been kept from bleeding for an hour or two, although the ligature be then untied, and the navel-string and belly chafed and foked in warm water, no more blood will be discharged.

SECT. II. *Washing and Dressing the Child.*

The child being delivered, the navel-string tied and cut, a warm cloth or flannel-cap put on its head, and its body wrapped in a warm receiver, it may be given to the nurse or an assistant, in order to be washed clean from that scurf which sometimes covers the whole scarf-skin, and is particularly found upon the hairy scalp, under the arm-pits, and in the groins. This ablution is commonly performed with warm water, mixed with a small quantity of Hungary water, wine, or ale, in which a little pomatum or fresh-butter hath been dissolved. This composition cleans all the surface, and the oily part, by mixing with, and attenuating, the mucus, prepares it for the linen-cloth, which dries and wipes off the whole: nevertheless milk and water, or soap and water, is preferable to this mixture. In laborious or preternatural cases, when considerable force hath been used in delivering the child, the whole body ought to be examined; and if there is any mark or contusion on the head, it will disappear, if anointed with pomatum, and gently rubbed or chafed with the accoucheur's hand: if any limb is dislocated or broken, it ought to be reduced immediately: luxations, though they seldom happen, are more incident to the shoulder than to any other part, the humerus being easily dislocated, and as easily reduced. The bones of the arm and thigh are more subject to fracture than any other of the extremities: the first is easily cured, because the arm can be kept from being moved; but a fracture in the thigh-bone is a much more troublesome case, because, over and above the difficulty of keeping the bones in a proper situation, the part is often necessarily moved in cleaning the child. In this case, the best method is to keep the child lying on one side, after the thigh hath been secured by a proper bandage, so that the nurse may change the cloth without moving the part; and to lay it upon bolsters or pillows, raised above the wet-nurse, that it may suck with greater freedom: if any of the bones are bent, they may be brought into their proper form by a slow, gentle, and proper extension.

During the time of washing and dressing the child, it ought to be kept moderately warm, especially in the head and breast, that the cold air may not obstruct perspiration; the head and body ought to be kept moderately tight with the clothes, for the convenience of handling, and to prevent its catching cold, especially if the child be weakly; but if it be vigorous and full-grown, it cannot be too loosely clothed, because the brain, thorax, and abdomen, suffer by too great compression. The clothing of newborn children ought also to be suitable to the season of the year and the nature of the weather; the extremes of cold and heat being avoided, as equally hurtful and dangerous. Instead of the many superfluous inventions of nurses, and those who make clothes for children, with a view to make an expensive and pompous appearance, the dress ought to be contrived with all imaginary simplicity: the child being washed, the navel-string secured, and the head covered with a linen or woollen cap, as already directed, a shirt and waistcoat may be put on the body, and over it a flannel-skirt or petticoat, open before, with a broad head-band, as commonly used, or rather a waistcoat joined to it, so as that they can be put on at once: this ought to be rather tied than pinned before;

and, instead of two or more blankets, may be covered with a flannel or fustian gown; while the head is accommodated with another cap, adorned with as much finery as the tire-woman shall think proper to bestow.

In short, the principal aim of this point is to keep the child's head and body neither too tight nor too slovenly, too hot nor too cold; that it may be warm, though not over-heated; and easy, though not too loose; that respiration may be full and large; that the brain may suffer no compression; and that, while the child is awake, the legs may be at liberty: to reject all unnecessary rollers, cross-cloths, neck-cloths, and blankets; and to use as few pins as possible; and those that are absolutely necessary with the utmost caution.

SECT. III. *How to manage when any of the common Passages are locked up, or the Tongue tied.*

When the child cannot make water, because the passage is filled up with mucus; after having unsuccessfully practised the common methods of holding the belly near the fire, and rubbing the parts with *ol. ruta*, &c. we must introduce a probe, or very small catheter, along the urethra into the bladder; an operation much more easily performed in female than in male children.

In boys, the prepuce alone is sometimes imperforated; in which case an opening is easily made. But if there is no passage in the urethra, or even through the whole length of the glans, all that can be done is to make an opening with a lancet or bistory, near the mouth or sphincter of the bladder, in the lower part of the urethra, where the urine, being obstructed, pushes out the parts in form of a tumour; or, if no such tumefaction appears, to perforate the bladder above the pubes with a trocar: this, however, is a wretched and ineffectual expedient, and the other can but at best lengthen out a miserable life. If the anus is imperforated, and the faeces protrude the parts; or if it be covered with a thin membrane, and a bluish or livid spot appears, the puncture and incision commonly succeed: but when the rectum is altogether wanting, or impervious for a considerable way, the success of the operation is very uncertain: nevertheless it ought to be tried, by making an artificial anus with a bistory, remembering the course of the rectum, and the entry in both sexes. For further information on this subject, Mauriceau's and Saviard's Observations, and the Memoirs of the Academy of Surgeons, may be consulted.

In female children there is a thin membrane, in form of a crescent, called the *hymen*, that covers the lower part of the orifice of the vagina, and is rent in the first coition. The middle of it is sometimes attached to the lower part of the meatus urinarius, and on each side of the bridge is a small opening that will only admit the end of a probe, though it is sufficient for the discharge of the menses. This obstruction is commonly unknown till marriage, and hath often proved fatal to the unfortunate woman, who had concealed it through excess of modesty, and afterwards sunk into a deep melancholy, which cost her her life, rather than submit to inspection, and the easy cure of having the attachment snipt with a pair of scissars. On this consideration, Saviard advises all accoucheurs to inspect this part in every female child they deliver: and if there should be such a defect, to remedy it during her childhood: or, if the entry is wholly covered with the membrane, let a sufficient perforation be made, which will prevent great pain and tension in their riper years, when the menses, being denied passage, would accumulate every month, and at last push out this and the neighbouring parts, in form of a large tumour, the cause of which is generally unknown until it be opened.

Sometimes a thin membrane, rising from the under part of the mouth, stretches almost to the tip of the tongue, bracing it down, so as to hinder the child from taking hold of the nipple and sucking. This disorder, which is called *tongue-tying*, is easily remedied by introducing the fore-finger into the child's mouth, raising up the tongue, and snipping the bridle with a pair of scissars. If, instead of a thin membrane, the tongue is confined by a thick fleshy substance, the safest method is to direct the nurse to stretch it frequently and gently with her finger; or, if it appears like a soft fungus, to touch it frequently and cautiously with lunar caustic or Roman vitriol: but we ought to take care that we are not deceived by an inflammation, that sometimes happens in the birth, from the accoucheur's helping the head along with his finger in the child's mouth.

SECT. IV. *Mould-shot Heads, Contusions, and Excoriations.*

In laborious and lingering labours, the child's head is often long confined, and so compressed in the pelvis, that the bones of the upper part of the cranium are squeezed together, and ride over one another in different manners, according as the head presented. If the ossa parietalia rise over the os frontis, the case is called the *mould-shot*; if over the occiput, it goes by the name of the *horse-shoe-mould*. When the fontanel presents (though this is seldom the case) and is pushed down, the form of the head is raised up in the shape of a hog's back; whereas, in the former case, the vertex or crown of the head presented, and the whole was turned from a round to a very long figure. If the head is kept long in the pelvis, and the child not destroyed by the compression of the brain, either before, or soon after delivery, it commonly retains more or less of the shape acquired in that situation, according to the strength or weakness of the child. When the bones begin to ride over one another in this manner, the hairy scalp is felt lax and wrinkled; but,

M I D W I F E R Y.

but, by the long pressure and obstruction of the circulating fluids, it gradually swells, and forms a large tumour.

In these cases, when the child is delivered, we ought to allow the navel-string, at cutting, to bleed from one to two or three spoonfuls, especially if the infant be vigorous and full grown; and to provoke it by whipping and stimulating; for the more it cries, the sooner and better are the bones of the cranium forced outwards into their natural situation: or, if the head hath not been long compressed, and is not much inflamed, we can sometimes, with our hands, reduce it into its pristine shape. The meconium ought also to be purged off as soon as possible, to give freer scope to the circulating fluids in the abdomen, and make a revulsion from the surcharged and compressed brain. This may be effected with suppositories, clysters, repeated doses of *ol. amygdal. d.* mixed with *pulv. rhubarb. or de althæa, or syr. de cichæro, cum rheo.*

If the child is seized with convulsions soon after delivery, in consequence of this compression, and the vessels of the navel-string have not been allowed to bleed, the jugular-vein ought immediately to be opened, and from one to two ounces of blood taken away; an operation easily performed in young children: the urine and meconium must be discharged, and a small blister applied between the scapulae. When the scalp is bruised, inflamed, or swelled, let it be anointed or embrocated with a mixture of *ol. chamomel. acet.* and *spt. camphorat.* and cerates and poultices applied to the parts.

If the tumefaction is large, and we feel a considerable fluctuation of extravasated fluids, which cannot be taken up by the absorbent vessels, assisted with those applications, the tumour must be opened; though generally there is no occasion for a large incision, because, after the fluid is once discharged, the hollow scalp, by gentle pressure, is more easily joined in children than in older subjects. When the head is misshapen, it should not be bound or pressed, but left lax and easy; lest, the brain being compressed, convulsions should ensue.

The body of the child is sometimes covered all over with little red spots, called the *red-gum*, and commonly proceeding from the costiveness of the child, when the meconium hath not been sufficiently purged off at first. And here it will not be improper to observe, that, as the whole tract of the colon is filled with this viscid excrement, which hath been gradually accumulated for a considerable time; and as the small intestines, stomach, and gullet, are lined with a glary fluid or mucus; the child ought to take no other nourishment than pap as thin as whey, to dilute this fluid, for the first two days; or, indeed, till it sucks the mother's milk, which begins to be secreted about the third day, and is at first sufficiently purgative to discharge these humours, and better adapted for the purpose than any artificial purge.

If the mother's milk cannot be had, a nurse lately delivered is to be found; and if the purgative quality of her milk is decreased, she must be ordered to take repeated small doses of manna or lenitive electuary, by which it will recover its former virtue, and the child be sufficiently purged. If the child is brought up by hand, the food ought to imitate, as near as possible, the mother's milk: let it consist of loaf-bread and water boiled up together, in form of panada, and mixed with the same quantity of new cow's milk; and sometimes with the broth of fowl or mutton. When the child is colicky, two drachms of manna, or from two to four grains of rhubarb, may be given: and when the stools are green and curdled, it will be proper to absorb the prevailing acid with the testaceous powders, such as the *chel. cancror. simp.* or *test. ostrear.* given from the quantity of ten grains to a scruple: and for this purpose the *magnesia alba* is recommended, from one to two drachms a-day; as being both opening and absorbent. The red-gum may likewise proceed from the officiousness of the nurse, by which the scarf-skin hath been abraded or rubbed off; in which case the child must be bathed in warm milk, and the parts softened with pomatum: the same bath may also be used daily in the other kind, and the belly kept open with the aforementioned medicines; with which some syrup, tincture, or powder of rhubarb, may be mixed, or given by itself, if the stools are of a greenish hue.

Excoriations behind the ears, in the neck, and groin of the child, are sometimes, indeed, unavoidable in fat and gross habits; but most commonly proceed from the carelessness of the nurse, who neglects to wash and keep the parts clean; they are, however, easily dried up and healed, with *unguent. alb. pulv. e cerussa,* or fullers' earth. Yet we ought to be cautious in applying drying medicines behind the ears, because a discharge in that part frequently prevents worse diseases.

SECT. V. The APHTHA, or THRUSH.

The aphtha, or thrush, is a disease to which new-born children are frequently subject, and is often dangerous when neglected at the beginning. This disease proceeds from weakness and laxity of the contracting force of the stomach and intestines, by which the accented food is not digested; and from a defect in the necessary secretion of bile, with which it ought to be mixed. This prevailing acid in the primæ viæ produces griping and loose green stools, that weaken the child more and more, deprives it of proper nourishment and rest, and occasions a fever from inanition and irritation. The smallest vessels at the mouths of the excretory ducts in the mouth, gullet, stomach, and intestines, are obstructed and

ulcerated in consequence of the child's weakness, and acrimonious vomitings, belchings, and stools, and little foul ulcers are formed. These first appear in small white specks on the lips, mouth, tongue, and at the fundament: they gradually increase in thickness and extent; adopt a yellow colour, which, in the progress of the distemper, becomes dusky, and the watery stools (called the *watery gripes*) become more frequent. The whole inner surface of the intestines being thus ulcerated and obstructed, no nourishment enters the lacteal vessels; so that the weakness and disease are increased, the milk and pap, which are taken in at the mouth, pass off curdled and green, the child is more and more enfeebled, and the brown colour of the aphtha declares a mortification and death at hand. Sometimes, however, the aphthæ are unattended by the watery stools; and sometimes these last are unaccompanied with the aphtha.

In order to prevent this fatal catastrophe, at the first appearance of the disorder we ought to prescribe repeated doses of testaceous powders, to absorb and sweeten the predominant acid in the stomach, giving them from ten to twenty grains in the pap, twice or three times a day; and on every third night, from three to five grains of the *pulv. rhei, julap. e Creta;* oily and anodyne clysters, with epithems to the stomach, may also be administered. When these and every other prescription fail, the child, if not much weakened, is sometimes cured by a gentle vomit, consisting of *pulv. ipecacuan.* gr. j. given in a spoonful of barley-water, and repeated two or three times, at the interval of half an hour between each. When the child is much enfeebled, the *oleo-faccharum cinnamomi* or *anisi*, mixed with the pap, is sometimes serviceable. If the milk is either too purgative or binding, the nurse should be changed, or take proper medicines to alter its quality; or, if the child has been brought up by hand, woman's milk may be given on this occasion, together with weak broths; but if the child cannot suck, the milk of cows, mares, or asses, may be substituted in its room, diluted with barley-water.

SECT. VI. TEETHING.

Children commonly begin to breed their fore-teeth about the seventh, and sometimes not before the ninth month; nay, in some the period is still later. Those who are healthy and lax in their bellies, undergo dentition easier than such as are of a contrary constitution. When the teeth shoot from their sockets, and their sharp points begin to work their way through the periosseum and gums, they frequently produce great pain and inflammation, which, if they continue violent, bring on feverish symptoms and convulsions, that often prove fatal. In order to prevent these misfortunes, the swelled gum may at first be cut down to the tooth, with a bistory or fleam; by which means the patient is often relieved immediately: but if the child is strong, the pulse quick, the skin hot and dry, bleeding at the jugular will be also necessary, and the belly must be kept open with repeated clysters. On the other hand, if the child is low, sunk, and emaciated, repeated doses of *Spt. C. C. Tinct. Fulgin.* and the like, may be prescribed; and blisters applied to the back, or behind the ears.

PART X.

Of the MANAGEMENT of Women from the Time of their Delivery to the End of the Month, with the several DISEASES to which they are subject during that Period.

SECT. I. The EXTERNAL APPLICATION.

The woman being delivered of the child and placenta, let a soft linen cloth, warmed, be applied to the external parts: and if she complains much of a smarting soreness, some pomatum may be spread upon it. The linen that was laid below her, to sponge up the discharges, must be removed, and replaced with others that are clean, dry, and warm. Let her lie on her back, with her legs extended close to each other; or upon her side, if she thinks she can lie easier in that position, until she recovers from the fatigue: if she is spent and exhausted, let her take a little warm wine or caudle, or, according to the common custom, some nutmeg and sugar grated together in a spoon: the principal design of administering this powder, which, among the good women, is seldom neglected, is to supply the want of some cordial draught, when the patient is too weak to be raised, or supposed to be in danger of retchings from her stomach being overloaded. When she hath in some measure recovered her strength and spirits, let the cloths be removed from the parts, and others applied in their room; and if there is a large discharge from the uterus, let the wet linen below her be also shifted, that she may not run the risk of catching cold.

When the patient is either weak or faintish, she ought not to be taken out of bed, or even raised up to have her head and body shifted, until she is a little recruited; otherwise she will be in danger of repeated faintings, attended with convulsions, which sometimes end in death. To prevent these bad consequences, her skirt and petticoat ought to be loosened and pulled down over the legs, and replaced by another, well warmed, with a broad head-band to be slipped in below, and brought up over her thighs and hips: a warm double cloth must be laid on the belly, which is to be surrounded by the head-band of the skirt pinned moderately tight over the cloth, in order to compress the viscera and the relaxed parietes of the abdomen, more or less, as the woman can easily bear it; by which means the uterus is kept firm in the lower part of the abdomen, and prevented from rolling from side to side when the patient is turned; but the principal end of this compression is to hinder

MIDWIFERY.

too great a quantity of blood from rushing into the relaxed vessels of the abdominal contents; especially when the uterus is emptied all of a sudden by a quick delivery. The pressure being thus suddenly removed, the head is all at once robbed of its proportion of blood, and the immediate revulsion precipitates the patient into dangerous lypothemia.

For this reason, the belly ought to be firmly compressed by the hands of an assistant, until the bandage is applied; or, in lieu of it, a long towel, sheet, or roller, to make a suitable compression: but for this purpose different methods are used in different countries, or according to the different circumstances of the patient. The head-clothes and shift ought also to be changed, because, with sweating in time of labour, they are rendered wet and disagreeable. Several other applications are necessary when the external and internal parts are rent or inflamed, misfortunes that sometimes happen in laborious and preternatural cases.

The directions for ordering the bed in time of labour, and of the applications after delivery, are absolutely necessary to be known by young practitioners; because all these precautions are for the ease and safety of the patient when attended by unexperienced nurses.

CASE I.

Inflammations of the labia pudendi, rectum, urethra, vagina, and uterus, chiefly happen when the head, shoulder, breech, or any other part of the fetus, hath been forced into the pelvis, and long detained in that situation; so that, by many strong pains, the delivery was effected, or great force and violence were required to turn or extract the child. These inflammations, if slight, are commonly relieved, or altogether resolved, by a plentiful discharge of the lochia, rest, and profuse sweating; but if violent, bleeding, warm fomentations, cataplasms, and emollient clysters, may be necessary; though the first and last must be used with caution. If the pressure hath been so great as totally to obstruct the circulating fluids in those parts, a mortification ensues; either total, by which the woman is soon destroyed; or partial, when the mortified parts separate and cast off in thick sloughs, then digest, and are healed as a common sore.

CASE II.

If, in consequence of the long pressure of the child's head at that part of the vagina where its outward surface is attached to the back and under part of the bladder, the mortification affects the coats of the vesica urinaria, as well as those of the vagina, when the sloughs fall off, the urine will pass that way, and hinder the opening (if large) from being closed; this is an inexpressible inconvenience and misfortune to the poor woman, both from the smell and continual wetting her clothes. The vagina and bladder may also be lacerated by the forceps, crochet, or any other instrument imprudently forced up: but, in that case, the urine is immediately discharged through the wound; whereas, in a mortification, it comes off in a natural way, until the slough begins to separate and fall off. As soon as this misfortune is known, the cure ought to be attempted: this (according to some) consists in keeping a flexible catheter always in the bladder, that the urine may be continually solicited to come through the urethra rather than through the vagina: but if this precaution hath been neglected, and the lips of the ulcer are turned callous, we are directed to pare them off with a curved knife, buttoned at the point, or consume them with a lunar caustic; and, if the opening is large, to close it with a double sitch, keeping the flexible catheter to the bladder until it is entirely filled up: but we wish this operation may not be found impracticable.

CASE III.

The os externum is frequently torn, particularly at the perinaeum; and sometimes the laceration reaches to the anus. At other times (but more seldom) both vagina and rectum are torn for the space of two or three inches upwards, and the two form but one cavity at the lower part. The laceration is frequently occasioned from the excessive largeness of the child's head; from the rigidity of the fibres in women who are near the borders of forty when their first child is born: from the accoucheur's neglecting to slide the perinaeum over the head when it is forcibly propelled by the pains, or from his omitting to keep up the head with the flat of his hand, that it may not come too suddenly along; from too great violence used in laborious or preternatural labours; and from the operator's incautious manner of thrusting in his hand. If the laceration be small, the part soon heals up, and the only inconvenience attending the wound is a smarting after making water; and when the laceration is large, extending to the edge of the sphincter ani, or even farther, this pain is still more troublesome, and increased upon the least motion, by the friction of the lips against each other.

In the third case, it is supposed that there is an absolute necessity to make, as soon as possible, two, three, or sometimes four, deep stitches through the torn vagina and rectum, the knots being tied in the vagina, and two more stitches in the perinaeum, to assist the reunion of the parts; for if the sphincter ani is entirely separated, and continues in that condition, the patient can seldom retain her excrements for any length of time. If this misfortune should remain unknown, or the operation unperformed, on account of the woman's weakness, until the lips of the wound are grown callous,

these callous edges must be pared off with scissars; or, if that should be found impracticable, scarified with the point of a lancet or bistory, and then stitched as before directed: and the stitches must be made very deep, otherwise they will not hold; because there is but little muscular flesh in the vagina and rectum: but the colon ought first to be emptied with clysters, and the patient take little or no solid food, that the stitches may not be overstrained when she goes to stool. When the laceration reaches so high as to endanger the woman's retentive faculty, this method, doubtless, ought to be tried; but not otherwise, because the operation very rarely succeeds.

SECT. II. Air, Diet, Sleeping and Watching, Motion and Rest, Retention and Excretion, and Passions of the Mind.

Although we cannot remove the patient immediately after delivery into another climate, we can qualify the air, so as to keep it in a moderate and salutary temper, by rendering it warm or cold, moist or dry, according to the circumstances of the occasion. With regard to diet, women in time of labour, and even till the ninth day after delivery, ought to eat little solid food, and none at all during the first seven days: let them drink plentifully of warm diluting fluids, such as barley-water, gruel, chicken-water, and teas; caudles are also commonly used, composed of water-gruel boiled up with mace and cinnamon, to which, when strained, is added a third or fourth part of white wine, or less, if the patient drinks plentifully, sweetened with sugar to her taste: this composition is termed *white caudle*; whereas, if ale is used instead of wine, it goes under the name of *brown caudle*. In some countries, eggs are added to both kinds; but in that case, the woman is not permitted to eat meat or broths till after the fifth or seventh day: in this country, however, as eggs are not part of the ingredients, the patient is indulged with weak broth sooner, and sometimes allowed to eat a little boiled chicken. But all these different preparations are to be prescribed weaker or stronger, with regard to the spices, wine, or ale, according to the different constitutions and situations of different patients: for example, if she is low and weak, in consequence of an extraordinary discharge of any kind, either before or after delivery, or if the weather is cold, the caudles and broths may be made the stronger; but if she is of a full habit of body, and has the least tendency to a fever, or if the season is excessive hot, these drinks ought to be of a very weak consistence, or the patient restricted to gruel, tea, barley and chicken water, and these varied according to the emergency of the case.

Her food must be light and easy of digestion, such as panada, biscuit, and sago: about the sixth or seventh day, she may eat a little boiled chicken, or the lightest kind of young meat; but these last may be given sooner or later according to the circumstances of the case, and the appetite of the patient. In the regimen, as to eating and drinking, we should rather err on the abstemious side, than indulge the woman with meat and strong fermented liquors, even if these last should be most agreeable to her palate; for we find by experience that they are apt to increase or bring on fevers, and that the most nourishing and salutary diet is that which we have above prescribed. Every thing that is difficult of digestion, or quickens the circulating fluids, must of necessity promote a fever; by which the necessary discharges are obstructed, and the patient's life endangered.

As to the article of sleeping and watching, the patient must be kept as free from noise as possible, by covering the floors and stairs with carpets and cloths, oiling the hinges of the doors, silencing the bells, tying up the knockers, and, in noisy streets, strewing the pavement with straw: if, notwithstanding these precautions, she is disturbed, her ears must be stuffed with cotton, and opiates administered to procure sleep; because watching makes her restless, prevents perspiration, and promotes a fever. Motion and rest are another part of the non-naturals to which we ought to pay particular regard. By tossing about, getting out of bed, or sitting up too long, the perspiration is discouraged and interrupted; and in this last attitude the uterus, not yet fully contracted, hangs down, stretching the ligaments, occasioning pain, cold shivering, and a fever: for the prevention of those bad symptoms, the patient must be kept quiet in bed till after the fourth or fifth day, and then be gently lifted up in the bed-clothes, in a lying posture, until the bed can be adjusted, into which she must be immediately reconveyed, there to continue, for the most part, till the ninth day; after which period women are not so subject to fevers as immediately after delivery. Some there are who, from the nature of their constitution, or other accidents, recover more slowly; and such are to be treated with the same caution after as before the ninth day, as the case seems to indicate. Others get up, walk about, and recover, in a much shorter time; but these may, some time or other, pay dearly for their foolhardiness, by encouraging dangerous fevers; so that we ought rather to err on the safe side, than run any risk whatsoever.

What next comes under consideration is the circumstance of retention and excretion. We have formerly observed, that in time of labour, before the head of the child is locked into the pelvis, if the woman has not had easy passage in her belly that same day, the rectum and colon ought to be emptied by a clyster, which will assist the labour, prevent the disagreeable excretion of the faeces before the child's head, and enable the patient to remain two or

M I D W I F E R Y.

or three days after without the necessity of going to stool. However, should this precaution be neglected, and the patient very colive after delivery, we must beware of throwing up stimulating clysters, or administering strong cathartics, lest they should bring on too many loose stools, which, if they cannot be stopt, sometimes produce fatal consequences, by obstructing the perspiration and lochia, and exhausting the woman, so as that she will die all of a sudden; a catastrophe which hath frequently happened from this practice. Wherefore if it be necessary to empty the intestines, we ought to prescribe nothing but emollient clysters, or some very gentle opener, such as manna, or *Elect. Lenitivum*.

But no excretion is of more consequence to the patient's recovery than a free perspiration; which so is absolutely necessary, that unless she has a moisture continually on the surface of her body for some days after the birth, she seldom recovers to advantage: her health, therefore, in a great measure, depends upon her enjoying undisturbed repose, and a constant breathing sweat, which prevents a fever, by carrying off the tension, and assists the equal discharge of the lochia; and when these are obstructed, and a fever ensues, with pain and restlessness, nothing relieves the patient so effectually as rest and profuse sweating, procured by opiates and sudorifics at the beginning of the complaints; yet these last must be more cautiously prescribed in excessive hot, than in cool weather.

The last of the non-naturals to be considered are the passions of the mind, which also require particular attention. The patient's imagination must not be disturbed by the news of any extraordinary accident which may have happened to her family or friends; for such information hath been known to carry off the labour-pains entirely, after they were begun, and the woman has sunk under dejection of spirits: and, even after delivery, these unreasonable communications have produced such an anxiety as obstructed all the necessary excretions, and brought on a violent fever and convulsions, that ended in death.

SECT. III. Violent FLOODINGS.

All women, when the placenta separates, and after it is delivered, lose more or less red blood, from the quantity of half a pound to that of one pound or even two; but should it exceed this proportion, and continue to flow without diminution, the patient is in great danger of her life. This hazardous hæmorrhage is known by the violence of the discharge, wetting fresh cloths as fast as they can be applied; from the pulse becoming low and weak, and the countenance turning pale: then the extremities grow cold; she sinks into faintings; and, if the discharge is not speedily stopped or diminished, is seized with convulsions, which often terminate in death.

This dangerous efflux is occasioned by every thing that hinders the emptied uterus from contracting; such as, great weakness and lassitude, in consequence of repeated floodings before delivery: the sudden evacuation of the uterus; sometimes, though seldom, it proceeds from part of the placenta being left in the womb: it may happen when there is another child or more still undelivered; when the womb is kept distended with a large quantity of coagulated blood; or when it is inverted by pulling too forcibly at the placenta.

In this case, as there is no time to be lost, and internal medicines cannot act so suddenly as to answer the purpose, we must have immediate recourse to external application. If the disorder be owing to weakness, by which the uterus is disabled from contracting itself, so that the mouths of the vessels are left open; or though contracted a little, yet not enough to restrain the hæmorrhage of the thin blood: or if in separating the placenta, the accoucheur has scratched or torn the inner surface or membrane of the womb; in these cases, such things must be used as will assist the contractile power of the uterus, and hinder the blood from flowing into it and the neighbouring vessels: for this purpose, cloths dipped in any cold astringent fluid, such as oxycerate, or red tart wine, may be applied to the back and belly. Some prescribe venesection in the arm, to the amount of five or six ounces, with a view of making revulsion: if the pulse is strong, this may be proper; otherwise, it will do more harm than good. Others order ligatures, for compressing the returning veins at the hams, arms, and neck, to retain as much blood as possible in the extremities and head. Besides these applications, the vagina may be filled with tow or linen rags dipped in the abovementioned liquids, in which a little alum or saccharum saturni hath been dissolved: nay, some practitioners inject proof-spirits warmed, or, foking them up in a rag or sponge, introduce and squeeze them into the uterus, in order to constrict the vessels.

If the floodings proceed from another child, the retention of the placenta, or coagulated blood, these ought immediately to be extracted; and if there is an inversion of the uterus, it must be speedily reduced. Should the hæmorrhage, by these methods, abate a little, but still continue to flow, though not in such a quantity as to bring on sudden death, some red wine and jelly ought to be prescribed for the patient, who should take it frequently, and a little at a time; above all things, chicken or mutton broths, administered in the same manner, for fear of overloading the weakened stomach, and occasioning retchings: these, repeated in small quantities, will gradually fill the exhausted vessels and keep up the circulation. If the pulse continues strong, it will be proper to order repeated

draughts of barley-water, acidulated with elixir of vitriol: but if the circulation be weak and languid, extract of the bark, dissolved in *Aq. Cinnamoni tenuis*, and given in small draughts, or exhibited in any other form, will be serviceable; at the same time, lulling the patient to rest with opiates. These, indeed, when the first violence of the flooding is abated, if properly and cautiously used, are generally more effectual than any other medicine.

SECT. IV. The AFTER-PAINS.

After-pains commonly happen when the fibrous part of the blood is retained in the uterus or vagina, and formed into large clots, which are detained by a sudden contraction of the os internum and externum, after the placenta is delivered: or, if these should be extracted, others will sometimes be formed, though not so large as the first, because the cavity of the womb is continually diminishing after the birth. The uterus, in contracting, presses down those coagulums to the os internum; which being again gradually stretched, produces a degree of labour-pains, owing to the irritation of its nerves: in consequence of this uneasiness, the woman squeezes the womb as in real labour; the force being increased, the clots are pushed along, and when they are delivered she grows easy. The larger the quantity is of the coagulated blood, the severer are the pains, and the longer they continue.

Women in the first child seldom have after-pains; because, after delivery, the womb is supposed to contract, and push off the clots with greater force in the first than in the following labours: after-pains may also proceed from obstructions in the vessels, and irritations at the os internum. In order to prevent or remove these pains as soon as the placenta is separated and delivered, the hand being introduced into the uterus, may clear off the coagula. When the womb is felt, through the parietes of the abdomen, larger than usual, it may be taken for granted that there is either another child, or a large quantity of clotted blood: and which soever it may be, there is a necessity for its being extracted. If the placenta comes away of itself, and the after-pains are violent, they may be alleviated and carried off by an opiate: for, by sleeping and sweating plentifully, the irritation is removed, the evacuations are increased, the os uteri is insensibly relaxed, and the coagula slide easily along. When the discharge of the lochia is small, the after-pains, if moderate, ought not to be restrained; because the squeezing which they occasion promotes the other evacuation, which is necessary for the recovery of the patient. After-pains may also proceed from an obstruction in some of the vessels, occasioning a small inflammation of the os internum and ligaments; and the squeezing thereby occasioned may not only help to propel the obstructing fluid, but also (if not too violent) contribute to the natural discharges.

SECT. V. Of the LOCHIA.

When the large vessels of the uterus are emptied immediately after delivery, the discharge frequently ceases for several hours, until the fluids in the smaller vessels are propelled into the larger, and then begins to flow again, of a paler colour.

The red colour of the lochia commonly continues till the fifth day, though it is always turning more and more serous from the beginning; but, about the fifth day, it flows of a clear, or sometimes (though seldom) of a greenish tint: for the mouths of the vessels, growing gradually narrower by the contraction of the uterus, at last allow the serous part only to pass. As for the greenish hue, it is supposed to proceed from a dissolution of the cellular or cribriform membrane or mucus that surrounded the surface of the placenta and chorion; part of which, being left in the uterus, becomes livid, decays, and, dissolving, mixes with and tinctures the discharge as it passes along.

Though the lochia commonly continue to the eighteenth or twentieth day, they are every day diminished in quantity, and soonest cease in those women who suckle their children, or have had an extraordinary discharge at first; but the colour, quantity, and duration, differ in different women; in some patients, the red colour disappears on the first or second day; and in others, though rarely, it continues, more or less, to the end of the month: the evacuation in some is very small, in others excessive: in one woman it ceases very soon; in another, flows during the whole month: yet all these patients shall do well.

The space that is occupied before delivery, from being six inches in diameter, or eighteen inches in circumference, will, soon after the birth, be contracted to one third or fourth of these dimensions.

The discharge of the lochia being so different in women of different constitutions, and besides in some measure depending upon the method of management and the way of life peculiar to the patient, we are not to judge of her situation from the colour, quantity, and duration of them, but from other symptoms that attend the discharge: and if the woman seems hearty, and in a fair way of recovery, nothing ought to be done with a view to augment or diminish the evacuation. If the discharge be greater than she can bear, it will be attended with all the symptoms of inanition; but as the lochia seldom flow so violently as to destroy the patient of a sudden, she may be supported by a proper nourishing diet, assisted with cordial and restorative medicines. Let her, for example, use broths, jellies, and asses-milk; if the pulse is languid and sunk, she may take repeated doses of the *Confec. Cardiac.* with mixtures composed of the cordial waters and volatile spirits. Subastringents and opiates

M I D W I F E R Y .

opiates, frequently administered, with the *Cort. Peruv.* in different forms, and austere wines, are of great service. On the other hand, when the discharge is too small, or hath ceased altogether, the symptoms are more dangerous, and require the contrary method of cure; for now the business is to remove a too great plenitude of the vessels in and about the uterus, occasioning tension, pain, and labour, in the circulating fluids; from whence proceed great heat in the part, restlessness, fever, a full hard quick pulse, pains in the head and back, nausea, and difficulty of breathing. These complaints, if not at first prevented, or removed by rest and plentiful sweating, must be treated with venesection and the antiphlogistic method.

When the obstruction is recent, let the patient lie quiet, and encourage a plentiful diaphoresis, by drinking frequently of warm, weak, diluting fluids; such as water-gruel, barley-water, tea, or chicken-broth: she may likewise take opiates and sudorifics, in different forms, as may be agreeable to the stomach. *Theriac. Androm.* from ʒss to ʒj. *Laud. liquid.* from gut. x. to gut. xx. *Pilul. Japonac.* from gr. v. to gr. x. or *Syr. de Meconio.* from ʒss to ʒj. These may be repeated occasionally, with other forms of opiates; and if they fail to procure rest and sweating, the following diaphoretics, without opium, ought to be administered.

℞ *Pulv. Contrayerv. Cam.* ʒss. *Pulv. Castor Ruff. Sal. Succin.* āā. gr. v. *Syr. Croci.* q.s.s. *Bolus statim sumendus cum haust. sequent. et repetat. quarta vel sexta quaque hora ad tres vices vel ut opus fuerit.*

℞ *Aq. Cinnamon. ten.* ʒiʒs. *cum Spiritu. Syr. Croci.* āā. ʒij. *Add. Sal. Vol. C. C.* gr. iv. m.

Should these methods be used without success, and the patient, far from being relieved by rest, plentiful sweating, or a sufficient discharge of the obstructed lochia, labours under a hot dry skin, anxiety, and a quick hard and full pulse, the warm diaphoretics must be laid aside; because if they fail of having the desired effect, they must necessarily increase the fever and obstruction, and recourse be had to bleeding at the arm or ankle, to more or less quantity, according to the degree of fever and obstruction, and this evacuation must be repeated as there is occasion. When the obstruction is not total, it is supposed more proper to bleed at the ankle than at the arm; and at this last, when the discharge is altogether stopped. Her ordinary drink ought to be impregnated with nitre, and the following draughts, or others of the same kind, prescribed.

℞ *Sal. Absynth.* ʒj. *Succ. Limon.* ʒss. *Aq. Cinnamon. simp.* ʒiʒs. *Pul. Contrayerv. Comp.* ʒj. *Sacch. Alb.* q.s.s. *Haustus statim sumendus, et quarta vel sexta quaque hora repetendus.*

SECT. VI. THE MILK-FEVER.

About the fourth day, the breasts generally begin to grow turgid and painful. We have formerly observed, that during the time of uterine gestation, the breasts in most women gradually increase till the delivery, growing softer as they are enlarged by the vessels being more and more filled with fluids; and by this gradual distention they are prepared for secreting the milk from the blood after delivery. During the two or three first days after parturition, especially when the woman has undergone a large discharge, the breasts have been sometimes observed to subside and grow flaccid; and about the third or fourth day, when the lochia begin to decrease, the breasts swell again to their former size, and stretch more and more, until the milk, being secreted, is either sucked by the child, or frequently of itself runs out at the nipples.

Most of the complaints incident to women after delivery proceed either from the obstruction of the lochia in the uterus, or of the milk in the breast, occasioned by any thing that will produce a fever; such as catching cold, long and severe labour, eating food that is hard of digestion, and drinking fluids that quicken the circulation of the blood in the large vessels; by which means the smaller, with all the secretory and excretory ducts, are obstructed.

If she is costive, emollient and gently opening clysters may be occasionally injected; and the breasts must be fomented, and sucked either by the mouth or pipe-glasses. If by these means the fever is abated, and the necessary discharges return, the patient commonly recovers; but if the complaints continue, the antiphlogistic method must still be pursued. If notwithstanding these efforts the fever is not diminished or removed by a plentiful discharge of the lochia from the uterus, the milk from the breasts, or by a critical evacuation by sweat, urine, or stool, and the woman is every now and then attacked with cold shiverings, an abscess or abscesses will probably be formed in the uterus or neighbouring parts, or in the breasts; and sometimes the matter will be translated to the other situations, and the seat of it foretold from the parts being affected with a violent pain; these abscesses are more or less dangerous, according to the place in which they happen, the largeness of the suppuration, and the good or bad constitution of the patient.

If, when the pains in the epigastric region are violent, and the fever increased to a very high degree, the patient should all of a sudden enjoy a cessation from pain without any previous discharge or critical eruption, the physician may pronounce that a mortification is begun; especially if at the same time the pulse becomes low, quick, wavering, and intermitting: if the woman's countenance, from being florid, turns dusky and pale, while she herself, and all the attendants conceive her much mended; in that case, she will grow delirious, and die in a very short time.

What we have said on this subject regards that fever which proceeds from the obstructed lochia, and in which the breasts may likewise be affected; but the milk-fever is that in which the breasts are originally concerned, and which may happen though the lochia continue to flow in sufficient quantity; nevertheless they mutually promote each other, and both are to be treated in the manner already explained in the former section; namely, by opiates, diluents, and diaphoretics, in the beginning; and these prescriptions failing, the obstructions must be resolved by the antiphlogistic method described before. The milk-fever alone, when the uterus is not concerned, is not so dangerous, and much more easily relieved. Women of a healthy constitution, who suckle their own children, have good nipples, and whose milk comes freely, are seldom or never subject to this disorder, which is more incident to those who do not give suck, and neglect to prevent the secretion in time, or, when the milk is secreted, take no measures for emptying their breasts. This fever likewise happens to women who try too soon to suckle, and continue their efforts too long at one time; by which means the nipples, and consequently the breasts, are often inflamed, swelled, and obstructed.

In order to prevent too great turgescency in the vessels of the breasts, and the secretion of milk, in those women who do not choose to suckle, it will be proper to make external applications of those things which, by their pressure and repulsive force, will hinder the blood from flowing in too great quantity to this part, which is now more yielding than at any other time: for this purpose, let the breasts be covered with *Emp. de minio*, *Diapalma*, or *Emp. simp.* spread upon linen, or cloths dipped in camphorated spirits, be frequently applied to these parts and the arm-pits; while the patient's diet and drink are of the slightest kind, and given in small quantities. Notwithstanding these precautions, a turgescency commonly begins about the third day; but by rest, moderate sweating, and the use of these applications, the tension and pain will subside about the fifth or sixth day, especially if the milk runs out at the nipples: but if the woman catches cold, or is of a full habit of body, and not very abstemious, the tension and pain increasing, will bring on a cold shivering, succeeded by a fever; which may obstruct the other excretions, as well as those of the breast.

In this case, the sudorifics recommended in the former section must be prescribed; and if a plentiful sweat ensues, the patient will be relieved; at the same time the milk must be extracted from the breasts by sucking with the mouth or glasses. Should these methods fail, and the fever increase, she ought to be bled in the arm: and, instead of the external application hitherto used, emollient liniments and cataplasms must be substituted, in order to soften and relax. If in spite of these endeavours the fever proceeds for some days, the patient is frequently relieved by critical sweats, a large discharge from the uterus, millary eruptions, or loose stools mixed with milk, which is curdled in the intestines. But should none of these evacuations happen, and the inflammation continue with increasing violence, there is danger of an imposthume, which is to be brought to maturity, and managed like other inflammatory tumours; and no astringents ought to be applied, lest they produce scirrhus swellings in the glands.

As the crisis of this fever, as well as of that last described, often consists in millary eruptions over the whole surface of the body, but particularly on the neck and breasts, by which the fever is carried off, nothing ought to be given which will either greatly increase or diminish the circulating force, but such only as will keep out the eruptions. But if, notwithstanding the eruptions, the fever, instead of abating, is augmented, it will be necessary to diminish its force, and prevent its increase by those evacuations before mentioned. On the contrary, should the pulse sink, the eruptions begin to retreat inwardly, and the morbid matter be in danger of falling upon the viscera, we must endeavour to keep them out, by such opiates and sudorific medicines as we have already prescribed in obstructions of the lochia; and here blisters may be applied with success. On this subject Sir David Hamilton and Hoffman may be consulted.

SECT. VII. THE PROLAPsus VAGINA, RECTUM, and UTERUS.

When the head of the child is long retained about the middle of the vagina, the lower part of that sheath sometimes swells, and, as the head comes farther down, is pushed out at the os externum, occasioning great difficulty in delivering the woman: sometimes also the lower part of the rectum is protruded through the sphincter ani, especially if the patient is troubled with the inward piles. The cure of both these complaints consists in reducing the prolapsus: if this cannot be done immediately in the last, on account of the swelling of the protruded part, emollient fomentations and poultices must be used, in order to remove the inflammation. When it is reduced, the woman must be confined more than usual to her bed; and if that part falls down again in consequence of her straining at stool or in making water, it must be reduced occasionally; as she recovers strength the complaints will in all probability vanish; otherwise astringent fumigations or fomentations must be used. If the disorder be of long duration, pessaries, adapted to the part, whether vagina or rectum, must be applied.

A prolapsus uterus may happen from the same causes, or from any

the
not
sons
will
part,
pur-
ma,
rated
pins;
and
ns, a
rell,
nition
if the
or is
n and
by a
those

ection
patient
tracted
should
looded
o used,
order to
ceeds
sweats,
fe stools
should
continue
which
lamina-
ell they

d, often
ie body,
er is car-
eatly in-
will keep
he fever,
diminish
ore men-
tions be-
langer of
n out, by
rescribed
e applied
Hollman

M, and

the middle
es swells,
the os ex-
e woman:
ed through
with the in-
is in reduc-
in the hall,
ollient to-
ove the in-
be confined
wn again in
ter, it multi-
e complaint
nigations of
ng duration
m, must be

ses, or from
any



*Anatomical Tables, illustrative of the Theory and Practice
(of Midwifery. See the System.)*

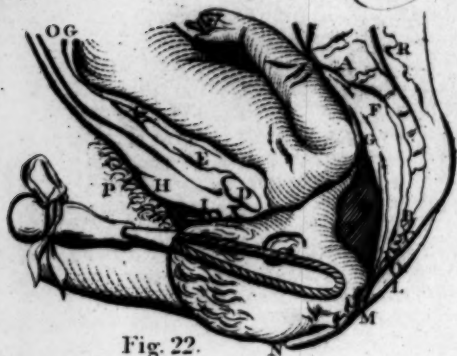


Fig. 22.



Fig. 37.

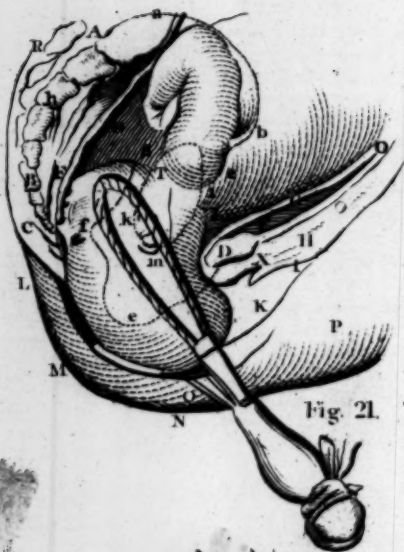


Fig. 21.

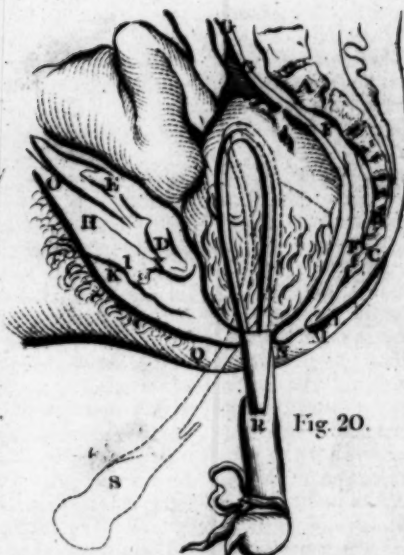


Fig. 20.



Fig. 19.



Fig. 29.



Fig. 27.



Fig. 24.



Fig. 39.



Fig. 38.



*Anatomical Tables, illustrative of the Theory and Practice
of Midwifery. See the System.*

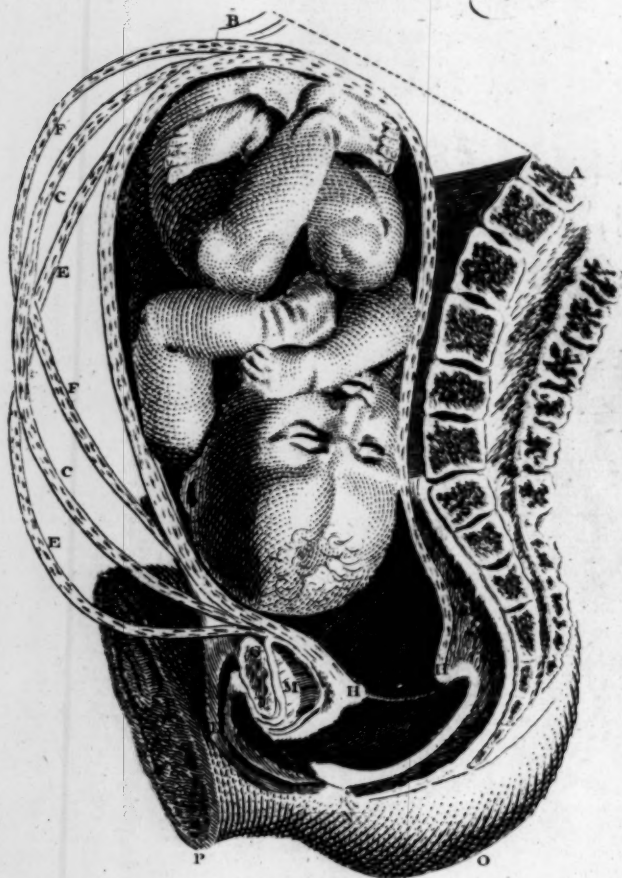


Fig. 16.



Fig. 17.

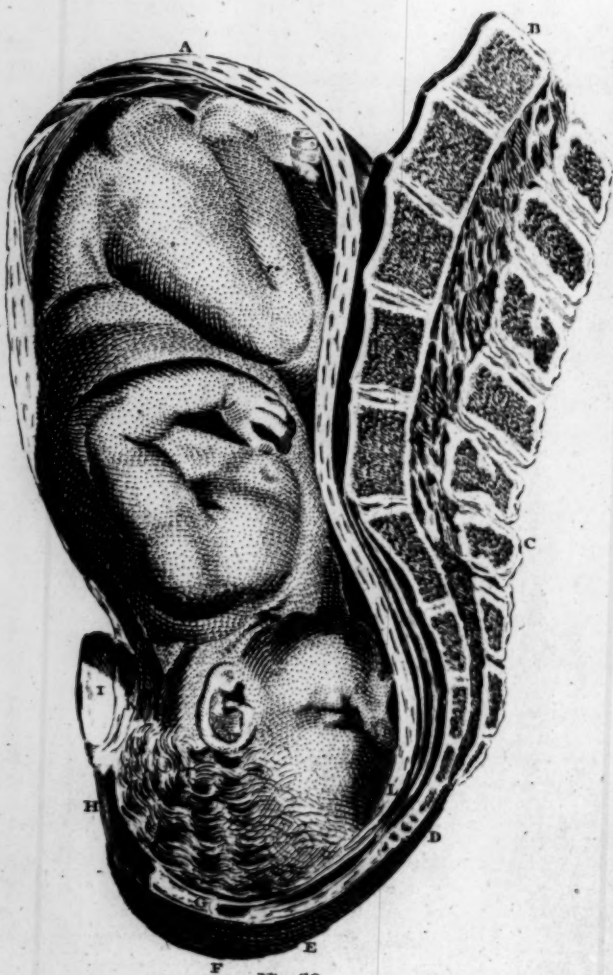


Fig. 18.



Fig. 23.

Reduced from Smellie's Tables, by Frederick Birnie, Anatomical Draughtsman to the late Dr. William Hunter, & Engraved by William Taylor.

Engraved for Hall's Encyclopedia, & Printed for C. Cook, No. 17, Paternoster Row.



*Anatomical Tables, illustrative of the Theory and Practice
of Midwifery. See the System.*



Fig. 25.



Fig. 26.



Fig. 28.



Fig. 33.

Reduced from Smellie's Tables by Frederick Birnie, Anatomical Demonstrator to the late Dr. William Hunter, and Engraved by William Taylor.

Entered for Hall's Encyclopedia, & Printed for C. Cooke, No. 27, Paternoster Row.

(*Anatomical Tables illustrative of the Theory and Practice*)
of Midwifery. See the System.

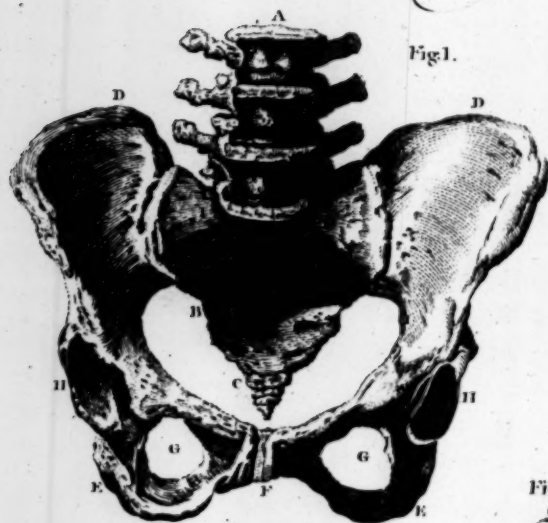


Fig. 1.

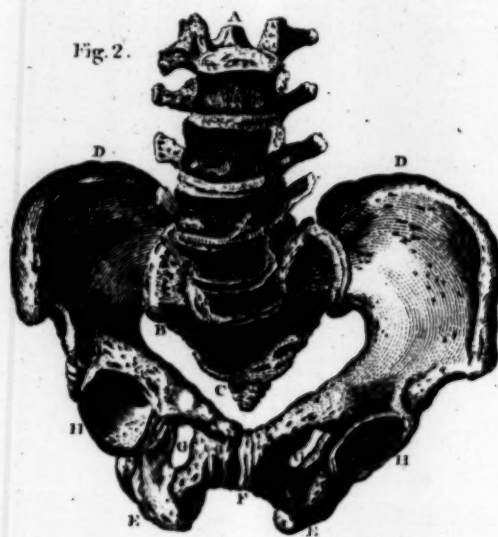


Fig. 2.



Fig. 6.

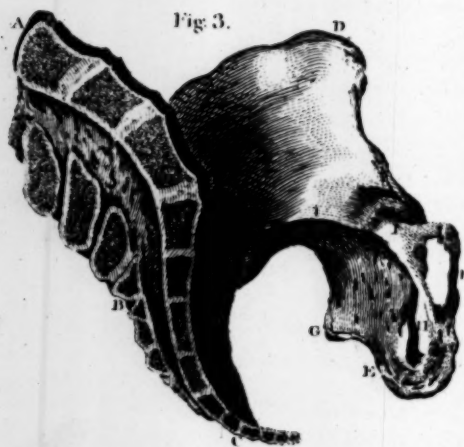


Fig. 3.



Fig. 5.



Fig. 7.



Fig. 4.



Fig. 8.



Fig. 9.

M I D W I F E R Y.

any thing that will too much relax the ligament and peritonæum, by which the womb is suspended; such as an inveterate fluor albus, that, by its long continuance and great discharge, weakens the womb and all the parts. This misfortune, when it proceeds from labour, does not appear till after delivery, when the uterus is contracted to its small size; nay, not for several weeks or months after that period, until by its weight the os externum is gradually stretched wider and wider, so as to allow the womb to slip through it; and in this case it descends covered with the vagina, that comes down along with it, and hangs between the thighs: though the os tincæ only can be perceived on account of this covering, the shape and substance of the uterus may be easily distinguished.

As this prolapsus comes on gradually, the woman of herself can (for the most part) reduce and keep it up while in bed; but when she rises and walks, it will fall down again. When the complaint is not of long standing, and the womb does not come altogether through the os externum, the patient may be cured by astrigent injections: and in the next pregnancy, when the upper part of the uterus is distended so as to fill the pelvis and rise above its brim, the os internum will be raised higher in the vagina: and after delivery, if the woman is confined to her bed for twenty or thirty days, the ligaments generally contract so as to keep up the womb, and prevent any future prolapsus. But when the complaint is of long continuance; when the uterus and vagina descend quite through the os externum, and by the friction in walking, occasioned by the vagina rubbing against the thighs, and the os uteri upon the cloths that are used for supporting it, an inflammation, excoriation, and ulceration, are produced, inviting a greater flux of fluids to the part; these symptoms, joined with a fluor albus from the inside of the uterus, destroy the hope of a second impregnation, or cure by injections; and we can only promise to palliate the disease, by reducing the uterus and keeping it up with a pessary; by which means, used for a length of time, the parts will recover their tone, and the disease be radically cured.

If the uterus be so much inflamed that it cannot be reduced, generally evacuations must be prescribed, and fomentations and poultices applied in order to diminish its bulk, so as that it may be replaced. For this complaint, different kinds of pessaries have been used; some of the globular form; others that open with a spring, as described in the Medical Essays of Edinburgh. But those most in use are of a flat form, with a little hole in the middle, and made of cork waxed over, ivory, box, ebony, lignum vitæ, of a triangular, quadrangular, oval, or circular shape. Those that are circular seem best to answer the intention, because we can more easily introduce a large one of that than of any other figure; it lies more commodiously in the vagina; and, as it always tilts a little upwards and downwards, never hinders the passage of the urine or faeces: these instruments, however, ought to be larger or smaller, according to the laxity or rigidity of the os externum.

There is a pessary lately invented at Paris, which hath an advantage over all others; because the woman can introduce it in the morning, and take it out at night: it is supported and kept in the vagina by a small stalk, the lower end of which forms a little ball that moves in a socket; this socket is furnished with straps which are tied to a belt that surrounds the patient's body. The pessary is extremely well calculated for those who are in an easy way of life; but the other kind is best adapted to hard-working women, who have not time or conveniency to fix or mend the bandage when it wants repair.

SECT. VIII. The Evacuations necessary at the End of the Month after Delivery.

Those who have had a sufficient discharge of the lochia, plenty of milk, and suckle their own children, commonly recover with ease; and, as the superfluous fluids of the body are drained off at the nipples, seldom require evacuations at the end of the month: but, if there are any complaints from fulness, such as pains and stitches, after the twentieth day, some blood ought to be taken from the arm, and the belly gently opened by frequent clysters, or repeated doses of laxative medicines.

If the patient has tolerably recovered, the milk having been at first suckled or discharged from the nipples, and afterwards discontinued, no evacuations are necessary before the third or fourth week; and sometimes not till after the first flowing of the menses, which commonly happens about the fifth week; if they do not appear within that time, gentle evacuations must be prescribed, to carry off the plethora and bring down the catamenia.

PART XI.

The requisite QUALIFICATIONS OF Accoucheurs and Midwives.

SECT. I. Of the ACCOUCHEUR.

Those who intend to practise Midwifery ought, first of all, to make themselves masters of anatomy, and acquire a competent knowledge in surgery and physic; because of their connection with the obstetric art, if not always, at least in many cases. He ought to take the best opportunities he can find of being well instructed; and of practising under a master, before he attempts to deliver by himself.

In order to acquire a more perfect idea of the art, he ought to perform with his own hands upon proper machines, contrived to convey a just notion of all the difficulties to be met with in every kind of labour; by which means he will learn how to use the for-

ceps and crotchets with more dexterity, be accustomed to the turning of children; and consequently be more capable of acquitting himself in troublesome cases, that may happen to him when he comes to practise among women: he should also embrace every occasion of being present at real labours; and indeed of acquiring every qualification that may be necessary or convenient for him in the future exercise of his profession. But over and above the advantage of education, he ought to be endowed with a natural sagacity, resolution; and prudence; together with that humanity which adorns the owner, and never fails of being agreeable to the distressed patient; in consequence of this virtue, he will assist the poor, as well as the rich, behaving always with charity and compassion. He ought to act and speak with the utmost delicacy of decorum, and never violate the trust reposed in him, so as to harbour the least immoral or indecent design; but demean himself in all respects suitable to the dignity of his profession.

SECT. II. Of the MIDWIFE.

A Midwife, though she can hardly be supposed mistress of all these qualifications, ought to be a decent sensible woman, of a middle age, able to bear fatigue: she ought to be perfectly well instructed with regard to the bones of the pelvis, with all the contained parts, comprehending those that are subservient to generation: she ought to be well skilled in the method of touching pregnant women, and know in what manner the womb stretches, together with the situation of all the abdominal viscera: she ought to be perfectly mistress of the art of examination in time of labour, together with all the different kinds of labour, whether natural or preternatural, and the methods of delivering the placenta: she ought to live in friendship with other women of the same profession, contending with them in nothing but knowledge, sobriety, diligence, and patience; she ought to avoid all reflections upon men-practitioners; and when she finds herself at a loss, candidly to have recourse to their assistance; on the other hand, this confidence ought to be encouraged by the man, who, when called, instead of openly condemning her method of practice (even though it should be erroneous) ought to make allowance for the weakness of the sex, and rectify what is amiss, without exposing her mistakes. This conduct will as effectually conduce to the welfare of the patient, and operate as a silent rebuke upon the conviction of the midwife; who finding herself treated so tenderly, will be more apt to call for necessary assistance on future occasions, and to consider the accoucheur as a man of honour and a real friend. These gentle methods will prevent that mutual calumny and abuse which too often prevail among the male and female practitioners: and redound to the advantage of both: for no accoucheur is so perfect but that he may err sometimes; and on such occasions he must expect to meet with retaliation from those midwives whom he may have roughly used.

EXPLANATION OF THE PLATES.

With an Abridgement of the Practice of MIDWIFERY, intended to illustrate the System and Cases before recited.

FIGURE I. represents, in a front view, the bones of a well formed pelvis. A, the five vertebrae of the loins. B, the os sacrum. C, the os coccygis. D, D, the ossa ilium. E, E, the ossa ischia. F, the ossa pubis. G, the foramina magna. H, H, the acetabula. I, I, I, I, I, the brim of the pelvis, or the circumference of its cavity which is described at the sides by the inferior parts of the ossa ilium, and at the back and foreparts by the superior parts of the ossa pubis and sacrum.

In this plate, besides the general structure and figure of the several bones, the dimensions of the brim of the pelvis and the distance between the upper parts of the ossa ischia are particularly to be attended to; from which it will appear, that the cavity of the brim is commonly wider from side to side, than from the back to the forepart, but that the sides below are in the contrary proportion. The reader, however, ought not from this to conclude that every pelvis is similar in figure and dimensions, since even well-formed ones differ in some degree from each other. In general the brim of the pelvis measures about five inches and a quarter from the side, four inches and a quarter from the back to the fore part; there being likewise the same distance between the inferior parts of the ossa ischia. All these measures, however, must be understood as taken from the skeleton; for in the subject, the cavity of the pelvis is considerably diminished by its teguments and contents. Correspondent also to this diminution, the usual dimensions of the head of the full-grown foetus are put three inches and a half from ear to ear, and four inches and a quarter from the fore to the hind head. Vide Fig. 19, 20, 21.

FIGURE II. exhibits a front view of a distorted pelvis. A, the five vertebrae of the loins. B, the os sacrum. C, the coccygis. D, D, the ossa ilium. E, E, the ossa ischia. F, the ossa pubis. G, G, the foramina magna. H, H, the acetabula.

From this plate may appear the great danger incident to both mother and child when the pelvis is distorted in this manner; it being only two inches and a half at the brim from the posterior to the anterior part, and the same distance between the inferior parts of each os ischia. Vide Fig. 30, where the pelvis is one quarter of an inch narrower at the brim than this, but sufficiently wide below. Various are the forms of distorted basins, but the last mentioned

MIDWIFERY.

tioned is the most common. It is a great happiness, however, in practice, that they are seldom so narrow, though there are instances where they have been much more so. The danger in all such cases must increase or diminish according to the degree of distortion of the pelvis and size of the child's head.

FIGURE III. gives a lateral and internal view of the pelvis, the same being divided longitudinally. A, the three lower vertebrae of the loins. B, the *os sacrum*. C, the *os coccygis*. D, the left *os ilium*. E, the left *os ischium*. F, the *os pubis* of the same side. G, the acute process of the *os ischium*. H, the *foramen magnum*. I, I, I, the brim of the pelvis.

This plate shows the distance from the superior part of the *os sacrum* to the *os pubis*, as well as from the last mentioned bones to the *coccyx*, which in each amounts to about four inches and a quarter. The depth likewise is shewn of the posterior, lateral, and interior parts of the pelvis, not in the line of the body, but in that of the pelvis from its brim downward, which is three times deeper on the posterior than interior part, and twice the depth of the last at the sides.

From this view appears also the angle which is formed by the last vertebra of the loins and the superior part of the *os sacrum*, as likewise the concavity or hollow space in the posterior internal part of the pelvis, arising from the posterior curvature of the last mentioned bone and *coccyx*; finally, the distance from which to the posterior parts of the *os ischium* is here expressed. Vide Fig. 19, 20, 21, 22.

FIGURE IV. gives a front view of the uterus *in situ* suspended in the vagina; the anterior parts of the *os ischium*, with the *os pubis*, *pubenda*, *perinaeum*, and *anus*, being removed, in order to show the internal parts. A, the last vertebra of the loins. B, B, the *os ilium*. C, C, the *acetabula*. D, D, the inferior and posterior parts of the *os ischium*. Vide Fig. 32, where the *os pubis* and the interior parts of the *os ischium* are represented by dotted lines. E, the part covering the extremity of the *coccyx*. F, the inferior part of the *rectum*. G, G, the vagina cut open longitudinally, and stretched on each side of the *collum uteri*, to show in what manner the uterus is suspended in the same. H, H, part of the *vesica urinaria* stretched on each side of the vagina and inferior part of the *fundus uteri*. I, the *collum uteri*. K, the *fundus uteri*. L, L, the *tubae Fallopiæ* and *fimbriae*. M, M, the *ovaria*. N, N, the *ligamenta lata* and *rotunda*. O, O, the superior part of the *rectum*.

FIGURE V. gives a view of the internal parts, as seen from the right groin, the pelvis being divided longitudinally. A, the lowest vertebra of the loins. B, C, the *os sacrum* and *coccyx*, with the integuments. D, the left *os ilium*. E, the inferior part of the left *os ischium*. F, the *os pubis* of the same side. G, the *foramen magnum*. H, the *acetabulum*. I, I, I, the inferior part of the *rectum* and *anus*. K, the *os externum* and *vagina*; the *os uteri* lying loosely in the same. L, the *vesica urinaria*. M, N, the *collum* and *fundus uteri*, with a view of the cavity of both. The attachment of the vagina round the outside of the lips of the mouth of the womb is here likewise shewn, as also the situation of the uterus, as it is pressed downwards and backwards by the intestines and urinary bladder into the concave and inferior part of the *os sacrum*. O, the *ligamenta lata* and *rotunda* of the left side. P, P, the Fallopian tube, with the *fimbria*. Q, the *ovarium* of the same side. R, R, the superior part of the *rectum* and inferior part of the colon.

FIGURE VI. gives a front view of the uterus in the beginning of the first month of pregnancy: the anterior part being removed, that the embryo might appear through the *amnios*, the *chorion* being dissected off. A, the *fundus uteri*. B, the *collum uteri*, with a view of the rugous canal that leads to the cavity of the *fundus*. C, the *os uteri*.

FIGURE VII. is the same view and section of the parts as in Fig. 6; it shows the uterus as it appears in the second or third month of pregnancy, its anterior part being here likewise removed. F, the *anus*. G, the *vagina*, with its *placæ*. H, H, the posterior and inferior part of the urinary bladder extended on each side, the anterior and superior part being removed. I, I, the mouth and neck of the womb, as raised up in examining the same by the touch, with one of the fingers in the vagina. K, K, the uterus as stretched in the second or third month, containing the embryo, with the *placenta* adhering to the *fundus*.

It appears from this and the former figure, that at this time nothing can be known, with respect to pregnancy, from the touch in the vagina, as the resistance of the uterus is so inconsiderable that it cannot prevent its being raised up before the finger. Women at this period miscarry oftener than at any other. It is a great happiness, however, in practice, that although they are frequently much weakened by large discharges, yet they rarely sink under the same, but are sooner or later relieved by labour coming on, which gradually stretches the neck and mouth of the womb, by the membranes being forced down with the waters.

From the structure of the parts, as represented in this and the former figure, it may appear that it is much safer to restrain the flooding, and support the patient, waiting with patience the efforts of nature, than to endeavour to stretch the *os uteri*, and deliver either with the hand or instruments, which might endanger a laceration and inflammation of the parts.

FIGURE VIII. represents the uterus in the fourth or fifth

month of pregnancy, in the same view and section of the parts with the former figure, excepting that in this the anterior part of the *collum uteri* is not removed.

In the natural situation, the mouth and lips of the womb are covered with the vagina, and these parts are contiguous to each other; but here the vagina, G, is a little stretched from the neck and lips of the former, in order to show the parts more distinctly. I, the neck of the womb, which appears in this figure thicker, shorter, and softer, than in the former. K, the inferior part of the *fundus uteri*: the stretching of which can sometimes be felt through the vagina, by pushing up a finger on the anterior or lateral part of the same.

The uterus now is so largely stretched as to fill all the upper part of the pelvis, and begins also to increase so much as to rest on the brim, and to be supported by the same, the *fundus* at the same time being raised considerably above the pelvis. The size or bulk of the fetus is finally here to be observed, with the *placenta* adhering to the posterior part of the uterus.

FIGURE IX. is the same view and section of the parts as in Fig. 8, in order to shew the contents, and the internal parts as they appear in the sixth or seventh month of pregnancy. A, the uterus stretched up to the umbilical region. B, B, the superior part of the *os ilium*. C, C, the *acetabula*. D, D, the remaining posterior parts of the *os ischium*. E, the *anus*. F, the *vagina*. G, the bladder of urine. H, the neck of the womb, shorter than in Fig. 8, and raised higher by the stretching of the uterus above the brim of the pelvis. I, the vessels of the uterus larger than in the unimpregnated state. K, K, the *placenta* adhering to the inferior and posterior parts of the uterus. L, L, the membranes that surround the fetus, the head of which is here represented (as well as of those in Fig. 8, situated downwards at the inferior part of the uterus, which is the usual situation of the fetus when at rest, and surrounded with a great quantity of waters, as the head is heavier than any other part. With respect to the situation of the body of the fetus, though the fore parts are often turned towards the sides and posterior parts of the uterus, they are here represented at the anterior part or forwards, in order to shew them in a more distinct and picturesque manner.

From this figure may appear the difficulty of stretching the *os uteri* in flooding cases, even at this period, from the length and thickness of the neck of the womb, especially in the first pregnancy: much the same method, however, is to be allowed here as was directed in Fig. 8, till labour comes on to dilate the *os uteri*. If the flooding is then considerable, the membranes should be broken, that the uterus may contract, and thereby lessen the discharge. The labour likewise, if it is necessary, may be assisted by dilating the *os uteri*, in time of the pains: which also, if wanting, may be provoked by the same method, when the patient is in danger. If this danger is imminent, and the woman seems ready to expire, the uterus, as appears from the figure, is at this time sufficiently stretched to receive the operator's hand to extract the fetus, if the *os internum* can be safely dilated.

Lastly, It may be observed that women are in greater danger in this period and afterwards, than in the former months.

FIGURE X. represents the abdomen of a woman opened in the sixth or seventh month of pregnancy. A, A, A, A, the parietes of the abdomen opened, and turned back to show, B, the uterus. C, C, C, the intestines raised upwards. D, the *labia pudendi*, which are sometimes affected in pregnancy with cedematous swellings, occasioned by the pressure of the uterus upon the returning veins and lymphatics. If the labia are so tumefied as to obstruct the patient's walking, the complaint is removed by puncturing the parts affected. By which means the serous fluid is discharged for the present, but commonly recurs; and the same operation must be repeated several times, perhaps before delivery; after which, however, the tumefaction entirely subsides. From this figure it appears, that the stretching of the uterus can easily be felt at this period in lean subjects, through the parietes of the abdomen, especially if the intestines do not lie before it. In general indeed as the uterus stretches, it rises higher; by which means the intestines are likewise raised higher, and are also pressed to each side. Hence the nearer the woman is to her full time, the stretching is more easily felt.

FIGURE XI. exhibits a front internal view of the gravid uterus in the beginning of labour; the anterior parts being removed, as in Fig. 15; but in this the membranes not being broken, form a large bag containing the waters and fetus. A, the substance of the uterus. B, B, C, C, D, D, the bones of the pelvis. E, the *coccyx*. F, the inferior part of the *rectum*. G, C, G, C, the vagina. H, H, the mouth of the womb, largely stretched in time of a pain, with I, the membranes and waters. This circumstance make it usually certain that labour is begun; whereas, from the degree of dilatation represented in Fig. 15, there is little to be ascertained unless the pains are regular and strong, the *os uteri* being often found more open several days, and even weeks, before labour commences. K, the *chorion*. L, the same dissected off at the inferior part of the uterus, in order to show the head of the fetus through the *amnios*. [N.B. This hint is taken from one of Dr. Albinus's Tables of the gravid uterus.] M, the *placenta*; the external convex surface of which, divided into a number of lobes, is here represented, its concave internal parts being covered by the *chorion*.

MIDWIFERY.

chorion. The placenta has been found adhering to all the different parts of the internal surface of the uterus, and sometimes even over the inside of the os uteri; this last manner of adhesion, however, always occasions floodings as soon as the same begins to dilate. Fig. 8, 9, 14, 15, shew the internal surface of the placenta towards the fœtus, with the vessels composing its substance proceeding from the funis, which is inserted in different placentas, into all the different parts of the same, as well as in the middle. The thirty-third and thirty-sixth figures shew the insertion of the funis into the abdomen of the fœtus.

With respect to the expulsion of the placenta when the membranes break, the uterus contracts, as the waters are evacuated, till it comes in contact with the body of the fœtus: the same being delivered, the uterus grows much thicker, and contracts closely to the placenta and membranes, by which means they are gradually separated, and forced into the vagina. This shews that we ought to follow the method which nature teaches, waiting with patience, and allowing to separate in a slow manner; which is a much safer practice, especially when the patient is weak; as the discharge is neither so great or sudden as when the placenta is hurried down in the too common method. But then we must not run into the other extreme, but assist when nature is not sufficient to expel the same.

FIGURE XII. shews the external female parts of generation. A, the lower part of the abdomen. B, B, the *labia pudendi* separated. C, the *clitoris* and *præputium*. D, D, the *nymphæ*. E, the *os magna*, or *os externum*. F, the *meatus urinarius*. G, the *frænum labiorum*. H, the *perinæum*. I, the *anus*. K, the part that covers the extremity of the *coccyx*. L, L, the parts that cover the tuberosities of the *os ischium*.

As it is of great consequence to every practitioner in midwifery to know exactly the situation of the parts concerned in parturition, and which have not been accurately described by former anatomists, with a view to this particular branch, we have given this draught from a subject, in order to demonstrate these parts in the ordinary course of the system. From a view, then, of the situation of the parts, it appears, that the os externum is not placed in the middle of the inferior part of the pelvis, but at the anterior and inferior part of the pubes: and that the labia cover, likewise, the anterior part of these bones.

Secondly. It may be observed, that, as the *frænum labiorum*, which is nearly adjoining to the inferior part of the *os pubis*, is only about an inch from the anus, between which and the *coccyx* there is about three inches distance; it follows, that the anus is nearer to the first-mentioned bones than to the latter.

Thirdly. The view of this, and of Fig. 4 and 5, will furnish proper hints with respect to the method of touching or examining the os uteri, without hurting or inflaming the parts; as it appears that the os externum is placed forward towards the pubes, and the os uteri backward towards the rectum and coccyx. By this wise mechanism of nature, many inconveniences are often prevented, which must happen if these parts were opposite to each other, and situated in the middle of the inferior part the pelvis; particularly a prolapsus of the vagina and uterus, either in the unimpregnated state, or in any of the first four months of pregnancy; as also too sudden deliveries in any of the last months.

Fourthly. From a view of the situation of the parts, it will appear, that, in labour, when the os uteri is sufficiently opened to allow a passage for the head of the fœtus, the same is protruded to the lower part of the vagina, by which the external parts are pushed out in form of a large tumour, as in Fig. 13.

Lastly. It may be observed, that, when it is necessary to dilate the os externum, the principal force ought to be applied downwards, and towards the rectum, to prevent the urethra and neck of the bladder from being hurt or inflamed.

FIGURE XIII. is intended principally to shew in what manner the perinæum and external parts are stretched by the head of the fœtus in a first pregnancy, towards the end of labour. A, the abdomen. B, the *labia pudendi*. C, the *clitoris* and its *præputium*. D, the hairy scalp of the fœtus swelled at the vertex, in a laborious case, and protruded to the os externum. E, F, the *perinæum* and *anus* pushed out by the head of the fœtus in form of a large tumour. G, G, the parts that cover the tuberosities of the *os ischium*. H, the part that covers the *os coccygis*.

The perinæum in this figure is stretched two inches, or double its length in the natural state; but when the os externum is so much dilated by the head of the fœtus as to allow the delivery of the same, the perinæum is generally stretched to the length of three, and sometimes four, inches. The anus is likewise lengthened an inch, the parts, also, between it and the coccyx being much distended. All this ought to caution the young practitioner never to precipitate the delivery at this time, but to wait and allow the parts to dilate in a slow manner; as, from the violence of the labour-pains, the sudden delivery of the head of the fœtus might endanger the laceration of the parts. The palm of the operator's hand ought, therefore, to be pressed against the perinæum, that the head may be prevented from passing till the os externum is sufficiently dilated to allow its delivery, without tearing the *frænum* and parts betwixt that and the anus, which are at this time very thin.

FIGURE XIV. is the same view and section of the parts with

the former, and represents the uterus in the eighth or ninth month of pregnancy. A, the uterus, as stretched to near its full extent, with the waters, and containing the fœtus entangled in the funis; the head presenting at the upper part of the pelvis. B, B, the superior part of the *os ilium*. C, C, the *acetabula*. D, D, the remaining posterior parts of the *os ischium*. E, the *coccyx*. F, the inferior part of the *rectum*. G, G, G, the *vagina* stretched on each side. H, the os uteri, the lips of which appear larger and softer than in the foregoing figure, the neck of the womb being likewise stretched to its full extent, or entirely obliterated. I, I, part of the *vesica urinaria*. K, K, the placenta at the superior and posterior part of the uterus. L, L, the membranes. M, the funis umbilicalis.

This and the foregoing figure shew in what manner the uterus stretches, and how its neck grows shorter, in the different periods of pregnancy; as also the magnitude of the fœtus. Notwithstanding it has been handed down as an invariable truth, from the earliest accounts of the art to the present times, that when the head of the fœtus presented, the face was turned to the posterior part of the pelvis; yet, from Mr. Oald's observation, as well as from some late dissections of the gravid uterus, and what we have observed in practice, we are led to believe that the head presents, for the most part, as is here delineated, with one ear to the pubes, and the other to the os sacrum; though sometimes this may vary, according to the form of the head, as well as that of the pelvis. Consult Dr. Hunter's elegant plates of the gravid uterus.

FIGURE XV. gives a front view of twins in utero in the beginning of labour; the anterior parts being removed, as in the preceding figures. A, the uterus as stretched with the membranes and waters. B, B, the superior parts of the *os ilium*. C, C, the *acetabula*. D, D, the *os ischium*. E, the *coccyx*. F, the lower part of the *rectum*. G, G, the *vagina*. H, the os internum stretched open about a finger's-breadth, with the membranes and waters, in time of labour-pains. I, I, the inferior part of the uterus stretched with the waters which are below the head of the child that presents. K, K, the two placentas adhering to the posterior part of the uterus, the two fœtuses lying before them; one with its head in a proper position, at the inferior part of the uterus; and the other situated preternaturally, with the head to the fundus: the bodies of each are here entangled in their proper funis, which frequently happens in the natural, as well as preternatural, positions. L, L, L, the membranes belonging to each placenta.

This representation of twins, according to the order observed in the system, ought to have been placed among the last figures, but we have placed it here in order to shew the os uteri grown much thinner than in the former figure, a little open and stretched by the waters and membranes which are pushed down before the head of one of the fœtuses in time of a labour-pain. With respect to the position of twins, it is often different in different cases, but was thus in a late dissection of a gravid uterus by Dr. Mackenzie.

FIGURE XVI. shews (in a lateral view and longitudinal division of the parts) the gravid uterus when labour is somewhat advanced. A, the lowest vertebra of the back. B, the *scrobiculus cordis*; the distance from which to the last-mentioned vertebra is here shewn by dotted lines; as also part of the region below the diaphragm. C, C, the usual thickness and figure of the uterus when extended with the waters at the latter end of pregnancy. D, the same contracted and grown thicker after the waters are evacuated. E, E, the figure of the uterus when pendulous. In this case, if the membranes break when the patient is in an erect position, the head of the fœtus runs a risk of sliding over and above the *os pubis*, whence the shoulders will be pushed into the pelvis. F, F, the figure of the uterus when stretched higher than usual, which generally occasions vomitings and difficulty of breathing. [Consult, on this subject, M. Leveret, *Sur le Mécanisme de différentes Grossesses*.] G, the os pubis of the left side. H, H, the os internum. I, the vagina. K, the left nymphæ. L, the *labium pudendi* of the same side. M, the remaining portion of the bladder. N, the anus. O, P, the left hip and thigh.

In this period of labour, the os uteri being more and more stretched by the membranes pushing down and beginning to extend the vagina, a great quantity of water is forced down at the same time, and (if the membranes break) is discharged; whence the uterus contracts itself nearer the body of the fœtus, which is here represented in a natural position, with the vertex resting at the superior part of the *os pubis*, and the forehead towards the right os ilium. As soon as the uterus is in contact with the body of the fœtus, the head of the same is forced backwards toward the os sacrum from the line of the abdomen B, G, into that of the pelvis, viz. from the uppermost F, to near the end of the coccyx, and is gradually pushed lower, as in the following figure. If the membranes do not break immediately upon their being pushed into the vagina, they should be allowed to protrude still further, in order to dilate the os externum.

FIGURE XVII. in the same view and section of the parts as in Fig. 8, shews the natural position of the head of the fœtus when sunk down into the middle of the pelvis after the os externum is fully opened, a large quantity of the waters being protruded, with the membranes, through the os externum, but prevented from being all discharged, from the head's filling up the vagina. A, the uterus a little contracted, and thicker, from some of the waters being sunk down

MIDWIFERY.

down before the child, or discharged. B, B, the superior parts of the *os ilium*. C, the inferior part of the *rectum*. D, D, the *vagina* largely stretched with the head of the fœtus. E, E, the *os internum* fully opened. F, a portion of the *placenta*. G, G, the *membranes*. H, H, the *ligamenta lata*. I, I, the *ligamenta rotunda*. Both these last stretched upwards with the *uterus*.

The vertex of the fœtus being now down at the inferior part of the right *os ischium*, and the wide part of the head at the narrow and inferior part of the pelvis, the forehead, by the force of the pains, is gradually moved backwards; and as it advances lower, the vertex and occiput turn out below the pubes, as in the next figure. Hence we may learn of what consequence it is to know that it is wider from side to side at the brim of the pelvis, than from the back to the fore part; and that it is wider from the fore to the hind head of the child, than from ear to ear.

FIGURE XVIII: in a similar view and section of the parts with Fig. 16, shews the forehead of the fœtus turned (in its progression downwards, from its position in the former figure) backwards to the *os sacrum*, and the occiput below the pubes; by which means the narrow part of the head is to the narrow part of the pelvis, that is, between the inferior parts of the *os ilium*. Hence it may be observed, that, though the distance between the inferior parts of the last-mentioned bones is much the same as between the coccyx and pubes; yet, as the cavity of the pelvis is much shallower at the anterior than lateral part, the occiput of the fœtus, when come down to the inferior part of either *os ilium*, turns out below the pubes: this answers the same end as if the pelvis itself had been wider from the posterior part than from side to side; the head likewise enlarging the cavity by forcing back the coccyx, and pushing out the external parts in form of a large tumour, as is already described in Fig. 13. A, the *uterus* contracted closely to the *fatus* after the waters are evacuated. B, C, D, the *vertebra* of the loins, *os sacrum*, and *coccyx*. E, the *anus*. F, the left hip. G, the *perinaum*. H, the *os externum* beginning to dilate. I, the *os pubis* of the left side. K, the remaining portion of the bladder. L, the posterior part of the *os uteri*.

FIGURE XIX. and the three following, shew in what manner the head of the fœtus is helped along with the forceps as artificial hands, when it is necessary to assist with the same, for the safety of either mother or child. In this figure the head is represented as forced down into the pelvis by the labour-pains, from its former position in Fig. 16. A, A, B, C, the *vertebra* of the loins, *os sacrum*, and *coccyx*. D, the *os pubis* of the left side. E, the remaining part of the bladder. F, F, the *intestinum rectum*. G, G, G, the *uterus*. H, the *mons veneris*. I, the *clitoris*, with the left *nympha*. X, the *corpus cavernosum clitoridis*. V, the *meatus urinarius*. K, the left *labium pudendi*. L, the *anus*. N, the *perinaum*. Q, P, the left hip and thigh. R, the skin and muscular part of the loins.

The patient in this case may be, as in this figure, on her side, with her breech a little over the side or foot of the bed, her knees being likewise pulled up to her belly, and a pillow placed between them, care being taken, at the same time, that the parts are, by a proper covering, defended from the external air. When the position of the head is known, the operator must withdraw his hand, and wait to see if the stretching of the parts will renew or increase the labour-pains, and allow more space for the advance of the head in the pelvis. If this, however, proves of no effect, the fingers are again to be introduced, and one of the blades of the forceps (lubricated with lard) is then to be applied along the inside of the hand or fingers and left ear of the child, as represented in the figure. But if the pelvis is distorted, and projects forward at the superior part of the *os sacrum*, and the forehead, therefore, cannot be moved a little backwards, in order to turn the ear from that part of the pelvis which prevents the end of the forceps to pass the same: in that case, the blade must be introduced along the posterior part of the ear at the side of the distorted bone. The hand that was introduced is then to be withdrawn, and the handle of the introduced blade held with it, as far back as the *perinaum* will allow, whilst the fingers of the other hand are introduced to the *os uteri*, at the pubes or right groin, and the other blade placed exactly opposite to the former. This done, the handles being taken hold of and joined together, the head is to be pulled lower and lower every pain, till the vertex, as in this figure, is brought down to the inferior part of the left *ischium*, or below the same. The wide part of the head being now advanced to the narrow part of the pelvis, betwixt the tuberosities of the *os ilium*, is to be turned from the left *ischium* out below the pubes and the forehead, backwards to the concave part of the *os sacrum* and *coccyx*, as in Fig. 20, and afterwards the head brought along and delivered, as in Fig. 21 and 22. But if it is found that the delivery will require a considerable degree of force, from the head being large, or the pelvis narrow, the handles of the forceps are to be tied together with a fillet, as represented in the figure, to prevent their position being changed, whilst the woman is turned on her back, as in Fig. 27, which is then more convenient for delivering the head than when lying on her side.

This figure shews that the handles of the forceps ought to be held as far back as the *os externum* will allow, that the blades may be in an imaginary line between that and the middle space between the umbilicus and scrobiculus cordis. When the forceps are applied along the ears and sides of the head, they are nearer

to one another, have a better hold, and mark less, than when over the occipital and frontal bones.

FIGURE XX. in the same view with the former, represents the head of the *fatus* brought lower with the forceps, and turned from the position in the former figure, in imitation of the natural progression by the labour-pains, which may likewise be supposed to have made this turn before it was necessary to assist with the forceps. If the head is squeezed into a longish form, as in Fig. 24, and has been detained many hours in this position, the pains not being sufficient to complete the delivery, the assistance of the forceps must be taken to save the child, though the woman may be in no danger. But if the head is high up in the pelvis, as in the former figure, the forceps ought not to be used except in the most urgent necessity.

This figure also shews that the handles of the forceps are still to be kept back to the *perinaum*, and when in this position, they are in a line with the upper part of the *sacrum*, and if held more backwards, when the head is a little higher, they would be in a line with the *scrobiculus cordis*. If the forceps are applied when the head is in this position, they are more easily introduced when the patient is in a supine position, as in Fig. 27. Neither is it necessary to tie the handles, which is only done to prevent their alteration when turning the woman from her side to her back. In several cases a long sort of forceps, that are curved upwards, are of great use to help along the head when the body is delivered first, as in Fig. 38; the same are represented here by dotted lines. They may be used in laborious cases, as well as the others, but are not managed with the same ease.

Most of the parts of this figure being marked with the same letters as the former, the descriptions there given will answer in this, except the following: L, M, the *anus*. M, N, the *perinaum*. O, the common integuments of the *abdomen*. R, the short forceps. S, the long curved forceps. The first of these is eleven inches long, and the last twelve inches and a half—we have, after several alterations, found it sufficient: but this need not confine others who may choose to alter them from this standard. Vide Fig. 1. Plate of Instruments.

FIGURE XXI. in the same view and section of the parts, shews the head of the *fatus* in the same position, but brought lower down with the forceps than in the former figure; for in this the *os externum* is more open, the occiput comes lower down from below the pubes, and the forehead past the *coccyx*, by which both the *anus* and *perinaum* are stretched out in form of a large tumour, as in Fig. 13.

When the head is so far advanced, the operator ought to extract with great caution, lest the parts should be torn. If the labour-pains are sufficient, the forehead may be kept down and helped along in a slow manner, by pressing against it with the fingers on the external parts below the coccyx: at the same time, the forceps being taken off, the head may be allowed to stretch the *os externum* more and more in a gradual manner, from the force of the labour-pains, as well as assistance of the fingers. But if the former are weak and insufficient, the assistance of the forceps must be continued. (Vide the description of the parts in Fig. 19.) S, T, in this representation, the left side of the *os uteri*. The dotted lines demonstrate the situation of the bones of the pelvis on the right side, and may serve as an example for all the views of the same. a, b, c, h, the outlines of the *os ilium*. D, e, f, the same of the *pubis* and *ischium*. i, i, k, the *acetabulum*. And m, n, the *foramen magnum*.

FIGURE XXII. in the same view and section of the pelvis, is intended, by outlines, to shew, that, as the external parts are stretched, and the *os externum* is dilated, the occiput of the *fatus* rises up with a semicircular turn from out below the pubes, the under part of which bones are as an axis or fulcrum, on which the back part of the neck turns, whilst, at the same time, the forehead and face, in their turn upwards, distend largely the parts between the coccyx and *os externum*. This is the method observed by nature in stretching these parts in labour; and as nature is always to be imitated, the same method ought to be followed when it is necessary to help along the head with the forceps. Vide the three former figures for the descriptions and references.

FIGURE XXIII. in the same section of the parts, but with a view of the right side, shews the head of the *fatus* in the contrary position to the three last figures, the vertex being here in the concavity of the *sacrum*, and the forehead turned to the pubes. A, B, the *vertebra* of the loins, *os sacrum*, and *coccyx*. C, the *os pubis* of the right side. D, the *anus*. E, the *os externum* not yet begun to stretch. F, the *nympha*. G, the *labium pudendi* of the right side. H, the hip and thigh. I, I, the *uterus* contracted, the waters being all discharged.

When the head is small, and the pelvis large, the parietal bones and the forehead will, in this case, as they are forced downwards by the labour-pains, gradually dilate the *os externum*, and stretch the parts between that and the coccyx in form of a large tumour, as in Fig. 13, till the face comes down below the pubes, when the head will be safely delivered. But if the same be large, and the pelvis narrow, the difficulty will be greater, and the child in danger; as in the following figure.

FIGURE XXIV. shews the head of the *fatus* in the same position as in the former figures; but being much larger, it is by

over
resents
turned
natural
posed
th the
n Fig.
pans
of the
n may
as in
in the

are still
n, they
more
be in a
d when
d when
is it ne-
their al-
k. In
, are of
ed first.
They
are not

e same
wer in
nam.
rt for-
eleven
, after
confine
Vide

parts,
lower
is the
m be-
n both
mour,

extra
bour-
elped
rs on
recept
exter-
f the
rmer
ll be
S, T,
otted
the
f the
e of
e fo-

vis,
are
cious
the
the
ead
een
by
ays
it is
ree

ith
on-
the
es.
os
ret
he
he

es
ds
ch
r,
be
ne
a-

te
y
g

Various Instruments used in the Practice of Midwifery. See the System.

Plate 5



Fig. 2.



Fig. 1.



Fig. 3.



Fig. 5.



Fig. 8.



Fig. 4.



Fig. 7.



Fig. 6.



Fig. 9.



Fig. 11.



Fig. 10.



Fig. 13.



Fig. 12.



Fig. 14.



Fig. 15.



Fig. 16.

Fig. 17.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.



Representation of the manner in which the Fetus is nourished in Utero, also a View of the Membrana decidua discovered by the late W. Hunter. See System of Midwifery

Fig. 42.



In Figure 42, an opening is made into the Uterus, to show the Placenta and Membranes, with the Vessels issuing from the Mother to the Fetus. Figure 40 is a portion of the sponge part of the Placenta, dissected off, that the Vessels may be more completely seen.

Engraved by W. D. Bayly, sculp. & J. G. Smith, delin. & J. G. Smith, sculp. & J. G. Smith, delin. & J. G. Smith, sculp.

u of
hy/ce
)

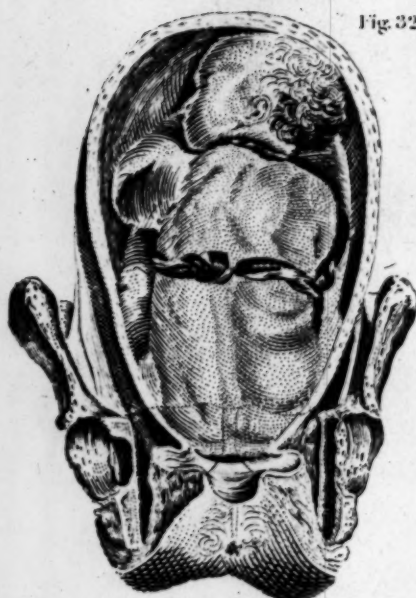


ig. 40.



1.

*Anatomical Tables, illustrative of the Theory and Practice
of Midwifery. See the System.*



Reduced from Smellie's Tables by Frederick Birnie, Anatomical Draughtsman to the late Dr. William Hunter, and Engraved by William Taylor.

Engraved for Hall's Encyclopedia, & Bound for C. Cooke, N° 17, Paternoster Row.

*Anatomical Tables, illustrative of the Theory and Practice
of Midwifery. In the System.*

Fig. 12.



Fig. 13.

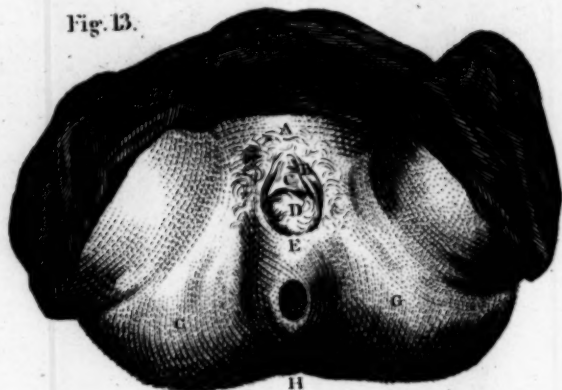


Fig. 10.



Fig. 11.



Fig. 14.



Fig. 15.



MIDWIFERY.

strong labour-pains squeezed into a longish form with a tumour on the vertex, from the long compression of the head in the pelvis. If the child cannot be delivered with the labour-pains, or turned and brought footling, the forceps are to be applied on the head, as described in this figure, and brought along as it presents: but if that cannot be done without running the risk of tearing the perineum, and even the vagina and rectum of the woman, the forehead must be turned backwards to the sacrum. To do this more effectually, the operator must grasp firmly with both hands the handles of the forceps, and at the same time pushing upwards raise the head as high as possible, in order to turn the forehead to one side, by which it is brought into the natural position; this done, the head may be brought down and delivered as in Fig. 19.

Vide the former Figure for the description of the parts, except K. the tumour on the vertex. The same compression and elongation of the head, as well as the tumour on the vertex, may be supposed to happen in a greater or less degree in the Figures 19, 20, 21, 22, as well as in this, where the difficulty proceeds from the head being large, or the pelvis narrow. Vide Fig. 30, 31.

L, the forceps. Sometimes the forehead may be moved to the natural position by the assistance of the fingers or only one blade of the forceps. The forceps may either be the straight kind, or such as are curved to one side, when it is necessary to use one or both blades. M, the vesica urinaria much distended with a large quantity of urine from the long pressure of the head against the urethra; which shows that the urine ought to be drawn off with a catheter, in such extraordinary cases, before you apply the forceps, or in preternatural cases where the child is brought footling. N, the underpart of the uterus. O, O, the os uteri.

FIGURE XXV. shows, in a front view of the parts, the forehead of the *fœtus* presenting at the brim of the pelvis, the face being turned to one side, the fontanel to the other, and the feet and breech stretched towards the fundus uteri. A, A, the superior part of the ossa ilium. B, the anus. C, the perineum. D, the os externum; the thickness of the posterior part before it is stretched with the head of the child. E, E, E, the vagina. F, the os uteri not yet fully dilated. G, G, G, the uterus. H, the membrana adiposa.

If the face is not forced down, the head will sometimes come along in this manner; in which case the vertex will be flattened, and the forehead raised in a conical form; and when the head comes down to the lower part of the pelvis, the face or occiput will be turned from the side, and come out below the pubes. But if the head is large, and cannot be delivered by the pains, or if the wrong position cannot be altered, the child must, if possible, be brought footling, or delivered with the forceps.

FIGURE XXVI. shows, in a lateral view, the face of the child presenting, and forced down into the lower part of the pelvis, the chin being below the pubes, and the vertex, in the concavity of the os sacrum: the waters likewise being all discharged, the uterus appears closely joined to the body of the child, round the neck of which is one circumvolution of the funis. A, B, the vertebrae of the loins, os sacrum, and coccyx. C, the os pubis of the left side. D, the inferior part of the rectum. E, the perineum. F, the left labium pudendi. G, G, G, the uterus.

When the pelvis is large, the head, if small, will come along in this position, and the child be saved: for as the head advances lower, the face and forehead will stretch the parts between the frenum labiorum and coccyx in form of a large tumour.

If the pelvis, however, is narrow, and the waters not all gone, the vertex should, if possible, be brought to present; but if the uterus is so closely contracted that this cannot be effected, on account of the strong pressure of the same and slipperiness of the child's head, in this case the method directed in the following Figure is to be taken.

FIGURE XXVII. represents, in the lateral view, the head of the *fœtus* in the same position as in the former Figure; but the delivery is supposed to be retarded from the largeness of the head, or a narrow pelvis.

In this case, if the head cannot be raised, and pushed up into the uterus, it ought to be delivered with the forceps in order to save the child. This position of the chin to the pubes is one of the safest cases where the face presents, and is most easily delivered with the forceps, the manner of introducing of which over the ears is shown in this Figure. The patient must lie on her back with her breech a little over the bed, her legs and thighs being supported by an assistant sitting on each side. The chin is then to be raised up over the pubes, whilst the forehead, fontanel, and occiput, are brought out slowly from the perineum and fundament, to prevent the same from being hurt or lacerated. But if the *fœtus* can neither be turned nor extracted with the forceps, the delivery must be left to the labour pains, as long as the patient is in no danger; but if danger is apparent, the head must be delivered with the curved crotchets. Vide Fig. 10, Plate of instruments.

When the face presents, and the chin is to the side of the pelvis, the patient must lie on her side; and after the forceps are fixed along the ears, the chin is to be brought down to the os ischium, and then turned out below the pubes, and delivered in a slow manner as before. Vide Fig. 19, 20, 21, 22, for the description of the parts.

No. 109. VOL. II.

FIGURE XXVIII. shows, in a lateral view of the right side, the face of the *fœtus* presenting, as in Fig. 26, but in the contrary position; that is, with the chin to the os sacrum, and the bregma to the pubes, the waters evacuated, and the uterus contracted. A, the os externum not yet begun to stretch. B, the anus. Vide Fig. 23. for the further description of the parts.

In such cases, as well as in those of the last-mentioned Figure, if the child is small, the head will be pushed lower with the labour pains, and gradually stretch the lower part of the vagina and the external parts; by which means the os externum will be more and more dilated, till the vertex comes out below the pubes, and rises up on the out side; in which case the delivery is then the same as in natural labours. But if the head is large, it will pass along with great difficulty; whence the brain and vessels of the neck will be so much compressed and obstructed as to destroy the child. To prevent which, if called in time, before the head is far advanced in the pelvis, the child ought to be turned and brought footling. If the head, however, is low down, and cannot be turned, the delivery is then to be performed with the forceps, either by bringing along the head as it presents, or as in the following Figure. See the references in the preceding Figure.

FIGURE XXIX. represents a lateral view of the left side of the subject, the *fœtus* in the same situation as in the former Figure. The head here is squeezed into a very oblong form; and though forced down so as fully to dilate the os externum, yet the vertex and occiput cannot be brought so far down as to turn out from below the pubes (as in the foregoing Figure), without tearing the perineum and anus, as well as the vagina and rectum.

The best method, in this case, after either the short or long curved forceps have been applied along the ears (as is represented in the Figure), is to push the head as high up in the pelvis as is possible; after which the chin is to be turned from the os sacrum to either os ischium, and afterwards brought down to the inferior part of the last-mentioned bone. This done, the operator must pull the forceps with one hand, whilst two fingers of the other are fixed on the lower part of the chin or under-jaw, to keep the face in the middle, and prevent the chin from being detained at the os ischium as it comes along; and in this manner move the chin round with the forceps and the above fingers till brought under the pubes; which done, the head will be easily extracted, as in Fig. 27.

In general, with respect to the posture of the woman in the application of the forceps, when the ears are to the sides of the pelvis, the forceps, as was observed in Fig. 27, are most easily introduced when the patient lies upon her back, and her breech over the side of the bed; but when the ear is to the pubes or groin, they are better applied when the patient lies on her side as was observed in the cases where the vertex presented.

Vide Fig. 27. for the description of the parts, and the references. Also Fig. 10. Plate of Instruments, for the manner of using the crotchet.

FIGURE XXX. gives a lateral view of a distorted pelvis divided longitudinally, with the head of a *fœtus* of the seventh month passing the same. Vide the Explanation of Fig. 3.

A, B, C, the os sacrum and coccyx. D, the os pubis of the left side. E, the tuberosity of the os ischium of the same side.

The head of the *fœtus* here, though small, is with difficulty squeezed down into the pelvis, and changed from a round to an oblong form before it can pass, there being only the space of two inches and one quarter between the projection of the superior part of the sacrum and ossa pubis. If the head is soon delivered, the child may be born alive; but if it continues in this manner many hours, it is in danger of being lost, on account of the long pressure upon the brain. To prevent which, if the labour-pains are not sufficiently strong, the head must be helped along with the forceps, as directed in Fig. 19.

This figure may serve as an example of the extreme degree of distortion of the pelvis, between which and the well-formed one are many intermediate degrees, according to which the difficulty of delivery must increase or diminish, as well as from the disproportion of the pelvis and head of the *fœtus*; all which cases require the greatest caution, both as to the management and safety of the mother and child.

FIGURE XXXI. gives a side-view of a distorted pelvis, as in the former Figure, with the head of a full-grown *fœtus* squeezed into the brim, the parietal bones decussating each other, and compressed into a conical form. A, B, C, the os sacrum and coccyx. D, the os pubis of the left side. E, the tuberosity of the os ischium. F, the processus acutus. G, the foramen magnum.

This Figure shows the impossibility in such a case to save the child, unless by the Cæsarian operation; which, however, ought never to be performed, except when it is impracticable to deliver at all by any other method. Even in this case, after the upper part of the head is diminished in bulk, and the bones are extracted, the greatest force must be applied in order to extract the bones of the face and basis of the skull, as well as the body of the *fœtus*.

FIGURE XXXII. represents, in a front view of the pelvis, as in Fig. 25, the breech of the *fœtus* presenting, and dilating the os internum the membranes being too soon broke. The fore parts of the child are to the posterior part of the uterus; and the funis with a knot upon it surrounds the neck, arm, and body.

MIDWIFERY.

We have sometimes felt in these cases, (when labour was begun, and before the breech was advanced into the pelvis), one hip at the sacrum, the other resting above the os pubis, and the private parts to one side: but before they could advance lower, the nates were turned to the sides and wide part of the brim of the pelvis, with the private parts to the sacrum, as in this Figure; though sometimes to the pubes as in the following figures. As soon as the breech advances to the lower part of the basin, the hips again return to their former position, viz. one hip turned out below the os pubis, and the other at the back parts of the os externum.

N. B. In this case the child, if not very large, or the pelvis narrow, may be often delivered alive by the labour pains; but if long detained at the inferior part of the pelvis, the long pressure of the funis may obstruct the circulation. In most cases where the breech presents, the effect of the labour-pains ought to be waited for, till at least they have fully dilated the os internum and vagina, if the same have not been stretched before with the waters and membranes. In the mean time, whilst the breech advances, the os externum may be dilated gently during every pain, to allow room for introducing a finger or two of each hand to the outside of each groin of the foetus, in order to assist the delivery when the nates are advanced to the lower part of the vagina. But if the foetus is larger than usual, or the pelvis narrow, and after a long time and many repeated pains the breech is not forced down into the pelvis, the patient's strength at the same time failing, the operator must, in a gradual manner, open the parts, and, having introduced a hand into the vagina, raise or push up the breech of the foetus, and bring down the legs and thighs. If the uterus is so strongly contracted that the legs cannot be got down, the largest end of the blunt hook is to be introduced as directed in Fig. 3, in the Plate of Instruments. As soon as the breech or legs are brought down, the body and head are to be delivered, as described in the next Figure, only there is no necessity here to alter the position of the child's body.

The description of the parts in this and the following Figure is the same as in Fig. 25, only the dotted lines in this describe the place of the ossa pubis, and the anterior parts of the ossa ischium, which are removed, and may serve in this respect as an example for all the other front views, where, without disfiguring the Figure, they could not be so well put in.

FIGURE XXXIII. shows, in the same view and with the same references as the former, the breech of the foetus presenting; with this difference, however, that the fore-parts of the child are to the fore-part of the uterus. In this case, when the breech coming double as it presents is brought down to the hams, the legs must be extracted, a cloth wrapped round them, and the fore-parts of the child turned to the back-parts of the woman. If a pain should in the mean time force down the body of the child, it ought to be pushed up again in turning, as it turns easier when the belly is in the pelvis, than when the breast and shoulders are engaged; and as sometimes the face and forehead are rather towards one of the groins, a quarter-turn more brings these parts to the side of the pelvis, and a little backwards, after which the body is to be brought down. If the child is not large, the arms need not be brought down, and the head may be delivered by pressing back the shoulders and body of the child to the perineum, and, whilst the chin and face are within the vagina, to bring the occiput out from below the pubes. If the woman has strong pains, and when by the felt pulsation of the vessels of the funis umbilicalis, or the struggling motion of the foetus, it is certain that the child is still alive, wait with patience for the assistance of the labour: but if that and the hand are sufficient, and the pulsation of the funis turns weaker, and if the child cannot be brought double, the breech must be pushed up; and if the resistance of the uterus is so great as to prevent the extraction of the legs, the patient ought to be turned on her knees and elbows. When the legs are thus brought down, the woman, if needful, is to be again turned on her back, to allow more freedom to deliver the body and head, as before described. If the head, after several trials, cannot be delivered, without endangering the child from overstraining the neck, the long curved forceps ought to be applied, as in Fig. 38. If these fail, and the patient is not in danger, some time may be allowed for the effect of the labour-pains; which likewise proving insufficient, the crotchet must be used as in Fig. 10, in the plate of instruments, and when it is certain that the child is dead, or that there is no possibility of saving it.

FIGURE XXXIV. represents, in a front view of the pelvis, the foetus compressed by the contraction of the uterus into a round form, the fore-parts of the former being towards the inferior part of the latter, and one foot and a hand fallen down into the vagina. In this figure the anterior part of the pelvis is removed by a longitudinal section through the middle of the foramen magnum.

A, A, the superior parts of the ossa ilium. B, B, the uterus. C, the mouth of the womb stretched, and appearing in O, O, O, O, the vagina. D, the inferior and posterior part of the os externum. E, E, E, E, the remaining part of the ossa pubis and ischium. F, F, F, F, the membrana adiposa.

This and the three following Figures, representing four different preternatural positions of the foetus in utero, may serve as examples for the manner of delivery in these as well as in all other preternatural cases.

In all preternatural cases, the foetus may be easily turned and

delivered by the feet, if known before the membranes are broke and the waters discharged; or if the pelvis is narrow, and the patient is strong, the head, if large, may be brought down so as to present in the natural way: but if all the waters are discharged and the uterus is strongly contracted to the body of the foetus, this last method can seldom take place, on account of the strong pressure of the uterus and slipperiness of the child's head.

In the present case, the woman may either be laid on her back or side, as described in Fig. 19 and 27, and the operator, having slowly dilated the os externum with his fingers, must introduce the same into the vagina, and push up into the uterus the parts of the foetus that present; or if there is space for it, his hand may pass in order to dilate the os internum, if not sufficiently stretched previously by the membranes and waters. This done, he must advance his hand into the uterus, to know the position of the foetus; and, as the breech is rather lower than the head, search for the other leg, and bring down both feet without the os externum. If the membranes are broken before the os uteri is largely opened, and the hand of the operator cannot be introduced, which sometimes happens in a first pregnancy, the parts of the foetus should be allowed to protrude still further, by which means the rigidity of the os externum will in time be lessened.

FIGURE XXXV. represents, in the same view with the former, the foetus in the contrary position; the breech and fore-parts being towards the fundus uteri, the left arm in the vagina, and the fore arm without the os externum, the shoulder being likewise forced into the os uteri.

The operator in this case must introduce his fingers between the back part of the vagina and the arm of the foetus, in order to raise the shoulder and make room for pressing his hand into the uterus to distinguish the position. This being known, he ought to push up the shoulder to that part of the uterus where the head is lodged, in order to raise the same to the fundus.

If the feet cannot be brought down lower than into the vagina, a noose may be introduced over both ankles, by which the legs are brought lower by pulling the noose with one hand, whilst the other, previously introduced into the uterus, pushes up the shoulders and head. By this double force the position of the foetus is to be altered, and the delivery effected. In these cases, as the shoulder is raised to the fundus, the arm commonly returns into the uterus; but if the arm is so swelled as to prevent the introduction of the operator's hand, and cannot be folded up or returned into the uterus, it must be taken off at the shoulder or elbow, in order to deliver and save the woman. If both the arms come down when the breast presents, the methods above described are to be used. Vide the explanations and references of the foregoing Figure.

FIGURE XXXVI. exhibits, in the same view likewise of the pelvis with the former, a third position of the foetus, when compressed into the round form; the belly, viz. or umbilical region, presenting at the os internum, and the funis fallen down into the vagina, and appearing at the os externum.

The delivery in this case is to be effected as in the former Figure, by pushing up the breast and bringing down the legs. When the belly presents, it is easier coming at the legs than when the breast presents, because in the former case the head is nearer to the fundus uteri, and the legs and thighs lower. If the belly or breast is forced down into the lower part of the pelvis, the child will be in danger from the bending of the vertebrae and the pressure of the spinal marrow. Such great force is also required to raise these parts up into the uterus, in order to come at the feet, that it will sometimes be necessary to turn the woman to her knees and elbows to diminish the resistance of the abdominal muscles. When the funis comes down without the os externum, if there is a pulsation felt, it must immediately be replaced and kept warm in the vagina, to preserve the circulation, and prevent a stagnation from its being exposed to the cold air. If the funis comes down when the head presents, the child is in danger, if not speedily delivered with the pains, or brought footling. See explanations in the two former Figures.

FIGURE XXXVII. shows, in a lateral view of the pelvis, one of the most difficult preternatural cases. The left shoulder, breast, and neck of the foetus presenting, the head reflected over the pubes to the right shoulder and back, and the feet and breech stretched up to the fundus, the uterus contracted at the same time in form of a long sheath round the body of the foetus.

A, B, C, the os sacrum and coccyx. D, the os pubis of the left side. E, part of the urinary bladder. F, the rectum. H, I, K, the private parts. M, the anus. M, N, the perineum. V, the matrus urinarius. O, the os uteri, not yet opened, and situated backwards towards the rectum and coccyx. R, S, the same represented in dotted lines as opened when the labour is begun. T, U, the same more fully dilated, but nearer to the posterior than anterior part of the pelvis. W, P, the same not fully stretched at the fore-part, though entirely obliterated at the back-part, the uterus and vagina being there only sometimes one continued surface.

Hence it appears why the anterior part of the os uteri is frequently protruded before the head of the foetus at the pubes, which, if it retards delivery, is removed by sliding it up with a finger or two between the head and last mentioned part. Vide FIG. 11, 14, 15, 16, 17.

FIGURE

M I D W I F E R Y.

FIGURE XXXVIII. shows, in a lateral view of the *pelvis*, the method of assisting the delivery of the head of the *fœtus* with the long curved forceps, in preternatural cases, when it cannot be done with the hands as described in Figures 32, 33.

A, the three lowest *vertebræ* of the loins, with the *os sacrum* and *coccyx*. B, the *os pubis* of the left side. C, C, the *perinæum* and *anus* pressed backwards with the forceps. D, the *intestines*. E, E, the *parietes* of the *abdomen*. F, F, F, the *uterus*. G, the posterior part of the *os uteri*. H, the *rectum*. I, the *vagina*.

After the body and arms of the child are delivered, and the different methods used to bring down the head with the hands, as directed in Fig. 37. the following method is to be tried, in order to save the child, who must otherwise be lost by overstraining the neck and spinal marrow. The woman being in the supine position, as in Fig. 27. one of the assistants ought to hold the body and arms of the child up towards the abdomen of the woman, to give more room to the operator, who having introduced one hand up to the child's face, and moved it from the side a little backwards for the easier application of the forceps along the sides of the head, must then turn his hand to one of the ears, and introduce one of the blades with the other hand between the same and the head, with the curved side towards the pubes, as in this figure. This done, the hand is to be brought down to hold the handle of the blade of the forceps till the other hand is introduced to the other side of the head, by which means the same is pressed against the blade that is up, and which is thus prevented from slipping whilst the other hand introduces the second blade on the opposite side. The blades being thus introduced, care must be taken that, in joining them, no part of the *vagina* is locked in.

The handles of the forceps should be raised upwards, and the same caution used in bringing the head through the *os externum*, as described in Fig. 22, 23. By this method the head will be delivered, the child frequently saved, and the use of the crotchet prevented, except in those basins that are so narrow that it is impossible to deliver without diminishing the bulk of the head.

FIGURE XXXIX. represents, in a lateral view of the *pelvis*, the method of extracting, with the assistance of a curved crotchet, the head of the *fœtus*, when left in the *uterus*, after the body is delivered and separated from it, either by its being too large, or the *pelvis* too narrow.

A, B, C, the *os sacrum* and *coccyx*. D, the *os pubis* of the left side. E, E, the *uterus*. F, the locking part of the crotchet. g, h, i, the point of the crotchet on the inside of the cranium.

If this case happens from the forehead's being towards the pubes, or the child long dead, and so mortified that both the body and under jaw are separated unexpectedly, the long forceps that are curved upwards will be sufficient to extract the head; but if the same is large, and the *pelvis* narrow, and the delivery cannot be effected by the above method, then the head must be opened, that its bulk may diminish as it is extracted. The patient being placed either on her back or side, as in the explanation of Fig. 19. and 27, the left hand of the operator is to be introduced into the *uterus*, and the forehead of the *fœtus* turned to the right side of the brim of the *pelvis*, and a little backwards, the chin being downwards; after which the palm of the hand and fingers are to be advanced as high as the fontanel, and the head grasped with the thumb and little finger on each side, as firm as is possible, whilst an assistant presses on each side of the *abdomen* with both hands, to keep the *uterus* firm in the middle and lower part of the same. This done, the operator having with his right-hand introduced and applied the crotchet of the head, (the point being turned towards the forehead, and the convex side towards the *sacrum*), he must go up along the inside of the left-hand as high as the fontanel, and there, or near it, fix the point of the crotchet, keeping still the left-hand in the former position, till with the other he pierces the cranium with the point of the instrument, and tears a large opening in it from K to I; after this, keeping the crotchet steady, he may slide down with his left-hand in a cautious manner, lest the former position should be altered, and the head will sink lower down by the assistants pressing on the *abdomen*. The two fore-fingers of the left-hand are then to be introduced into the mouth, and the thumb below the under-jaw, the hand being above the blade of the crotchet. When this firm hold is taken, the operator may begin and pull slowly with both hands; and as the brain discharges through the perforation, the head will diminish and come along.

The Figure may also serve for an example to show the method of fixing the crotchet on the head, when although the body is not separated from it, yet it cannot be delivered with the operator's hands or the long forceps, as in Fig. 32, and 38.

FIGURE XL. A, a portion of placenta magnified to shew the vessels more distinctly. B, one of the arteries of the *fœtus*, sent off by the navel string. C, the inhaling, or absorbing vessel of the artery. D, one of the veins belonging to the navel string. The letter D is placed upon the curvature, where the artery of the *fœtus* anastomoses with the vein. E, the exhaling vessel from the vein of the *fœtus*. F, an artery of the *uterus* opening into the spongy part of the placenta. G, the veins of the *uterus*.

From this Figure it appears that both the vein and artery of the *uterus* are inducted into the placenta with their mouths extended, and do not anastomose, like the vessels of the *fœtus*. This portion

of placenta was chosen, in order to demonstrate the subject with greater simplicity and perspicuity.

FIGURE XLI. A, the *fœtus* out of the *uterus* to shew the situation of the after-birth with greater precision. B, the navel string. C, membranes of the placenta. D, arteries of the *fœtus* branching from the navel string to the placenta. E, inhaling vessels of the arteries of the *fœtus*. F, veins branches off from the navel string of the *fœtus*. G, exhaling vessels of the veins of the *fœtus*. H, the spongy part of the placenta. I, the arteries of the *uterus*. K, the veins of the *uterus*. L, the cavity of the *uterus*; the *uterus* is supposed to be cut in halves. M, the cut edges of the *uterus*. N, the *os uteri* or *os externum*.

In this Figure we have given a view of the *uterus* and *fœtus* at the ninth month, in which is shewn the placenta or after-birth adhering to the *uterus*, by the vessels of the mother: the vessels are supposed to be half extracted, in order to shew their connection with the placenta.

This exertion of nature may be discovered by examining the cotylidones or placentalæ of the cow; in which the vessels are distinctly seen as you pull the cotylidone from the *uterus*.

There being a full and distinct circulation in the vessels of the *fœtus* and placenta without any anastomoses with the vessels of the mother, the explanation of the nourishment of the *fœtus* was thereby rendered difficult, till the time of Mr. John Hunter's experiment, in which he injected the arteries of the *uterus*, from a recent subject about the eighth month of pregnancy, with wax, when he found that he filled the whole of the spongy part of the placenta; and after that the wax returned by the veins of the *uterus*, so that there was a complete circulation without any of the wax entering the vessels of the *fœtus*. Mr. John Hunter also injected the vessels of the navel-string, by putting his pipe into the artery of it, and by this means filled the whole of the vessels, which belonged to the *fœtus* in the placenta; but none of the vessels which belonged to the mother; for the wax returned back again by the veins of the navel-string. So that here again the circulation was full and complete; no branches anastomosing between the vessels of the *fœtus* and those of the mother. By these means therefore he demonstrated that the nourishment of the child in the *uterus* is by absorption, or in other words, that the blood from the mother is conveyed by the arteries of the *uterus* into the spongy part of the placenta, and there taken up by the inhaling vessels of the arteries of the *fœtus*, and thence passing by the arteries into the *fœtus*, the nutritious parts of the blood are separated by the animal œconomy of the *fœtus*, and the refuse blood returned by the veins back again to the placenta, where, as the last course, it is taken up by the veins of the mother.

That the *fœtus* must be nourished by absorption is evident from the structure of animals which are born without either mouth or nose, or any passage through these parts into the stomach; and yet the *fœtuses* are plump and well nourished, without imbibing the smallest degree of the *liquor amnii*, as some writers have advanced.

FIGURE XLII. A, decidua reflexa. B, decidua vera. C, the true chorion. D, the amnion. E, the navel string. F, cut edges of the *uterus*. G, the cervix uteri. H, the *os externum*. I, the fallopian tubes. K, one of the ovaries cut through to shew the corpus luteum, or that appearance which always takes place in early pregnancy in the ova of the ovary.

This figure exhibits a view of the pregnant *uterus* about the fourth month, to shew the texture and situation of the *membrana decidua*. This membrane with its peculiarities was first discovered by Dr. William Hunter. It is distinguished from the other, by the very near resemblance it bears to Brussels lace; the term by which the Doctor always expressed it. The *membrana decidua* is the inner lamella of the *uterus*, and connects the secundines with the *uterus*. It is the first membrane that is formed, and rather belongs to the *uterus* than to the secundines: for when the *uterus* is injected, this membrane is also injected, but none of the others. So peculiarly does this membrane belong to the *uterus*, that when conception in the ovary takes place, the *fœtus* will have a placenta there; but the *decidua* will be found in the *uterus*. The *membrana decidua* forms as soon as conception takes place; it covers the inside of the *uterus*. That part of it which covers the ovum Dr. Hunter called *decidua vera*, that part which overspread the *uterus*, he called *decidua reflexa*.

DESCRIPTION OF THE PLATE OF INSTRUMENTS, used in the Practice of MIDWIFERY in laborious and difficult Cases.

FIGURE 1. the straight short forceps, in the exact proportion as to the width between the blades, and length from the points to the locking part: the first being two and the second six inches, which with five inches and a half (the length of the handles), makes in all eleven inches and a half. The length of the handles may be altered at pleasure. We find, however, in practice, that this standard is the most convenient, and with less difficulty introduced than when longer, having also sufficient force to deliver in most cases where their assistance is necessary.

FIGURE 2. represents the posterior part of a single blade, in order to show the open part of the same, and the form and proportion

MIDWIFERY.

portion of the whole. The handles, however, as here represented, are rather too large.

For the figure and proportions of the long forceps, that are curved upwards, and covered in the same manner as the former, see FIG. 24. in the former Plate.

FIGURE 3. the blunt hook; used for three purposes. *First*, To assist the extraction of the head after the cranium is opened with the scissars, by introducing the small end along the ear on the outside of the head to above the under jaw, where the point is to be fixed; the other extremity of the hook being held with one hand, whilst two fingers of the other are to be introduced into the foresaid opening, by which holds, the head is to be gradually extracted.

Secondly, The small end is useful in abortions, in any of the first four or five months, to hook down the secundines when lying loose in the uterus, when the patient is much weakened by floodings from the too long retentions of the same, the pains being also unable to expel them, and when they cannot be extracted with the fingers. But if the placenta still adheres, it is dangerous to use this or any other instrument to contract the same, as it ought to be left till it separates naturally. If a small part of the secundines is protruded through the os uteri, and pulled away from what still adheres in the uterus, the mouth of the womb contracts, and that irritation is thereby removed which would have continued the pains, and have separated and discharged the whole.

Thirdly, The large hook at the other end is useful to assist the extraction of the body, when the breech presents; but should be used with great caution, to avoid the dislocation or fracture of the thighs.

FIGURE 4. Represents the whalebone-fillet, which may be sometimes useful in laborious cases, when the operator is not provided with the forceps in sudden and unexpected exigencies.

When the vertex of the fœtus presents, and the head is forced down into the lower part of the pelvis, the woman weak, and the pains not sufficient to deliver it, the double of the fillet is to be introduced along the fore-part of the parietal bones to the face, and, if possible, above the under jaw; which done, the whalebone may be either left in or pulled down out of the sheath, and every weak pain assisted by pulling gently at the fillet. If the head can be raised to the upper part of the pelvis, the fillet will be more easily got over the chin, which is a safer and better hold than on the face. If the face or forehead presents, the fillet is to be introduced over the occiput.

In such cases likewise the whalebone may be supplied by a twig of any tough wood, mounted with a limber garter or fillet sewed in form of a long sheath.

FIGURES 5. and 6. give two views of a new kind of pessary for the *prolapsus uteri*, being taken from the French and Dutch kind. After the uterus is reduced, the large end of the pessary is to be introduced into the *vagina*, and the os uteri retained in the concave part, where there are three holes to prevent the stagnation of any moisture. The small end without the os *externum* has two tapes drawn through the two holes, which are tied to four other tapes, that hang down from a belt that surrounds the woman's body, and by this means keep up the pessary. This sort may be taken out by the patient when she goes to bed, and introduced again in the morning; but as this sometimes rubs the os *externum*, so as to make its use uneasy, the round kind, FIG. 7. are of more general use. They are made of wood, ivory, or cork (the last covered with cloth and dipt in wax); the pessary is to be lubricated with pomatum, the edge forced through the passage into the *vagina*, and a finger introduced into the hole in the middle, lays it across within the os *externum*. They ought to be larger or smaller, according to the wideness or narrowness of the passage, to prevent their being forced out by any extraordinary straining.

FIGURES 8. and 9. give two views of a female catheter, to show its degree of curvature and different parts. Those for common use may be made much shorter, for convenience of carrying in the pocket: but sometimes, when the head or body of the child presses on the bladder above the *pubes*, it requires one of this length; and in some extraordinary cases we have been obliged to use a male catheter.

FIGURE 10. represents a pair of curved crotchets locked together in the same manner as the forceps. It is very rare that the use of both is necessary, excepting when the face presents with the chin turned to the *sacrum*, and when it is impossible to move the head to bring the child footling, or deliver with the forceps. In that case, if one crotchet is not sufficient, the other is to be introduced, and, when joined together, will act both as crotchets, in opening the *cranium*, and, as the head advances, will likewise act as forceps in moving and turning the head more conveniently for the delivery of the same. They may also be useful to assist when the head is left in the uterus, and one blade is not sufficient. There is seldom occasion, however, for the sharp crotchet, when the head presents; the blunt hook in FIG. 30. of the former Plate, being commonly sufficient; or even the forceps to extract the same, after it is opened with the scissars. Great care ought to be taken, when the sharp crotchet is introduced, to keep the point towards the *fœtus*, especially in cases where the fingers cannot be got up to guide the same. The dotted lines along the inside of one of the blades represent a

sheath that is contrived to guard the point till it is introduced high enough; the ligature at the handles marked with the two dotted lines is then to be united, the sheath withdrawn, and the point, being uncovered, is fixed as directed in FIG. 39. of the former Plate. The point, guarded with this sheath, may also be used instead of the blunt hook.

FIGURE 11. gives a view of the back part of one of the crotchets, which is twelve inches long.

FIGURE 12. gives a front-view of the point, to show its length and breadth, which ought to be rather longer and narrower than here represented.

FIGURE 13. represents the scissars proper for perforating the *cranium* in very narrow and distorted *pelvises*. They ought to be made very strong, and nine inches at least in length, with stops or rests in the middle of the blades, by which a large dilatation is more easily made. The above instruments ought only to be used in the most extraordinary cases, where it is not possible to save the woman without their assistance.

Among the few improvements which have been made in the obstetrical apparatus, the most important are the alterations in the forceps, by which the inconveniences formerly attending the use of that instrument are obviated, and the operation is rendered more safe and easy.

In contriving these alterations, the intentions were, 1. That the large curves should correspond as nearly as possible with that of the pelvis. 2. That their points should be thrown forwards, and made round, to prevent their hitching, or even pressing uneasily against any part of the pelvis; and likewise to maintain their hold of the head whilst it is to be brought forwards in that curved line of direction which nature observes. 3. That an inverted curve should be made towards the joints, whereby the perineum may be saved from injury, the extracting force rightly conducted, and the handles at the same time kept from pressing uneasily on the inferior and anterior parts of the *pubes*. 4. That their substance should be reduced as much as possible, so that they are not made flexible, or so thin at the edges as to hurt the part. 5. That their clams may be made to press equally on the child's head, and spread gradually from the joint, so as not to dilate the os *vaginae* too suddenly. 6. That the clams be of a due breadth with the outer surface a little convex, and extremely smooth, that they may not press uneasily to hurt the woman. 7. That their length be such as can be applied safely and commodiously within the pelvis, and at the same time suit the different sizes of the heads as much as possible.

The instrument executed according to these intentions, is called the *short curved forceps*. It consists of two blades or parts; each of which is distinguished into the handle A, the joint B, C, and the clams D, E. See FIG. 14. which represents one of the blades before it is bent into its perfect state: *a, a, a*, are three holes for admitting screws to fix the wooden handle. FIG. 15. shows the instrument finished and locked, in which state it measures about 11 inches; and, when properly made, weighs about 11 ounces troy. The clams must be covered with the best Morocco leather, shaved thin, moistened with water, and sewed on with waxed silk.

FIGURE 16. represents a catheter lately preferred by practitioners. It is straight, perforated with 16 holes in four rows near the point, and terminated by a slight knob. The length is about 5½ inches.

The foregoing System was presented to us as an abridgement from Dr. Smellie, by a subscriber and contributor to this work. We have given the whole of the Plates contained in the Doctor's valuable Treatise. Doctor Smellie professes to have industriously avoided all Theory, except so much as may serve to aid the genius of young practitioners, and be as hints to introduce more valuable discoveries in the art. He adds, that as he has endeavoured to treat every particular in the most distinct though concise manner, many directions might occur that may be thought too minute and trivial by those who have already had the advantage of an extensive practice; but the work being principally intended for the instruction of young practitioners in general, he thought it necessary to mention every thing that he had found useful in the course of practice. The observations contained in his Treatise are not only the fruits of intense study and application, in the early part of life, but more immediately of his practice in London during ten years, in which he had given upwards of two hundred and eighty courses of Lectures on Midwifery, for the instruction of more than nine hundred pupils, exclusive of female students.

The Editor of this System, to render it as complete as possible, has introduced, in addition to Dr. Smellie's Plates, a view of the Membrana Decidua, first discovered by Doctor William Hunter, to shew the texture and situation of this Membrane, and which was considered as highly useful to the Doctor's Pupils, and all who are in possession of his excellent Lectures.

Though the manner in which the Fœtus is nourished in the womb, has been well explained in several anatomical publications, it has never been represented in any Treatise by Engravings; young students and practitioners have therefore been perplexed, for want of views to demonstrate and illustrate it; in consequence of which the Editor has introduced in this System two distinct views, in order to supply this defect, and to render the part more clear to our Readers.

TREATISE ON MILITARY AFFAIRS.

SECT. I.

RISE AND PROGRESS OF THE MILITARY STATE IN BRITAIN.

THIS state includes the whole of the soldiery; or such persons as are peculiarly appointed among the rest of the people, for the safeguard and defence of the realm. In a land of liberty, it is extremely dangerous to make a distinct order of the profession of arms. In absolute monarchies, this is necessary for the safety of the prince, and arises from the main principle of their constitution, which is that of governing by fear: but, in free states, the profession of a soldier, taken singly and merely as a profession, is justly an object of jealousy. In these no man should take up arms but with a view to defend his country and its laws: he puts not off the citizen when he enters the camp; but it is because he is a citizen, and would wish to continue so, that he makes himself for a while a soldier. The laws, therefore, and constitution of these kingdoms, know no such state as that of a perpetual standing soldier, bred up to no other profession than that of war: and it was not till the reign of Henry VII. that the kings of England had so much as a guard about their persons.

In the time of the Anglo-Saxons, as appears from Edward the Confessor's laws, the military force of England was in the hands of the dukes or heretochs, who were constituted through every province and county in the kingdom, being taken out of the principal nobility, and such as were most remarkable for being *sapientes, fideles, et animosi*. Their duty was to lead and regulate the English armies, with a very unlimited power; *prout eis visum fuerit ad honorem coronæ et utilitatem regni*. And because of this great power they were elected by the people in their full assembly, or folk-mote, in the same manner as sheriffs were elected: following still that old fundamental maxim of the Saxon constitution, that where any officer was entrusted with such power as, if abused, might tend to the oppression of the people, that power was delegated to him by the vote of the people themselves. Among the ancient Germans, the ancestors of our Saxon forefathers, they had their dukes, as well as kings, with an independent power over the military, as the kings had over the civil state. The dukes were elective, the kings hereditary: for so only can be consistently understood that passage of Tacitus, *Reges ex nobilitate, duces ex virtute sumunt*. In constituting their kings, the family, or blood-royal, was regarded; in choosing their dukes or leaders, warlike merit: just as Cæsar relates of their ancestors in his time, that whenever they went to war, by way either of attack or defence, they elected leaders to command them. This large share of power, thus conferred by the people, though intended to preserve the liberty of the subject, was perhaps unreasonably detrimental to the prerogative of the crown: and accordingly we find a very ill use made of it by Eadric, duke of Mercia, in the reign of king Edmund Ironside, who, by his office of duke, or heretoch, was entitled to a large command in the king's army, and, by his repeated treacheries, at last transferred the crown to Canute the Dane.

It seems universally agreed, by all historians, that king Alfred first settled a national militia in this kingdom, and by his prudent discipline made all the subjects of his dominions soldiers: but we are unfortunately left in the dark as to the particulars of this his so celebrated regulation; though, from what was last observed, the dukes seem to have been left in possession of too large and independent a power; which enabled duke Harold, on the death of Edward the Confessor, though a stranger to the royal blood, to mount, for a short space, the throne of this kingdom, in prejudice of Edgar Atheling the rightful heir.

Upon the Norman conquest, the feudal law was introduced here in all its rigour, the whole of which is built on a military plan. In consequence thereof, all the lands in the kingdom were divided into what were called knights fees, in number above 60,000; and for every knights fee a knight or soldier, *miles*, was bound to attend the king in his wars, for 40 days in a year: in which space of time, before war was reduced to a science, the campaign was generally finished, and a kingdom either conquered or victorious. By this means, the king had, without any expence, an army of 60,000 men always ready at his command. And accordingly we find one, among the laws of William the Conqueror, which in the king's name commands and firmly enjoins the personal attendance of all knights and others. This personal service, in process of time, degenerated into pecuniary commutations or aids; and at last the military part of the feudal system was abolished at the Restoration, by statute 12 Car. II. c. 24.

In the mean time we are not to imagine that the kingdom was left wholly without defence in case of domestic insurrections, or the prospect of foreign invasions. Besides those who by their military tenures were bound to perform 40 days service in the field, first the assise of arms, enacted 27 Hen. II. and afterwards the statute of Winchester, under Edward I. obliged every man, according to his estate and degree, to provide a determinate quantity of such arms as were then in use, in order to keep the peace; and constables were appointed in all hundreds by the latter statute, to see that such arms were provided. These weapons were changed by the statute 4 and 5 Ph. and M. c. 2. into others of more modern service; but both this and the former provisions were repealed in the reign of James I. While these continued in force, it was usual from time to time for our princes to issue commissions of

array, and send into every county officers in whom they could confide, to muster and array (or set in military order) the inhabitants of every district; and the form of the commission of array was settled in parliament in the 5th Hen. IV. But at the same time it was provided, that no man should be compelled to go out of the kingdom at any rate, nor out of his shire, but in cases of urgent necessity; nor should provide soldiers unless by consent of parliament. About the reign of king Henry VIII. lord-lieutenants began to be introduced, as standing representatives of the crown, to keep the counties in military order; for we find them mentioned as known officers in the statute 4 and 5 Ph. and M. c. 3, though they had not been then long in use; for Camden speaks of them in the time of queen Elizabeth as extraordinary magistrates, constituted only in times of difficulty and danger.

In this state things continued till the repeal of the statutes of armour in the reign of king James I; after which, when king Charles I. had, during his northern expeditions, issued commissions of lieutenancy, and exerted some military powers which, having been long exercised, were thought to belong to the crown, it became a question, in the long parliament, how far the power of the militia did inherently reside in the king; being now unsupported by any statute, and founded only upon immemorial usage. This question, long agitated with great heat and resentment on both sides, became at length the immediate cause of the fatal rupture between the king and his parliament: the two houses not only denying this prerogative of the crown, the legality of which claim perhaps might be somewhat doubtful; but also seizing into their hands the entire power of the militia, the illegality of which step could never be any doubt at all.

Soon after the restoration of king Charles II. when the military tenures were abolished, it was thought proper to ascertain the power of the militia, to recognize the sole right of the crown to govern and command them, and to put the whole into a more regular method of military subordination: and the order in which the militia now stands by law, is principally built upon the statutes which were then enacted. It is true, the two last of them are apparently repealed; but many of their provisions are re-enacted, with the addition of some new regulations, by the present militia laws: the general scheme of which is to discipline a certain number of the inhabitants of every county, chosen by lot for three years, and officered by the lord-lieutenant, the deputy-lieutenants, and other principal landholders, under a commission from the crown. They are not compellable to march out of their counties, unless in case of invasion or actual rebellion, nor in any case compellable to march out of the kingdom. They are to be exercised at stated times: and their discipline in general is liberal and easy; but, when drawn out into actual service, they are subject to the rigours of martial law, as necessary to keep them in order. This is the constitutional security which our laws have provided for the public peace, and for protecting the realm against foreign or domestic violence; and which the statutes declare is essentially necessary to the safety and prosperity of the kingdom.

When the nation was engaged in a war, more veteran troops and more regular discipline were esteemed to be necessary, than could be expected from a mere militia; and therefore at such times more rigorous methods were put in use for the raising of armies, and the due regulation and discipline of the soldiery; which are to be looked upon only as temporary excrescences bred out of the distemper of the state, and not as any part of the permanent and perpetual laws of the kingdom. For martial law, which is built upon no settled principles, but is entirely arbitrary in its decisions, is, as Sir Matthew Hale observes, in truth and reality no law, but something indulged rather than allowed as a law. The necessity of order and discipline in an army is the only thing which can give it countenance; and therefore it ought not to be permitted in time of peace, when the king's courts are open for all persons to receive justice according to the laws of the land. Wherefore, Thomas Earl of Lancaster being convicted at Pontefract, 15 Edw. II. by martial law, his attainder was reversed 1 Edw. III. because it was done in time of peace. And it is laid down, that if a lieutenant, or other, that hath commission of martial authority, doth, in time of peace, hang or otherwise execute any man by colour of martial law, this is murder: for it is against *magna charta*. And the petition of right enacts, that no soldier shall be quartered on the subject without his own consent; and that no commission shall issue to proceed within this land according to martial law. And whereas, after the Restoration, King Ch. II. kept up about 5000 regular troops, by his own authority, for guards and garrisons; which king James II. by degrees, increased to no less than 30,000 all paid from his own civil list; it was made one of the articles of the bill of rights, that the raising or keeping a standing army within the kingdom, in time of peace, unless it be with consent of parliament, is against law.

But as the fashion of keeping standing armies (which was first introduced by Charles VII. in France, 1445,) has of late years universally prevailed over Europe, (though some of its potentates, being unable themselves to maintain them, are obliged to have recourse to richer powers, and receive subsidiary pensions for that purpose,) it has also for many years past been annually judged necessary by our legislature, for the safety of the kingdom, the defence

MILITARY AFFAIRS.

of the possessions of the crown of Great Britain, and the preservation of the balance of power in Europe, to maintain, even in time of peace, a standing body of troops, under the command of the crown; who are however *ipso facto* disbanded at the expiration of every year, unless continued by parliament. And it was enacted by statute 10 W. III. c. 1. that not more than 12,000 regular forces should be kept on foot in Ireland, though paid at the charge of that kingdom: which permission is extended by 8. stat. Geo. III. c. 13. to 16,235 men in time of peace.

To prevent the executive power from being able to oppress, says baron Montesquieu, it is requisite that the armies with which it is entrusted should consist of the people, and have the same spirit with the people; as was the case at Rome, till Marius new modelled the legions by enlisting the rabble of Italy, and laid the foundation of all the military tyranny that ensued. Nothing then, according to these principles, ought to be more guarded against, in a free state, than making the military power, when such a one is necessary to be kept on foot, a body too distinct from the people. Like ours, therefore, it should wholly be composed of natural subjects; it ought only to be enlisted for a short and limited time; the soldiers also should live intermixed with the people; no separate camp, no barracks, no inland fortresses should be allowed. And perhaps it might be still better, if, by dismissing a stated number, and enlisting others at every renewal of their term, a circulation could be kept up between the army and the people, and the citizen and the soldier be more intimately connected together.

To keep this body of troops in order, an annual act of parliament likewise passes, "to punish mutiny and desertion, and for the better payment of the army and their quarters." This regulates the manner in which they are to be dispersed among the several inn-keepers and victuallers throughout the kingdom; and establishes a law-martial for their government. By this, among other things, it is enacted, that if any officer or soldier shall excite, or join any mutiny, or, knowing of it, shall not give notice to the commanding officer, or shall desert, or lift in any other regiment, or sleep upon his post, or leave it before he is relieved, or hold correspondence with a rebel or enemy, or strike or use violence to his superior officer, or shall disobey his lawful commands, such offender shall suffer such punishment as a court-martial shall inflict, though it extend to death itself.

However expedient the most strict regulations may be, in time of actual war, yet, in times of profound peace, a little relaxation of military rigour would not, one should hope, be productive of much inconvenience. And, upon this principle, though by our standing laws (still remaining in force, though not attended to) desertion in time of war is made felony without benefit of clergy, and the offence is triable by a jury and before the judges of the common law; yet, by our military laws before-mentioned, a much lighter punishment is inflicted for desertion in time of peace. So, by the Roman law also, desertion in time of war was punished with death, but more mildly in time of tranquillity. But our mutiny-act makes no such distinction; for any of the faults above-mentioned are, equally at all times, punishable with death itself, if a court-martial shall think proper. This discretionary power of the court-martial is indeed to be guided by the directions of the crown; which, with regard to military offences, has almost an absolute legislative power. "His Majesty (says the act) may form articles of war, and constitute courts-martial, with power to try any crime by such articles, and inflict such penalties as the articles direct." A vast and most important trust! an unlimited power to create crimes and annex to them any punishments not extending to life or limb! These are indeed forbidden to be inflicted, except for crimes declared to be so punishable by this act; which crimes we have just enumerated, and among which, we may observe, that any disobedience to lawful commands is one. Perhaps in some future revision of this act, which is in many respects hastily penned, it may be thought worthy the wisdom of parliament to ascertain the limits of military subjection, and to enact express articles of war for the government of the army, as is done for the government of the navy: especially as, by our present constitution, the nobility and gentry of the kingdom, who serve their country as militia officers, are annually subjected to the same arbitrary rule during their time of exercise.

One of the greatest advantages of our law is, that not only the crimes themselves which it punishes, but also the penalties which it inflicts, are ascertained and notorious; nothing is left to arbitrary discretion: the king by his judges dispenses what the law has previously ordained; but is not himself the legislator. How much therefore is it to be regretted, that a set of men, whose bravery has so often preserved the liberties of their country, should be reduced to a state of servitude in the midst of a nation of freemen! for Sir Edward Coke will inform us, that it is one of the genuine marks of servitude, to have the law, which is our rule of action, either concealed or precarious; *Miseri est servitus ubi jus est vagum aut incognitum*. Nor is this state of servitude quite consistent with the maxims of sound policy observed by other free nations. For the greater the general liberty is which any state enjoys, the more cautious has it usually been in introducing slavery in any particular order or profession. These men, as baron Montesquieu observes, seeing the liberty which others possess, and which they themselves are excluded from, are apt

(like eunuchs in the eastern seraglios) to live in a state of perpetual envy and hatred towards the rest of the community, and indulge a malignant pleasure in contributing to destroy those privileges to which they never can be admitted. Hence have many free states, by departing from this rule, been endangered by the revolt of their slaves: while, in absolute and despotic governments, where no real liberty exists, and consequently no invidious comparisons can be formed, such incidents are extremely rare. Two precautions are therefore advised to be observed in all prudent and free governments: 1. To prevent the introduction of slavery at all: or, 2. If it be already introduced, not to entrust those slaves with arms, who will then find themselves an overmatch for the freemen. Much less ought the soldiery to be an exception to the people in general, and the only state of servitude in the nation.

But as soldiers, by this annual act, are thus put in a worse condition than any other subjects; so, by the humanity of our standing laws, they are in some cases put in a much better. By statute 43 Eliz. c. 3. a weekly allowance is to be raised in every county for the relief of soldiers that are sick, hurt, and maimed; not forgetting the royal hospital at Chelsea for such as are worn out in their duty. Officers and soldiers, that have been in the king's service, are by several statutes, enacted at the close of several wars, at liberty to use any trade or occupation they are fit for, in any town in the kingdom (except the two universities), notwithstanding any statute, custom, or charter to the contrary. And soldiers in actual military service may make nuncupative wills, and dispose of their goods, wages, and other personal chattels, without those forms, solemnities, and expences which the law requires in other cases. Our law does not indeed extend this privilege so far as the civil law, which carried it to an extreme that borders upon the ridiculous: for if a soldier, in the article of death, wrote any thing in bloody letters on his shield, or in the dust of the field with his sword, it was a very good military testament.

SECT. II.

MILITARY DISCIPLINE, GENERAL AND PARTICULAR.

Military discipline, generally considered, is the training of soldiers, and the due enforcement of the laws and regulations instituted by authority for their conduct. Next to the forming of troops, military discipline is the first object that presents itself to our notice: it is the soul of all armies; and unless it be established amongst them with great prudence, and supported with unshaken resolution, they are no better than so many contemptible heaps of rabble, which are more dangerous to the very state that maintains them, than even its declared enemies.

Though the general principles of the art of war be the same in all ages and countries, yet in the particular modes various changes are effected by the flux of time, and by the improvements that are made, and the arts that are invented, in the course of it. Conquest is no longer established on the same basis, and the superiority of troops is no longer founded on the same principles as they have been. The event of a battle depends much less at present on the personal strength and prowess of individuals, than it did in the days of our forefathers: and the superiority of one nation over another in those particulars is no longer of the same importance. No great degree of personal strength is required for the present method of fighting; and, as for courage, it has been found to consist more in discipline, than in any particular constitution either of mind or body. Discipline improves the courage men have derived from nature, and by inspiring them with a confidence in themselves, and in each other, excites an artificial courage where the natural one is deficient. It is discipline that creates and preserves that principle of union, which guides and directs to an uniform end thousands of persons endowed with different and even opposite talents, and urged on by various interests, wishes and inclinations.

By the force of discipline men are kept in order and obedience to command, in opposition to the strongest immediate impulse of their passions. When troops are said to be routed, nothing more is meant, than that they are put into confusion, or that order, subordination, and obedience to command are fled; in which case every man consults his own personal safety, at the instigation of the predominant passion, fear, or the desire of self-preservation. Now those troops that are the best disciplined will retain the longest due order and obedience: therefore, the best disciplined troops are with the most difficulty put into confusion; or, in other words, are the least liable to be conquered.

But to illustrate the advantages of discipline is required neither logical proof, nor mathematical demonstration; its necessity having been established by the most convincing, if not the surest, of all tests, that of experience: and this subject has been so copiously treated by numbers of military authors, that it is needless to expatiate any further on it here; and indeed it would be difficult to produce any new matter on so threadbare a topic. It shall not then be our business to hold forth the use and necessity of discipline, but to explain what that discipline consists in through its several branches.

Before we proceed any further, it will be necessary to premise, that though some parts of our subject may appear trifling, yet, perhaps, they are so only in appearance, and may possibly be of more importance than our readers may imagine; that even the minutiae of

MILITARY AFFAIRS.

of discipline are not beneath the notice of any military man; for it has been a general remark, that as those regiments, which have made the best figure on the parade, have, when taken upon service, distinguished themselves the most against the enemy; so that those officers, who have in their riper years turned out to be the ablest generals, have, when young in the service, been the most remarkable for their attention to every point of discipline, to the minute and trifling, as well as to the greater and more important parts of their duty.

By *military discipline*, in a particular sense, we are to understand the mechanical part of the business of war; which is the only one that can be reduced to fixed and precise rules. Sometimes the word, *discipline*, bears the confined signification of *regiment*; or the principles, laws, and method of government; thus, when we say, such troops are kept under strict discipline, we mean, that the laws, by which they are governed, are severe: but here it is to be taken in its utmost latitude.

In this sense, we consider *military discipline* as divided into three distinct branches, which also admit of their several subdivisions. The first is, the formation, training and exercising of troops, or teaching them how to array themselves, the management of their arms, their movements or evolutions, and the practice of every thing that may be executed in the field: the second we take to be the ordinary duties and *routine* of the service, as the manner of mounting guards in camp and garrison, going rounds, paying honours, performing ceremonies, &c. which is intimately connected with the first part, and founded principally upon it: the third part of discipline consists in the laws and institutions of war, which are, first, the act of parliament for the government of the army; then the articles of war framed by his Majesty, as well as other regulations established by him; and lastly, the unwritten law, or custom of war which comprehends every thing that relates to rights of persons, administration of justice, &c. The same connexion subsists between this and the second part of discipline, as between the second and the first. Of these parts, the first is defined by the expression of *Military Arrangement*, the two others by that of *Discipline of War*.

SECT. III.

MILITARY ARRANGEMENT AND INSTITUTIONS.

An army is to be considered as it is formed of different *arms*, or kinds of troops, or as it is resolved into its component parts. As to the different kinds or species of troops, they are either cavalry, dragoons or infantry; besides the corps appointed to the service of the artillery. Infantry consisted formerly of pikemen and musketeers; but since the invention of the bayonet, pikes have been exploded throughout Europe. Of late years the institution of light-armed infantry has been revived, and a company in each regiment allotted to that service. Again, when we consider an army as resolved into its constituent parts, it is first divided into wings; those wings into brigades; and those brigades into regiments, or into squadrons and battalions.

It is worthy of observation, that in the most remote parts of the world, and among nations, who have not had the smallest intercourse with each other, the same divisions, or nearly the same, have been adopted in their respective armies; at least among such as have arrived to any degree of proficiency in the art of war. Experience, which is productive of the same effects in all countries, and which dictates the same precepts in all quarters of the globe, has pointed out to different people the necessity of forming their troops into small distinct bodies; the cavalry into squadrons, consisting of from 100 to 200 men and the infantry into battalions, of from 500 to 1000. The present establishment of battalions, which prevails among the European powers, is generally of about 600 or 700 men; which have been found as many as can be manœuvred together with ease and safety before an enemy.

The service of the dragoons, on its first institution, was a kind of medium between that of the cavalry and the infantry. They were then musketeers mounted on horseback, more for the sake of expedition, than for fighting or charging an enemy: when they had occasion to fight, they generally dismounted. But now, in most services in Europe, and particularly in the British, the dragoons are nothing inferior to the cavalry, but being still trained to the exercise of the foot, they are capable of serving alike on foot as on horseback.

The institution of dragoons we derived from the French, among whom it was devised by Marshal Brissac. Whence they took their name does not appear so clearly, various accounts being given.

Since dragoons have been put on the footing of cavalry, a very small number of the latter have been kept up in our service; there being at present only five regiments of cavalry, properly so called on the British and Irish establishments; besides the four troops of horse, and horse-grenadier guards. We have some regiments called Dragoon-guards; but this distinction is merely nominal; those three regiments being exactly on the same footing with the other regiments of dragoons: notwithstanding they claim precedence of them.

Of the dragoons or cavalry, some regiments are light and others heavy; but this regards only the size of men and horses

weight of offensive arms, and difference of training. Formerly the heavy cavalry were completely provided with defensive arms; at present none are used but the helmet, and that not musket-proof, worn by the dragoons. In time of war, indeed, the heavy-mounted have of late been furnished with skull caps and breast plates: and their use in battle may be readily conceived from a computation made by the King of Prussia, that in one action only above 600 horsemen's lives were saved by the *cuirass*, or breast-plate. Those worn by the French cavalry are proof only against a pistol bullet.

The bulk of our modern armies is composed, as was the case among the ancients, of infantry. In that dreary and barbarous interval between the decay of the military science, which took place with the subversion of the Roman empire, and its modern revival, which happened about the same time with that of arts and letters, an army was judged to be strong and formidable, in proportion as it abounded with cavalry; and this branch, from the superiority of its institution, the repute in which it was held, and the rank of the persons who composed it, challenged a precedence beyond the other, which it is now by no means entitled to. The English, indeed, who, during these ages, were superior to most, if not to all the other European nations in their military institution, always had in their armies a considerable body of infantry; (for most of the archers served on foot, though a great part of them were mounted) and this perhaps was a principal cause of those splendid victories, which our Edwards and Henrys obtained with small bodies over much greater numbers of the enemy. Among the French not a single foot soldier was to be seen; and their armies consisted entirely of horse, for the space of several centuries, excepting some mercenary foot, hired of foreigners, and particularly of their neighbours, the Swiss cantons. Infantry was no less neglected among the Spaniards, as we are informed from a circumstance which at the same time gives us the derivation of the name. The army of a Spanish monarch, which consisted entirely of cavalry, having been routed by the Moors, and being closely pursued by the enemy, the Infanta suddenly raised a body of men, whom she armed, as well as she could, and marched with all expedition to the succour of her father. The Moorish cavalry pursuing the Spaniards, in some disorder, the Infanta with her levies met them in a close country, engaged, and gave them a complete overthrow. Footmen were then so unusual among the Spaniards, that they had no name for them: Hence, on that occasion, they called them *Infanteria*, in honour of the Infanta; which name was perpetuated, and adopted by the other European armies.

SECT. IV.

SUBORDINATION OF RANK.

The first step towards the establishment of discipline, and the formation of the troops, is the appointment of officers to command them. And in this appointment of officers, the first principle is, that there be always *one supreme and sole in command*. Therefore a regular gradation or chain of authority must be observed, from the commander in chief of an army down to the lowest non-commission officer of a company; the smallest distinct body of which an army is composed. But exclusive of this subordinate chain, there are branches which take different directions, and which terminate in themselves; though they derive their origin from the same general head. Such are the officers who are called of the staff; they have peculiar departments, and are subject only to the authority of the commander of that body to which they are appendages; or to his superiors. Thus the adjutant-general is immediately subservient to the commander in chief; a major of brigade to his brigadier, and an adjutant to the commanding officer of his battalion.

It must be observed, that, by the system of subordinate representation, the power and prerogative of the highest officer descends in his absence to the next in degree; thus, while an officer remains, no corps can be without its commander. For instance, if the colonel and lieutenant-colonel of a regiment are not present, the major succeeds to the authority of command; and, in that case, the same obedience is due to him as to the colonel. This points out the method by which we shall consider the rank and duties of the different officers.

The officers, by which an army, considered as an aggregate body, is commanded, are the CAPTAIN GENERAL, or commander in chief, and the other GENERAL and STAFF OFFICERS.

A general appointed to command an army, has, for the most part, a commission of commander in chief: and the extent of his authority must depend on the powers with which he is invested by that commission; but that denomination was suspended for a considerable time, and has only taken place of late, by the appointment of the Duke of York, to the exalted station to which it is affixed. The rank of a field-marshal of France is permanent and general; whereas that of an English commander in chief or captain-general is temporary and local: for a lieutenant, or even a major general, has often in our service the appointment of commander in chief. The power of filling up vacant commissions, and of issuing warrants for the assembling and holding of general courts martial, &c. is usually

MILITARY AFFAIRS.

usually delegated by the king to the commanders in chief, whom he appoints, within their respective commands or districts. On service abroad, the commanders in chief generally have the privilege of signing the commission; but in Great Britain and Ireland, though they may nominate to vacancies, yet every thing is done in the king's name, and all commissions are signed by his Majesty.

A proper number of GENERAL OFFICERS are appointed according to the strength of the army. For this proportion no certain rules are established. When the army is considerable, the following may be considered as an adequate staff, exclusive of the commander in chief: a general for the horse, and one for the foot; or a general for each wing of the army: a major general for every two brigades; and about half that number of lieutenant generals. Notwithstanding the distinct appellations of general, lieutenant, and major general, their duties are much the same. Those terms serve to little other purpose, but to denote the successive gradations of rank.

At a siege, a general officer is appointed to the command of each attack. On the day of march, each column of the army has its own general officer to lead and command it. These duties are done by seniority.

Besides the general officers and their aid-de-camps, there are other officers upon the staff; who are properly called STAFF-OFFICERS of the army. Of these the principle are, the ADJUTANT and QUARTER-MASTER-GENERAL.

The adjutant-general is the officer who manages, in conjunction with the majors of brigade, the whole detail of the army. He is always an attendant upon the general's person, and must reside at or near the head quarters. This post of adjutant-general confers no rank on the person who holds it; but as it requires experience, no less than activity, it is in a large army usually occupied by a general officer.

The office of QUARTER-MASTER-GENERAL relates, as the name itself implies, to the distributions of quarters for the army. When the army is to encamp, he goes on the day before, with the major-general of the day, to choose the ground for the encampment. The adjutant-general is provided with a deputy, who is also an officer of the army, to assist him in the execution of his duty. The quarter-master-general likewise has a deputy, besides a certain number of assistants. These are the principal staff-officers.

A BRIGADIER, or as he is commonly styled BRIGADIER-GENERAL, is the commanding officer of a brigade; and his rank, like that of a captain-general, is temporary and local.

Each brigadier has an officer, called MAJOR OF BRIGADE, who serves him both in quality of adjutant and aid-de-camp: but as a brigadier is a general officer only in his own brigade, he cannot issue his orders, or extend his authority any farther.

The general officers always appoint their own aid-de-camps; but the majors of brigade are not always appointed by their own brigadiers. Sometimes they are nominated by his Majesty, or the person who represents him; in which case they have commissions. When appointed by the brigadiers, they are generally chosen among the captains or subalterns of the brigade. As the adjutants of regiments are often subaltern officers, the post of brigade-major should always be given to some officer of a higher rank: it has frequently been the maxim to confer this office on the oldest captain in the brigade.

The officers of a regiment or battalion are the field and staff officers; they correspond to the general and staff officers of an army. And first of the FIELD OFFICERS, who are in generally three, viz. a COLONEL, a LIEUTENANT-COLONEL, and a MAJOR.

The power of the colonel was formerly much more extensive than it is at present. As they generally raised their own regiments, they had the absolute disposal of the commissions; and if they had not authority to break their officers without trial, they had at least that to suspend them at discretion. They have still the power, when present with their regiments, of appointing the non-commissioned officers, and of reducing them without a court-martial: but all that remains of their former authority to fill up the vacant commissions, is that of examining, and either approving or rejecting such gentlemen as wish to purchase into the corps.

The cloathing and accoutrements of the regiment are provided by the colonel from the stoppages made for that purpose; and he has the sole power of fixing and altering the uniform, in conformity to the King's regulations. A colonel's command is from 600 to 1000 men or upwards. But it is to be remarked, that a colonel, as well as all other officers of whatsoever rank, cannot refuse to march with any number of men, however small, when the service requires it.

The LIEUTENANT-COLONEL is simply the *locum tenens* of the colonel, commanding the regiment in the absence of the latter. There are nevertheless some branches of the colonel's prerogative, which are peculiar to himself, whether absent or present with his corps, and which the lieutenant-colonel does not partake of. A lieutenant-colonel's command may consist of from 300 to 600 men, or upwards.

The third and last field-officer of a regiment is the MAJOR. When the colonel and lieutenant-colonel are both absent, he becomes the commanding officer; and, in that case, the oldest captain usually does his duty. The duties of the major are of great number and variety; but the first and principal one is to exercise the regiment under the inspection of the colonel; for

which reason he must have a perfect knowledge of the exercise, and of all the manœuvres.

The staff commission officers in a regiment are, the adjutant, the quarter-master, the surgeon, and the chaplain. The non-commission officers, who act upon the staff, are the serjeant-major, the quarter-master-serjeant, and the drum-major. These two last, indeed, are not in general reckoned as part of the staff: yet, having peculiar duties of their own, they come under our description of staff-officers.

The ADJUTANT is to the commanding-officer of a regiment what an aid-de-camp is to a general, and a major of a brigade to a brigadier. He likewise bears the same relation to a regiment as an adjutant-general does to an army.

The QUARTER-MASTER is the next staff officer to the adjutant. His employment is rather of a civil than a military nature, he having nothing to do with the discipline of the regiment. The name itself of quarter-master is expressive of his principal duty, viz. the care of providing and inspecting the quarters of the regiment.

The SURGEON is another commission officer on the staff of a regiment, and should not only be well skilled in the branch of surgery, but should also be a good physician and apothecary, being obliged to act in those three capacities towards the sick and wounded. He is allowed a mate to assist him, who has no commission, but acts by virtue of a warrant from the colonel. Before any person can be appointed surgeon or mate to a regiment, he must pass an examination for each degree before the board of surgeons.

The next and last commission officer on the staff is the CHAPLAIN; the nature of whose office is too well known to require any explanation. He is generally allowed, when he thinks proper, to act by deputy.

Having taken a summary view of the rank and duties of the officers properly belonging to an army, a brigade, and a regiment or battalion, we come to the consideration of those belonging to a company; the smallest independent body of which an army is composed.

The CAPTAIN is to his own company what the colonel is to the whole regiment. He has the entire charge and command of it in every particular that regards its discipline and œconomy.

A captain's usual command on guard, picquet, or detachment, is from 50 to 100 men; and he has always at least two subalterns along with him: with 100 men he has three subalterns.

The commission-officers in a company, subordinate to the captain, are, the LIEUTENANT and ENSIGNS; who are commonly called the SUBALTERN OFFICERS. These, though their rank is not the same, yet, for the most part, roll in duty together without distinction. Their ordinary duties are, in garrison, guards, detachments, courts-martial, visiting the hospital and barracks: in camp, guards, detachments, out-posts, picquets, courts-martial, fatigues or working parties, and orderly duties. No officer can change his duty with another, unless by permission of the commanding officer.

The non-commission officers of a company are the SERJEANTS and CORPORALS; and upon a proper choice of these officers, the discipline of the company, and consequently that of the corps, principally depends. For it is more immediately their business, than that of the commission officers, to instruct and form the soldiers; and from their continual intercourse with them they have it in their power to attend to matters which cannot so well come under the notice of the others.

The serjeants being the nerves and sinews of the corps, a commanding officer must, in promoting private soldiers to the knot, have principally in view the training up and forming of proper characters for the halbert. Any active young soldier, who has already perfected himself in the exercise, and has some general knowledge of his duty as a private soldier, with an emulous ambition of improvement, may be fit to do the duty of corporal: but to make a good serjeant, requires various qualifications, and good natural and acquired abilities. A serjeant should not only be perfectly expert himself in the exercise of the firelock and halbert, and in all the parade and field duties; but should likewise be able to instruct others: and he will be not only required to inform his inferiors alone, but sometimes his superiors likewise. He must understand writing and accounts, and must be well informed of the whole routine of the service and the customs of the army.

Since it requires such length of time and experience to qualify a soldier to do the duty of a serjeant, it follows that none but young men should be made corporals. Should the oldest soldiers in each company be promoted to the knot, they might be superannuated, or at least unfit for active service, by the time they became candidates for the halbert.

NEW MANUAL AND PLATOON EXERCISE. SECT. V.

In order to render this Treatise as complete as possible, we have presented our readers with a description of the manual exercise now in general practice throughout our army, and have introduced two new Plates, in order to illustrate each motion; and as figures essentially conduce to a due representation of the motions, it is presumed they will be considered as a valuable appendage to the new edition of this work.

MILITARY AFFAIRS.

A prodigious alteration has of late years been introduced in the manual exercise, corresponding to the present mode of drawing up the battalion. The motions of the old exercise were so wide, that it required double the interval now allowed between each file to perform them in; whence it was necessary to open the files, as well as the ranks, for the performance of the manual, and to close them again when it was over, for the firings: so that the opening and closing of the files made half the business of a field day: whereas, now, the same order serves for every different operation. Besides the avoiding of this inconvenience and delay, the new exercise has this further advantage over the old, that its motions are less complicated, and more easily compassed by a recruit. For these improvements in the manual we are indebted to the Prussians, from whom they have been either copied or imitated, by the troops of almost every power in Europe.

At the same time that the motions have been contracted, a considerable change has likewise been effected in the time. The British foot have lately adopted a slow time, as they now count one, two, three, between each motion, which alteration is considered as a material improvement. A quick motion certainly diminishes much the grace and beauty of the exercise, without the compensation of any solid advantage: for it does not appear that a battalion can fire oftener in the same space of time, since the quick method has taken place, than before. Besides, it may be doubted, whether steadiness be not of greater advantage in action than quick firing. At any rate it must be allowed, that the German troops in general fire as well and as quick as any troops in Europe; and yet they still adhere to the slow method of performing the manual.

POSITION OF THE SOLDIER UNDER ARMS.

Nothing is more essential than an equal squareness of body; the heels in a line and close; the knees in a line, without stiffness, the toes turned out, the arms hanging straight by the body, the thumbs as far back as the seams of the breeches, and the little fingers touching the thighs. The elbows and shoulders are to be kept back, the belly rather drawn in, and the breast advanced, but without constraint. The body should be upright, but inclining a little forward, so that the weight of it may bear chiefly on the forepart of the feet. The head to be erect, and neither turned to the right or left. The eyes alone to be glanced to the right.

The body of the soldier being in this position, the firelock is to be placed in his left hand, against the shoulder, his wrist to be a little turned out, the thumb alone to appear in front, the fore-finger to be under the butt, the left elbow close to the body, in exact uniformity with the right elbow. The firelock must rest full on the hand, (not on the tops of the fingers as was the custom formerly,) the shoulder square. The butt a little forward, and as low as the arm will admit without constraint, with the wrist pressed against the thigh. The piece must be kept steady and firm before the hollow of the shoulder; the body firm, erect, and square.

WORDS OF COMMAND.

(I.) ORDER ARMS. *Three Motions.*

1. Bring the firelock to the trail in two motions, seizing it first at the swell. 2. Bring it down to the right side, two inches from the ground. 3. Drop the butt to the ground, and bring the hand smart and flat on the sling. The muzzle against the hollow of the right shoulder.

(II.) FIX BAYONET.

At the word *fix*, change the thumb quick behind the barrel, seize the piece as soon as the word of command is fully expressed; push the muzzle a little forward, keeping the back of the hand to the front as represented in the figure, and draw out the bayonet with the left hand and fix it with the utmost celerity, standing steady at the order as above.

(III.) SHOULDER.

At the word *shoulder* change the thumb as in fixing bayonets, and at the last word *arms*, throw the piece smart to the shoulder at one motion, steadying it with the right hand. The right hand not to be raised above the belly, but instantly quitted and brought down by the side.

(IV.) PRESENT ARMS. *Three Motions.*

1. Seize the piece with the right hand under the guard, turning the lock to the front, but without moving the piece from the shoulder. 2. Bring it to the poise, meeting the piece smart with the left hand, the fingers extending along the sling, the wrist upon the guard, and the point of the left thumb the height of the eyes. 3. Bring down the firelock with a quick motion as low as the right hand will admit without constraint, slipping back the right foot at the same instant one inch. The firelock to be totally supported with the left hand, and the fingers of the right hand straight under the guard. The body to rest entirely on the left foot, and both the knees to be straight.

(V.) SHOULDER ARMS. *Two Motions.*

1. By an active turn of the right wrist bring the firelock to its proper position on the shoulder, the left hand grasping the butt. 2. Quit the right hand and bring it briskly down by the side.

(VI.) CHARGE BAYONET. *Two Motions.*

1. Bring the firelock at one motion smart across the body to

a low diagonal recover, as in the figure; the lock turned to the front as high as the breast, the muzzle slanting upwards, the butt proportionably depressed. The right hand to grasp the small of the butt, the left hand holding the piece at the swell, the thumbs of both hands pointing to the muzzle. 2. Make a half face to the right. Bring down the firelock to nearly an horizontal position, the muzzle a little raised, the right hand resting on the thigh just below the hip.

(VII.) SHOULDER ARMS. *Two Motions.*

1. Face to the front and throw up the piece to the shoulder by an active turn of the wrist, instantly grasping the butt with the left hand. 2. Quit the firelock briskly with the right hand, bringing it to its proper position by the side.

N. B. The first motion of the charge is that which a battalion will come to after firing; and when an attack is to be made with bayonets, at the word *charge*, the front rank is to come to the second position within a few yards of the enemy. Sentries will also come to the first motion of charge, when challenging any person who approaches their post.

SUPPORT ARMS. *Three Motions.*

1. Seize the small of the butt with the right hand. 2. Bring the left arm across the body under the lock. 3. Bring the right hand quickly down by the side.

N. B. The first and second motions are to be thrown into one in carrying arms, and the motions are reversed.

TIME.

In the manual three seconds of time is given between each motion, except in fixing bayonets, in which a longer time is given.

Corporals marching with reliefs, or commanding detachments, will carry their arms advanced.

PLATOON EXERCISE.

OF THE DIFFERENT MOTIONS TAUGHT AT DRILL.

(I.) PRIME AND LOAD.

1. Bring the firelock in one brisk motion to the priming position, the thumb of the right hand against the hammer or steel, the fingers clinched, the elbows a little turned out, so that the wrist may be clear of the cock. 2. Throw open the pan by a strong motion of the thumb, the piece kept steady in the left hand.

(II.) HANDLE CARTRIDGE.

1. Bring the hand round to the pouch, and draw out the cartridge. 2. Bring it to the mouth, holding it between the fore finger and the thumb, and bite off the top of it.

(III.) PRIME.

1. Shake some powder in the pan. 2. Shut the pan with the three last fingers. 3. Seize the small of the butt with the last three fingers.

(IV.) LOAD.

1. Face to the left on both heels, the right toe pointing directly to the front, the body half faced to the left. Bring the firelock to the left side, sloping under the arm, within two inches of the ground, the butt nearly opposite the left heel, the right hand at the same time catching the piece to steady it. 2. Shake the powder into the barrel, putting in after it the powder and ball. 3. Seize the top of the ramrod with the fore finger and thumb.

(V.) DRAW RAM ROD.

1. Force the ramrod half way out and seize it backhanded, exactly in the middle. 2. Draw it out and turn it with the fingers, the arms extended, and put it one inch into the barrel.

(VI.) RAM DOWN CARTRIDGE.

1. Push the ramrod down, holding it full handed in the middle till the hand touches the muzzle. 2. Slip the fore finger and thumb to the upper end, without letting the ramrod fall to the bottom of the barrel. 3. Push the cartridge well down to the bottom. 4. Strike two quick strokes with the ramrod.

(VII.) RETURN RAMRODS.

1. Draw the ram-rod half out, catching it back-handed. 2. Draw it out, turning it briskly from you, the arm extended. Return it to the loops. Come square to the front with the butt two inches off the ground.

(VIII.) SHOULDER ARMS.

Strike the top of the muzzle smartly with the right hand in order to fix the ram-rod and bayonet more firmly, at the same time throw it nimbly up to the shoulder at one motion.

N. B. In quick firing in platoons the motions are to be done regular but quick, without waiting for time, except at the casting about and coming to the shoulder.

PLATOON FIRING.

(I.) PLATOON, READY.

Spring the firelock to the recover, and instantly cock.

(II.) PRESENT.

Slip the left hand along the sling as far as the swell, and bring the piece to the present, stepping back six inches to the rear with the right foot.

(III.) FIRE.

Pull strong with the middle finger of the right hand. After firing drop the piece to the priming position, and proceed quick through the different motions, as directed above in priming and loading.

MILITARY AFFAIRS.

EXPLANATION OF THE POSITION OF EACH RANK IN THE FIRING.

(I.) FRONT RANK KNEELING, MAKE READY.

Spring the firelock briskly up to the recover, catching it in the left hand, and, without stooping, sink down with a quick motion on the right knee, keeping the left foot fast, the butt end of the firelock at the same time falling upon the ground; then cock with the fore finger and thumb of the right hand, holding the piece firm in the left hand, about the middle of that part which is between the lock and swell of the stock. The point of the left thumb to be close to the swell, and pointing upwards.

As the body is sinking, the right knee to be thrown so far back that the left leg may be perpendicular, the right foot thrown out a little to the right. The body to be kept straight, and the head as much up as if shouldered. The firelock must be upright, and the butt about four inches to the right of the inside of the left foot.

PRESENT.

Bring the firelock down firmly to the present, by sliding the left hand along the sling to the swell of the piece, without letting the motion tell as formerly; the right hand at the same time springing up the butt so high as the shoulder, that the head may not be too much lowered in taking aim, the right cheek to be close to the butt, the left eye shut, and look along the barrel with the right eye from the breech-pin to the muzzle, and remain steady.

FIRE.

Pull the trigger strong with the middle finger, and as soon as fired, spring up nimbly on the left leg, keeping the body erect, and the left foot fast, and bring the right heel to the hollow of the left. At the same time drop the firelock to the priming position, the height of the waistband of the breeches. Half cock, handle cartridge, and go on with the loading motions as before described.

(II.) CENTRE RANK, MAKE READY.

Spring the firelock briskly to the recover. As soon as the left hand seizes the piece above the lock, raise the right elbow a little, placing the right thumb upon the cock, with the fingers upon the plate of the lock, and then as quick as possible cock the piece, by dropping the elbow, and forcing down the cock with the thumb. Step at the same time a moderate pace with the right foot to the right, and keep the left fast. Seize the small of the butt with the right hand. The piece must be held in this position, perpendicular, and opposite the left side of the face, the butt close to the breast, but not pressed, the body erect and full to the front.

PRESENT.

As in the foregoing explanation for the front rank.

FIRE.

Pull the trigger strong with the middle finger, and as soon as fired, bring the firelock to the priming position, about the height of the stomach, go on as in the priming and loading directions, with this difference only, that the left foot is to be brought up to the right, at the same time that the firelock is brought to the priming position, and immediately after coming to the shoulder, the men will spring to the left again and cover their file-leaders.

(III.) REAR RANK, MAKE READY.

Recover and cock (as before directed for the centre rank), and as the firelock comes to the recover, step briskly to the right a full pace, at the same time placing the left about six inches before the point of the right foot; the body kept erect and square to the front.

PRESENT.

The same as in explanation for the centre rank.

FIRE.

As in the explanation for the centre rank, only in the priming position the piece is to be brought as high as the right breast. After firing and shouldering, the men will step back and cover their file-leaders as the centre rank.

N. B. In firing with the front rank standing, that rank will make ready, &c. as specified in the article relative to Platoon Exercise. Where there are only two ranks, the front rank will make ready the same as front rank standing, and the rear rank the same as in the directions for centre rank.

OFFICERS.

In giving words of command, as well in as out of ranks, officers are to stand steady, and in their proper position, their swords held firmly in the full of the right hand, with the upper part of the blade resting against the shoulder, the right wrist against the hip, and the elbow drawn back.

FIRING BY PLATOONS.

The officers instead of giving the words *Platoon, Make Ready, Present, Fire*, are to pronounce the words short, as for instance, *Toon, Ready, Psent, Fire*.

In firing by Platoons, or Divisions, the officers commanding them are to step out one pace, (on the close of the signal or preparative) and face to the left towards their men; they there stand perfectly steady till the last part of the next signal or general, when they step back again into their proper intervals all at the same time. After a division has fired, the right hand man of it steps out one pace in front of the officer, but still

keeping his own proper front, and gives the time for casting about and shouldering, after which he falls back again into his proper place in the front rank.

The fogle-man of a battalion is also to keep his front in giving the time of exercise.

In firing by grand divisions, the centre officer falls back on the preparative into the fourth rank, and is replaced by the covering serjeant.

MAURICE HASTIE,
First Regiment of Life Guards.

SECT. VI. FUSEE SALUTE.

Illustrated with Figures drawn from Life. Vide Plate IV.

FUSEE ADVANCED.

The first motion in the fusée salute of the officers in the grenadiers and light infantry, is to slip the right hand down the fusée as far as can be done with ease, at the same instant placing the right foot behind the left heel.

The second motion is to raise with the right hand the fusée from the ground, and bringing it with a smart motion to the left side of the body, seize it with the left at the cock, facing to the right about on both heels at the same time.

The third motion is to place the right foot in a line with the left, and throw back the right hand to the right side, letting the fusée fall against the left shoulder in the left hand, at the same time grasping the cock.

FUSEE RECOVERED.

With the left hand bring up the fusée to a perpendicular line, at the same time quit it with the right hand, and seize it again with the same hand at the small part of the stock, below the guard, and keep it in an erect position.

FUSEE PLANTED.

First motion: remove the left hand, bringing it down to the left side, turn at the same instant to the front on both heels, with an extended arm, and plant the butt of the fusée on the ground and in a line parallel with the right side.

Second motion: Raise the left hand, and, with the palm open, place it against the cap, as represented in the Plate.

When the general has passed, the left hand is to be brought down, with an easy, graceful motion, from the cap to the left side, where it was placed at the last motion of the salute.

FUSEE TRAILED.

First motion: Seize the fusée near the swivel of the stock with the right hand.

Second motion: Quit the fusée with the left hand, and with the right hand bring it over the right side, to the position of trailing, as represented in the Plate.

FUSEE SALUTE.

First motion: In stepping with the right foot, dart with the right hand the muzzle of the fusée forwards in a direct line, so as to bring it nearly on a level.

Second motion: At the next step with the left foot, turn the fusée round about in such a manner as to bring the muzzle sloping upwards towards the rear, with the lock downwards; at the same instant placing the left hand upon the small part of the stock behind the guard.

Third motion: Salute with the fusée, at the next step with the right foot, by turning it round towards the front, so as to incline the point of the bayonet towards the ground, with the lock of the fusée upwards, and throwing back the left hand to the left side, as before directed.

Fourth motion: At the next step, with the left front, raise the left hand, and, with the palm open, place it against the cap, as directed in the fusée planted.

When the general has passed about ten spaces, bring the fusée back again to the trailing position in two motions.

SECT. VII. SWORD SALUTE.

Illustrated with Figures drawn from Life. Vide Plate IV.

SWORD SUPPORTED.

Hold the belt of the sword near the right hip in the right hand, as low down the right side as can be done with ease, bring the flat of the blade across the body upwards, the upper part grasped with the left hand, and held opposite to the left shoulder, with the thumb running along the blade towards the point, as represented in the Plate.

SWORD ADVANCED.

Raise the right foot, and plant it in a line with the left, at the same time throwing back the left hand, to the left side, holding the hilt of the sword firm in the right hand against the outside of the right thigh, the blade running up the right side, and resting against the hollow of the right shoulder as represented in the Plate.

SWORD RECOVERED.

Let go the left hand, bringing it down to the left side, raising up at the same time the right hand nearly as high as the right shoulder, holding the sword in a perpendicular position opposite to the right breast.

SWORD SALUTE.

Bring the point of the sword in an easy graceful manner, with the right hand, as low down towards the ground as can be done by that hand with ease.

The hat to remain untouched. The officers should bring up their swords when the general has passed them to the former position.

g
is
g
on
be

di.

ra-
the
ing

for
the
ing

the
ing
the

ine,
e it
the

the
cells,
the

pen,

ught
e left

with

with
on of

h the
ne, so

n the
e slop-
is; at
of the

step
so as
th the
and to

, raise
ne cap,

ng the

IV.

e right
t, bring
er part
oulder,
oint, as

left, at
eft side,
ainst the
ght side,
as repre-

, raising
the right
on oppo-

ner, with
n be done

l bring up
he former

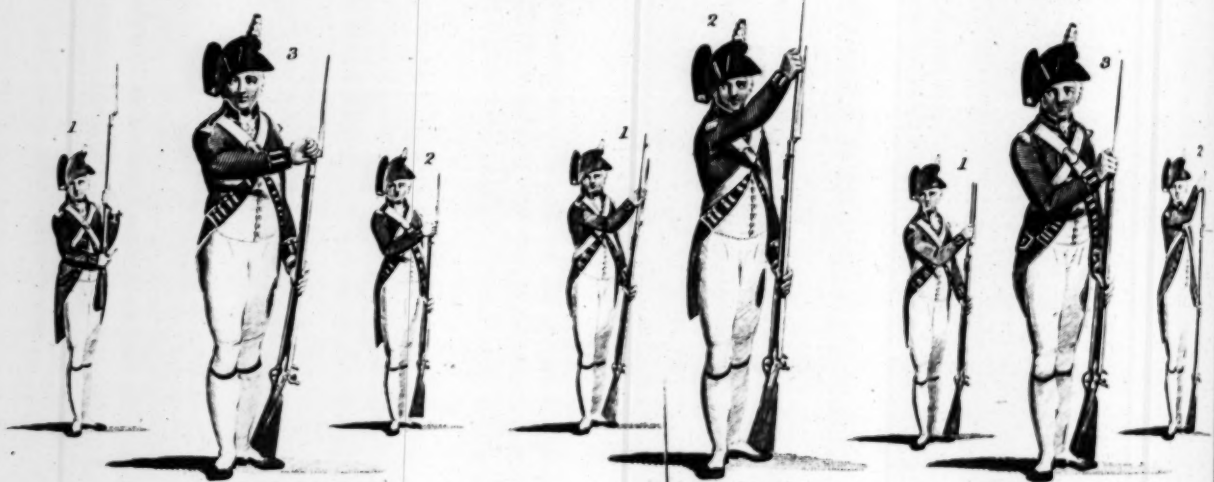
*Manual Exercise according to the late regulation by the Duke of York.
See Treatise on Military Affairs.*



1 Prime & Load

2 Handle Cartridge

3 Prime



4 Load

5 Draw Ramrod

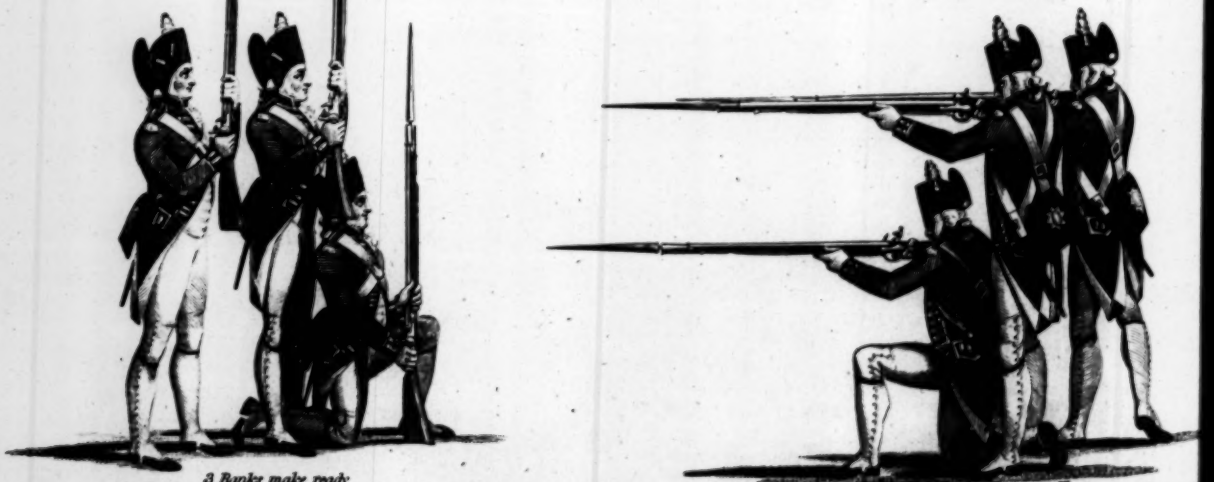
6 Ram down Cartridge



7 Return Ramrod

8 Shoulder Arms

9 Present—Fire



10 Ranker make ready

11 Ranker Present—Fire

Drawn from Life by W. Gessinger.

Printed for C. Cooke, No. 17, Paternoster Row, 4th Dec. 1825.

Engraved by W. Gessinger.



Rate:



Printed for C. Cooke, N^o 17, Antwerp Row. April 18. 1795.



*Three Rank Firings, with Officers Fusée and Sword Salute.
See Treatise on Military Affairs. Section 6. & 7.*



Rear Rank Firing



Center Rank Firing



Front Rank Firing Kneeling



Fusée Advanced



Fusée Recovered



Standing Salute, Fusée Planted



Fusée Trained



Marching Salute



Sword Supported



Sword Advanced



Sword Recovered



Sword Salute

*Manual Exercise according to the Discipline practiced in the Year 1791.
See Treatise on Military Affairs Section 8.*



24th Present Arms.



25th To the Right Face.



26th To the Right Face.



27th To the Right about Face.



28th To the Left Face.



29th To the Left Face.



30th To the Left about Face.



31st Shoulder Firelock.



32nd Charge Bayonet.



33rd Shoulder Firelock.



34th Advance Arms.



35th Shoulder Firelock.

Drawn from Life, by W. Crayner.

Engraved for the Hall's Encyclopedia & Printed for C. Dooly, N^o 17 Pall-mall Row, Augst 1791.

Engraved by W.



*Manual Exercise according to the Discipline practiced in the Year 1791.
See Treatise on Military Affairs Section 8.*



12th Return Firelock.



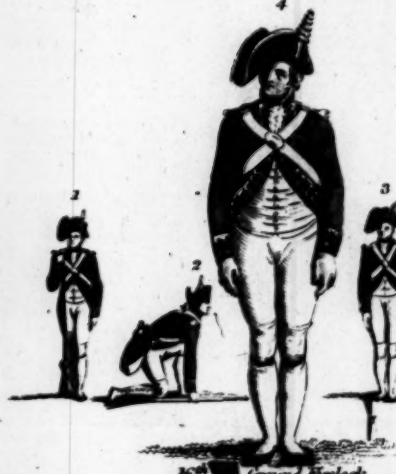
13th Shoulder Firelock.



14th Rest Firelock.



15th Order Firelock.



16th Ground Firelock.



17th Take up Firelock.



18th Rest Firelock.



19th Shoulder Firelock.



20th Secure Firelock.



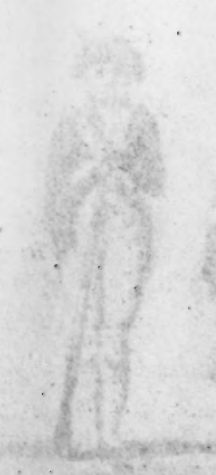
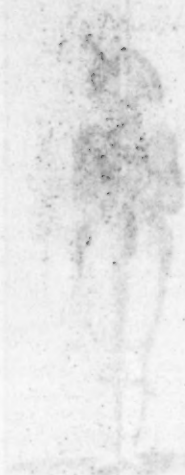
21st Shoulder Firelock.



22nd Fire Bayonet.



23rd Shoulder Firelock.



*Manual Exercise according to the Discipline practiced in 1791.
See Treatise on Military Affairs Section 8.*



Dress to the Right



1st Poize Firelock



2nd Cock Firelock



3rd Present



4th Fire



5th Half Cock Firelock



6th Handle Cartridge



7th Prime



8th Shut Pan



9th Load Cartridge



10th Draw Ramrod



11th Ram Down Cartridge

MILITARY AFFAIRS.

SECT. VIII.

DIRECTIONS FOR PERFORMING THE MANUAL EXERCISE, PREVIOUS TO THE REGULATIONS BY THE DUKE OF YORK, ILLUSTRATED BY FIGURES TAKEN FROM LIFE, DESCRIPTIVE OF ALL THE MOTIONS.

Though we have introduced the new, we have retained the old Manual, as there are many persons partial to the method of exercise previous to the introduction of the new, and with to see it described with Plates to illustrate the motions; for however apparently useless a number of motions may be, it certainly contributes to teach the learner to handle his arms with ease and dexterity. For the ultimate intention of all exercise can be nothing more than to render a battalion expert in what it may have to perform before an enemy. It should follow, therefore, that whatever cannot be so practised in the face of an enemy is superfluous, and that all superfluous and unnecessary matter should be exploded, as only tiring the patience of the soldier to no good purpose. However specious this conclusion may appear, yet it is certain there are many things in the exercise performed by a regiment, which it is never supposed are to be done before an enemy, the practice of which is attended by some collateral benefit.

(I.) POIZE YOUR FIRELOCK. *Two Motions.*

1. Seize the firelock by the small of the stock, with the right hand; at the same time turn the lock in the front, so as the cock may touch the left breast, keeping the barrel perpendicular.
2. Bring up the firelock with a quick motion, and strike the sling with the left hand; the fingers pointing upwards, and the wrist upon the guard; both elbows close down. N. B. The point of the fingers should be no higher than the mouth, and the firelock close in to the left side, and barrel perpendicular.

(II.) COCK YOUR FIRELOCK. *Two Motions.*

1. Turn the barrel inwards, support the firelock in the left hand, square the right elbow, with the thumb of the right hand upon the cock.
2. Bring the thumb over the cock, and seize the firelock by the small under the lock. N. B. As you do not cock in manual exercise, the motion only is to be made.

(III.) PRESENT. *One Motion.*

The right hand throws the firelock down to the present, and is stopped with the left at the swell, the butt to be raised to the shoulder, and the forefinger of the right hand before the trigger. N. B. At the time you bring the firelock down, draw the right foot back six inches, and turn the left toe to the front.

(IV.) FIRE. *One Motion.*

After you are supposed to have pulled the trigger, count *one, two*, then bring up the right heel with inside of the left, and at the same time bring the firelock to the priming position, by supporting the firelock in the left hand betwixt the swell and the lock, having hold of the cock between the 2d joint of the forefinger and thumb, and your elbow square. N. B. That you may have a full command of the firelock, the lock must be opposite the centre of your body, and the muzzle the height of your hat.

(V.) HALF COCK YOUR FIRELOCK. *One Motion.*

Bring the right elbow down upon the butt, still keeping your finger and thumb at the cock.

(VI.) HANDLE YOUR CARTRIDGE. *One Motion.*

Bring your right hand smartly down to your pouch, clapping it hard, then bring your hand up with the three last fingers shut, and your forefinger and thumb pointing to your mouth, your elbow down upon the stock.

(VII.) PRIME. *One Motion.*

Give a single shake over the pan, then bring your right hand behind the hammer, with your little finger laying across the barrel, your elbow square.

(VIII.) SHUT YOUR PANS. *Two Motions.*

1. Bring your elbow down upon the stock, still holding the hammer in your hand for the space of time that you count *one, two*.
2. Turn the piece nimbly round to the loading position, with the butt to the ground in a line with your left toe, barrel to the front; and leaning across, that the muzzle may be opposite the centre of your body, the three last fingers of your right hand shut, and laying against the barrel, your fore finger and thumb as high as the elbow down, your left arm extended, holding the firelock with the thumb behind the sling, and fingers upon the barrel.

(IX.) CHARGE WITH CARTRIDGE. *Two Motions.*

1. Raise your right elbow, turn the back of your hand inwards, with your fore finger upon the muzzle, count *one, two*, between this and the following motion.
2. Seize the ram-rod between the second joint of the fore finger and thumb, just below the top, your elbow down.

(X.) DRAW YOUR RAMMER. *Two Motions.*

1. Draw the rammer with a quick motion half way, seizing it at the muzzle back-handed.
2. Draw it quite out, turn it and enter it into the muzzle with your right arm extended.

(XI.) RAM DOWN YOUR CARTRIDGE. *One Motion.*

Spring the ram-rod in the barrel, which will recoil half way out, (there being no cartridge used in the manual exercise) seize it back handed at the muzzle; enter it into the loops, and return it quite home; bring the firelock into the hollow of the left arm, with the fingers of the right hand, the left still extended, with thumb behind the sling.

(XII.) RETURN YOUR RAMMER. *One Motion.*

Bring up the firelock with the left hand, seize it with the right under the cock, so as you may feel the lower side nail of the lock with your right thumb, bring the left elbow down upon the lock, and fingers extended. N. B. You must turn to the left upon both heels, and at the same time you bring the firelock up, to bring your body square to the front, it being necessary in the priming and loading positions, to be a quarter face to the right, having the right toe to the right, and left to the front.

(XIII.) SHOULDER YOUR FIRELOCK. *Two Motions.*

1. Quit the left hand and place it strong upon the butt, then let the right hand lay flat upon the breast, the fingers pointing to the stock.
2. Bring the right hand smart down by the right side, fingers extended.

(XIV.) REST YOUR FIRELOCK. *Three Motions.*

The first and second motions the same as directed for the poise.
3. Bring the firelock quick down to rest with the right hand, and seize it smart across the sling with the left, the little finger so low as the hammer spring, the thumb between the stock and barrel, the fingers of the right hand to be under the guard, and thumb behind the cock; the firelock must be no lower; then the butt to be opposite the centre of the left thigh, so as you may stand at this position in a graceful manner, and without restraint. N. B. At the time the firelock is brought down to the rest, step back 4 inches, with the right foot in a direct line; and on no account to cross your left heel.

(XV.) ORDER YOUR FIRELOCK. *Three Motions.*

1. Bring the firelock smartly into the right side, that the butt may be opposite the centre of the right thigh; seize it at the same time with the left hand above the swell, the fingers of the right hand being still under the guard.
2. Quit the firelock with the right hand, sinking it with the left till the butt is within 2 inches of the ground; at the same time seize it at the muzzle with the right hand, the back of the hand to the front, and the right elbow close down upon the stop swivel.
3. Bring up your right foot to the left, at the same time bring your left hand down by your left side, your fingers extended; and with the right hand bring the butt to the ground, and in a line with your right toe, the muzzle close into the hollow of your right arm. N. B. The body to be square to the front in all the motions of the order.

(XVI.) GROUND YOUR FIRELOCK. *Four Motions.*

1. Half face to the right upon your heels, at the same time turn the firelock, so that the lock may point to the rear. The flat of the butt must lie against the inside of the foot, at the same time slipping the right foot behind the butt of the firelock, the right toe pointing to the right, and the left toe to the front.
2. Step directly forward with your left foot as far as the swell of the firelock, then let your right hand slip down the piece, and lay it upon the ground, your left hand in the mean time hanging down by the calf of your left leg.
3. Raise yourself up again nimbly, bringing back your left foot to its former position, and keeping your body faced to the right.
4. Face again to the left upon your heels, and come to your proper front, letting your hands hang down your sides without motion.

(XVII.) TAKE UP YOUR FIRELOCK. *Four Motions.*

1. Face to the right upon both heels.
2. Briskly stoop down and come to the same position as in the second motion of grounding.
3. Raise yourself and firelock briskly, bringing it close to the right side.
4. Come to your proper front, seizing the firelock at the muzzle as in explanation XV.

(XVIII.) REST YOUR FIRELOCK. *Three Motions.*

1. Bring down briskly your right hand as low as you can, without restraint; seize the firelock with the thumb behind the sling, and fingers upon the barrel.

2. Raise

MILITARY AFFAIRS.

2. Raise up the firelock with your right hand, in a direct line from where it stood at the order; then seize it with the left, the little finger to be as low as the hammer spring, and the thumb between the stock and barrel, the left hand supporting the firelock, and the right elbow down upon the stock.

3. Bring the firelock smart to the rest with the left-hand, bring the fingers of the right under the guard. N. B. At the same time the firelock is brought across the body to the rest, you are to step back with the right foot 4 inches, as directed in the 22d motion.

(XIX.) SHOULDER YOUR FIRELOCK. *Two Motions.*

1. Bring up your right foot square with the left, and at the same time with the right hand turn the firelock into the shoulder, and with the left seize the butt smartly, keeping the firelock steady to the shoulder with the right hand. N. B. As soon as the left hand supports the firelock under the butt, the right to lay flat upon the breast, with the fingers pointing to the breech, as directed in the 18th motion.

2. Bring the right hand smartly down to the right side, fingers extended.

(XX.) SECURE YOUR FIRELOCK. *Three Motions.*

1. Bring the right hand briskly up, with the fingers under the cock, and the thumb to touch the lower side nail of the lock, in order to keep the firelock steady to the shoulder.

2. With the left hand seize the firelock about the swell, the thumb behind the sling, fingers upon the barrel, and elbow down upon the lock; the firelock to be kept steady in this motion.

3. Quit the right hand, bringing it down by the right side; at the same time, with the left hand, bring the firelock down to the secure, the guard under the arm, and muzzle pointing downwards, keeping the thumb of the left hand still upon the sling, and fingers upon the barrel.

(XXI.) SHOULDER YOUR FIRELOCK. *Three Motions.*

1. Bring the firelock up to the shoulder with the left hand, the right hand to be brought under the cock, as directed in the first motion of the secure.

2. Quit the left hand, strike it strong upon the butt, the firelock kept steady to the shoulder, and barrel perpendicular, the right hand to be in the position in the 18th motion.

3. Quit the right hand, and bring it smart across the body to the right side, fingers pointing down.

(XXII.) FIX YOUR BAYONET. *Three Motions.*

The first and second are the same as in the two first of the secure.

3. Bring the firelock down with the left hand, till the butt touch the ground, in a line with your left toe, the barrel to the front, and the muzzle let fall into the wield of your right arm; at the same time seize the scabbard with the left hand, and the socket of the Bayonet with the right; as soon as the bayonet is out of the scabbard, seize the firelock with the left hand, as low as you can, without restraint, and bring the muzzle opposite the centre of the body, and with the right hand screw the bayonet on; bring the muzzle of the firelock into the hollow of the left arm, the right hand laying across the breast, fingers touch the nose brags.

(XXIII.) SHOULDER YOUR FIRELOCK. *Three Motions.*

1. Bring the firelock up with the left hand, seize it under the cock with the right, as directed in the 17th motion, with the left elbow down upon the lock.

2. Quit the left hand, and place it strong upon the butt; at the same time the right hand laying flat upon the breast, as before directed.

3. Bring the right hand smart across to the right side, fingers extended. N. B. When the right hand is to be brought down by the right side, it must be done close and smart, and the body and firelock kept perfectly steady.

(XXIV.) PRESENT YOUR ARMS. *Three Motions.*

These three motions are described in the explanation of the 14th command.

(XXV.) TO THE RIGHT FACE. *Three Motions.*

1. Bring up the firelock with a quick motion to the poize, as directed in the second motion; at the same time place the hollow of the right foot against the left heel.

2. Face to the right, by turning upon both heels, the firelock to be perpendicular and kept steady.

3. Step the right foot back, and come smartly down to the present.

(XXVI.) TO THE RIGHT FACE. *Three Motions.*

Repeat the above described motions.

(XXVII.) TO THE RIGHT ABOUT FACE. *Three Motions.*

The motions are the same as before, only you must bring the right toe as far back as the left heel, to come to the right about, in place of the right only.

(XXVIII.) TO THE LEFT FACE. *Three Motions.*

1. Bring the firelock to the poize, and bring the right heel to the hollow of the left foot.

2. Face to the left, by turning upon both heels.

3. Come briskly down to the present.

(XXIX.) TO THE LEFT FACE. *Three Motions.*

Repeat the three last motions described.

(XXX.) TO THE LEFT ABOUT FACE. *Three Motions.*

Repeat the motions last referred to in every particular, except in coming to the left about, by bringing the right heel up to the ball of the left toe.

(XXXI.) SHOULDER YOUR FIRELOCK. *Two Motions.*

The motions the same as in the explanation of the 19th command.

(XXXII.) CHARGE YOUR BAYONET. *Two Motions.*

1. Turn up the lock as in the first explanation.

2. Bring the firelock smart down to the charge, meeting it in the palm of the left hand at the swell, at the same time you bring the firelock across the body, turn upon both heels a quarter face to the right; the right toe being to the right, and the left to the front. N. B. The right hand grasping the small of the stock, the point of the fingers must feel the top of the hip bone, the barrel horizontal, and pointing direct to the man.

(XXXIII.) SHOULDER YOUR FIRELOCK. *Two Motions.*

1. Bring up the firelock quick to the shoulder, place the left hand upon the butt, and bring the feet square to the front.

2. Quit the right hand, and throw it smartly down by the right side.

(XXXIV.) ADVANCE YOUR ARMS. *Four Motions.*

The first and second as in the explanation of the first command.

3. Bring the firelock smartly down the right side with the right hand, as low as can be admitted, without constraint; keep the body steady; slip the left hand to the swell; keep the guard between the thumb and fore-finger of the right hand, and the three last fingers under the cock, with the barrel to the rear.

4. Quit the left hand and bring it smartly down the left side.

(XXXV.) SHOULDER YOUR FIRELOCK. *Four Motions.*

1. Bring the firelock up in a direct line from where it is at the advance, just so high as to get hold of the small of the stock with the right hand; and at the same time seize the piece at the swell with the left.

2. Bring the firelock smart up to the poize with the right hand; the left to be as directed in the first explanation.

3. Bring the firelock quick into the shoulder, and strike the butt smart with the left hand.

4. Quit the right hand down by the right side; fingers pointing downwards.

(XXXVI.) PRIME AND LOAD. *Fifteen Motions.*

1. Come smartly to the recover, the firelock is sprung up with the left hand and seized with the right by the small, and the left about the hammer spring, the barrel is to the rear, the cock to touch the left breast, and both elbows close down upon the stock, the body to remain square to the front and the piece perpendicular.

2. Bring the firelock down with a brisk motion to the priming position (turning the right toe to the right and the left to the front) the left hand holding the firelock as in priming, the thumb of the right hand placed against the face of the hammer, the fingers clenched, and the elbow a little turned out, that the wrist may be clear of the cock.

3. Open the pan by throwing up the steel with a strong motion of the right arm, turning the elbow in, and keeping the firelock steady in the left hand.

4. Handle your cartridge.

5. Prime.

6. Shut your pan.

7. Cast about.

8. and 9. Load.

10. and 11. Drawn your rammer.

12. Ram down your cartridge.

13. Return your rammer.

14. and 15. Shoulder.

N. B. Observe that the motions of recover, coming down to the priming position, and opening the pan, are to be done in the usual time. The motions from handling the cartridge to shutting the pans, to be done as quick as possible. When the pans are shut, make a pause, and cast about. The loading motions are likewise to be executed with all imaginable briskness. Before the rammer is returned, another small pause must be made, counting *one, two*, between each motion, till the firelock is shouldered, but the motions themselves to be done with activity.

MILK, a well-known fluid, prepared by nature in the breasts of women, and the udders of other animals, for the nourishment of their young. Milk is a connecting and intermediate substance between animals and vegetables. It seems immediately to be secreted from the chyle, both being a white liquor of the same consistence: it is most copiously secreted after meals, and of an acefcent nature. In most animals who live on vegetables, the milk is acefcent; and it is uncertain, though at the same time no observation proves the contrary, whether it is not so likewise in carnivorous animals. But, whatever be in this, it is certain, that the milk of all animals who live on vegetables is acefcent. Milk being derived from the chyle, we thence conclude its vegetable nature; for in those who live on both promiscuously, more milk is got, and more quickly, from the vegetable than the animal food. Milk, however, is not purely vegetable; though we have a vegetable liquor that resembles its taste, consistence, colour, acefcent, and the separability of the oily part, viz. an emulsion of the nukes oleose and farinaceous substances. But these want the coagulable part of milk, which seems to be of animal-nature, approaching to that of the coagulable lymph of the blood. Milk, then, seems to be of an intermediate nature, between chyle taken up from the intestines and the fully elaborated animal fluid.

Its contents are of three kinds; first, an oily part, which, whatever may be said concerning the origin of other oils in the body, is certainly immediately derived from the oil of the vegetables taken in, as with these it agrees very exactly in its nature, and would entirely if we could separate it fully from the coagulable part. Another mark of their agreement is the separability, which proves that the mixture has been lately attempted, but not fully performed. 2dly. Besides this oily, there is a proper coagulable part: and, 3dly. Much water accompanies both, in which there is dissolved a saline saccharine substance. These three can be got separate in cheese, butter, and whey; but never perfectly so, a part of each being always blended with every other part.

Nothing is more common, from what has been said of its immediate nature, than to suppose that it requires no assimilation; and hence has been deduced the reason of its exhibition in the most weakly state of the human body. But wherever we can examine milk, we always find that it coagulates, suffers a decomposition, and becomes acefcent. Again, infants, who feed entirely on milk, are always troubled with eruptions, which every body observes are not of the same quality with the food taken; and therefore it appears, that, like all other food, milk turns naturally acefcent in the stomach, and only enters the chyle and blood in consequence of a new recombination. It approaches then to the nature of vegetable aliment, but is not capable of its noxious vinous fermentation, and therefore has an advantage over it; neither from this quality, like animal food, is it heating in the stomach, and productive of fever; though, at the same time, from its quantity of coagulated matter, it is more nourishing than vegetables.

Milk is evidently one of the best nourishments of the body: and it is not wonderful that it should prove so, when we consider that in all cases of nourishment the proximate matter taken to nourish ought to be as like as may be to the body to be nourished by it. We subsist by the same things by which we are generated, and even while in the state of a fetus in the womb, we are nourished not by blood, as some suppose, but by a lacteous juice, which is separated from the blood in the uterus by means of the placenta, as it is in the breasts of women who give suck, by glands and tubuli destined for that purpose. Meats which we daily feed upon pass down into the stomach indeed in their own form, but they do not nourish us till they are changed into chyle, or a milky liquor. Milk being analysed is found to be composed of fatty, serous, and terrestrial parts; and these its constituent principles being easily mixed and separated again, are made of it matter for the nourishment of the different parts of the body. The serous part, which is also nitrous, being a proper vehicle to convey through the vessels the fatty parts, which are as well adapted to all the offices of nutrition as any substance can be.

It is easy to infer from this account of milk that it is not only a proper food for children, but for grown people also; but proper regulations are to be observed as to its use in particular cases; no aliment any more than this being capable of suiting all constitutions and circumstances. Meat in the stomach is converted into chyle, or a substance like milk: this chyle passes into the heart through the blood-vessels, and its finest and most spirituous parts are there transmuted into the red part of the blood; and after this the other grosser parts of it are by different elaborations transformed into bile, and the several other humours of the body. It is evident that these humours, as well as the blood itself, must all have a supply; and that meat cannot give this supply, till it is converted into chyle or milk; how much labour then is saved the animal functions by giving at once into the stomach chyle ready formed, that is milk; and in cases where the action or juices of that organ are so debilitated as not to be of power to convert the meat into chyle, what remains but that the person must die slowly, by want of the supplies of the several fluids of the body, if something be not given that is capable of passing into the blood with less preparation than meats are; and what is so proper on such an

No 110.

occasion as milk, which is already so nearly allied to the nature of the fluid that should have been there separated from meat, that it will really supply all its offices?

Milk is almost suited to all temperaments; and it is even so to stomachs disposed to acefcent, more than those substances which have undergone the vinous fermentation; nay, it even cures the heart-burn, checks vinous fermentation, and precipitates the lees, when, by renewal of fermentation, the wine happens to be fouled. It therefore very properly accompanies a great deal of vegetable aliment; although sometimes its acefcent is troublesome, either from a large proportion taken in, or from the degree of it; for, according to certain unaccountable circumstances, different acids are formed in the stomach in different states of the body; in a healthy body, e. g. a mild one; in the hypochondriac disease, one sometimes as corrosive as the fossil acid. When the acidity of milk is carried to a great degree, it may prove remarkably refrigerant, and occasion cold crudities, and the recurrence of intermitting fevers. To take the common notion of its passing unchanged into the blood, it can suffer no solution. But if we admit its coagulum in the stomach, then it may be reckoned among soluble or insoluble foods, according as that coagulum is more or less tenacious. Formerly rennet, which is employed to coagulate milk, was thought an acid; but, from late observations, it appears that, if it be an acid, it is very different from other acids, and that its coagulum is stronger than that produced by acids. It has been imagined, that a rennet is to be found in the stomachs of all animals, which causes coagulation of milk; but the coagulation of milk seems to be owing to a weak acid in the stomach, the relics of our vegetable food, inducing, in healthy persons, a weak and soluble coagulum; but in different stomachs this may be very different, in these becoming heavy and less soluble food, and sometimes even evacuated in a coagulated undissolved state both by stomach and stool. As milk is acefcent, it may be rendered sometimes purgative by mixing with the bile; and some examples of this have been remarked. More commonly, however, it is reckoned among those foods which occasion costiveness.

Hoffman, in his experiments on milk, found that all kinds of it contained much water: and when this was dissipated, found the residuum very different in their solubility. But we must not thence conclude, that the same insolubility takes place in the stomach; for extracts made from vegetables with water are often very insoluble substances, and hardly diffusible through water itself: therefore, in Hoffman's extracts, if we may so call them, of milk, somewhat of the same kind might have appeared; and these substances, which in their natural state were not so, might appear very insoluble. However, we may allow that milk is generally insoluble in the intestines, as it is of a drying nature, and, as cheese, &c. is very costive. And this effect shews that milk is always coagulated in the stomach; for if it remained fluid, no feces would be produced, whereas sometimes very hard ones are observed. In the blood-vessels, from its animal-nature, it may be considered as nutritious; but when we consider its vegetable contents, and acefcent in the primæ viæ, we find, that, like animal food, it does not excite that degree of fever in time of digestion, and that from its acefcent it will resist putrefaction. Hence its use in hectic fevers, which, whatever be their cause, appear only to be exacerbations of natural feverish paroxysms, which occur twice every day, commonly after meals, and at night. To obviate these, therefore, we give such an aliment as produces the least exacerbation of these fevers; and of this nature is milk, on account of its acefcent vegetable nature.

There appears also somewhat peculiar to milk, which requires only a small exertion of the animal powers in order to its assimilation; and besides, in hectic complaints, there is wanted an oily, bland food, approaching to the animal-nature; so that on all these accounts, milk is a diet peculiarly adapted to them, and, in general, to most convalescents, and to those of inflammatory temperaments. So far of milk in general. We shall now speak of the particular kinds which are in common use.

The milk of women, mares, and asses, agree very much in their qualities, being very dilute, having little solid contents, and, when evaporated to dryness, having these very soluble, containing much saccharine matter, of a very ready acefcent, and, when coagulated, their coagulum being tender and easily broke down. From this view they have less oil, and seem to have less coagulable matter than the rest. The milk of cows, sheep, and goats agree, in opposite qualities to the three just mentioned; but here is somewhat more of gradation. Cows milk comes nearer to the former milk; goats milk is less fluid, less sweet, less flatulent, has the largest proportion of insoluble part after coagulation, and indeed the largest proportion of coagulable part; its oily and coagulable parts are not spontaneously separable, never throwing out a cream, or allowing butter to be readily extracted from it. Hence the virtues of these milks are obvious, being more nourishing, though, at the same time, less easily soluble in weak stomachs, than the three first, less acefcent than these, and so more rarely laxative, and peculiarly fitted for the diet of convalescents without fever. The three first again, are less nourishing, more soluble, more laxative, as more acefcent, and adapted to the convalescents with fever.

M I L

These qualities, in particular milks, are considerably diversified by different circumstances. First, different animals, living on the same diet, give a considerably different milk; for there seems to be something in the constitution, abstracting from the aliment, which constitutes a considerable diversity of milk, not only in the same species of animals, but also in the same animal, at different ages, and at different distances after delivery; this applies to the choice of nurses. Secondly, milk follows the nature of the aliment more than any other juice in the human body, being more or less fluid and dilute, more or less solid and nourishing, in proportion as these qualities are more or less in the aliment. The nature of the aliment differs according to its time of growth, *e.g.* old grass being always found more nourishing than young. Aliment, too, is always varied according to the season, as that is warm or dry, moist or cloudy.

The milk of each particular kind of animal is fitter for particular purposes, when fed on proper food. Thus the cow delights in the succulent herbage of the vale: if the sheep be fed there he certainly rots, but on the higher and more dry side of the mountain he feeds pleasantly and healthy; while the goat never stops near the bottom, but ascends to the craggy summit: and certainly the milks of these animals are always best on their proper soil, and that of goats is best on a mountainous country. From a dissertation of Linnæus, we have many observations concerning the diversity of plants on which each animal chooses to feed. All the Swedish plants which could be collected together were presented alternately to domestic animals, and then it appeared that the goat lived on the greatest variety, and even on many which were poisonous to the rest; that the cow made choice of the first succulent shoots of the plant, and neglected the fructification; which last was preferred by the goat. Hence may be deduced rules concerning the pasturage of different animals; *e.g.* Farmers find, that, in a pasture which was only fit to feed a certain number of sheep, an equal number of goats may be introduced, while the sheep are no less nourished than before.

It is not easy to assign the difference between milk fresh drawn and that detained in the open air for some time; but certainly there is some material one, otherwise nature would not universally have directed infants to sucking; and indeed it seems, better than the other, fitted for digestion and nourishment. Physicians have supposed that this depended on the evaporation of some *spt. rectior*, but we cannot conceive any such, except common water here: and besides, these volatile parts can hardly be nutritious. A more plausible account seems deducible from mixture: milk, new drawn, has been but lately mixed, and is exposed to spontaneous separation, a circumstance hurtful to digestion; none of the parts being, by themselves, so easily assimilated, as when they are all taken together. Hence, then, milk new-drawn is more intimately blended, and therefore then is most proper to the weakly and infants.

Another difference in the use of milk exposed for some time to the air, is taking it boiled or unboiled. Physicians have generally recommended the former; but the reason is not easily assigned. Perhaps it is this: Milk kept for some time exposed to the air has gone so far to a spontaneous separation; whereas the heat thoroughly blends the whole, and hence its resolution is not so easy in the stomach; and thus boiled milk is more costly than raw, and gives more feces. Again, when milk is boiled, a considerable quantity of air is detached, as appears from the froth on the surface; and air is the chief instrument of fermentation in bodies; so that, after this process, it is not liable to ascency; for these reasons it is proper for the robust and vigorous.

Milk by evaporation yields a sweet saline matter, of which Dr. Lewis gives the following proportions:

Twelve ounces of	Left of dry matter.	From which water extracted a sweet saline substance amounting to
Cows milk	13 drams.	1½ drams.
Goats milk	12½	1½
Human milk	8	6
Asses milk	8	6

The saline substance extracted from asses milk was white, and sweet as sugar; those of the others brown, or yellow, and considerably less sweet; that from cows milk had the least sweetness of any.

Milk, set in a warm place, throws up to the surface an unctuous cream, from which, by agitation, the butter is easily separated. The addition of alkaline salts prevents this separation, not (as some have supposed) by absorbing an acid from the milk, but by virtue of their property of intimately uniting oily bodies with watery liquors. Sugar, another grand intermedium betwixt oils and water, has this effect in a greater degree, though that concrete is by no means alkaline, or an absorbent of acids.

New cows milk, suffered to stand for some days on the leaves of butterwort or sun-dew, becomes uniformly thick, slippery, and coherent, and of an agreeable sweet taste, without any separation of its parts. Fresh milk, added to this, is thickened in the same manner, and this successively. In some parts of Sweden, as we are informed in the Swedish Memoirs, milk is thus prepared for food. New milk has a degree of glutinous quality, so as to be used for joining broken stone ware. There is a far greater tenacity in cheese properly prepared. Milk, when examined by a microscope, appears composed of numerous globules swimming in a transparent fluid.

M I L

On the SUGAR of MILK. By Mr. Jabrig, of Petersburg, as appeared in the Bath Register. Translated from the French.

During the travels which I undertook, by order of the academy of Petersburg, among the Mogul tribes who inhabit the frontiers of the government of Irkutsk, beyond the lake Baikal, on the banks of the river Selenga, I was particularly struck with the ingenious manner in which these people preserve, during their long winters, a very great quantity of milk, which they suffer to freeze in iron kettles, which serve them likewise for other purposes. When the milk contained in these kettles is perfectly congealed, they place them over a gentle fire, and take out the milk reduced to a cake of ice, by means of a wooden spatula. This operation is begun on the commencement of the first cold; for the milk is then found in greatest abundance, and the cakes of ice obtained by these means assume, as may be readily supposed, the form of the kettle in which they freeze, and may be preserved all the winter.

What, however, excited my curiosity most was, to see all these cakes of frozen milk covered, to a considerable depth, with a white and apparently farinaceous powder. I observed the same thing in my small dairy, which I was obliged to establish upon the same plan as these wandering people; and the children of my shepherds often brought me platesful of that powder which they ate; and which they used, also, to sweeten various articles of their food. After this discovery, I caused a number of cakes of frozen milk to be conveyed from a lower apartment to the top of the wooden house which I occupied, and which was a part of a temple consecrated to the idols of these Pagan people. These cakes in that place were exposed to the immediate contact of the dry cold air, which prevails in that country almost the whole year. These cakes were placed perpendicularly, and by these means were more exposed to the effects of the air. I visited them very often, and I perceived that this exposure contributed daily to increase the farinaceous substance with which their surface was covered. Every week I took it away, by scraping the cake to the depth of two inches, and afterwards spread it out upon a broad dish, in order that the cold might destroy any remains of moisture which would have prevented it from keeping for a length of time. This flour, when thus exposed to a great degree of cold, and, consequently, freed from all moisture, had a remarkably sweet and fugary taste. If dissolved in warm water, and strongly stirred by means of a chocolate stick, one may procure from it, at all times, and in all places, excellent and well tasted milk. This discovery I consider as of great utility, since it may enable navigators to supply themselves with milk during long sea-voyages. Nothing will be requisite, but to make the necessary preparations with care.

As I here speak of an experiment which I repeated several times, I can safely assure those who may be disposed to try it, that it will always succeed; but, at the same time, I am inclined to think, that all countries will not be equally favourable to the formation of this singular substance. The country in which I then resided, is one of the most elevated in the Northern part of Asia: an Alpine country, where the rivers are covered with ice almost six months in the year, though it lies under the 50th degree of latitude.

Another peculiarity of this country, is the dry cold air which prevails in it for a great part of the year.

Dry winds, as well as rain or snow, seldom come from the West: they come almost always from the North, and are, generally, preceded by a very mild South wind which blows for some time. The dry rarified air which continues here all winter, increases the evaporation of all moisture contained in these ice cakes, and leaves nothing but the milk, the essential constituent part, under the form of a white powder.

To obtain, in a little time, a large quantity of this powder, it will be necessary to employ raw, in preference to boiled milk. By making use of the latter, or that from which the cream has been taken, little or none will be obtained. Care also must be taken not to expose new milk, while it retains its natural heat, to the cold; for the sudden contact of the cold carries all its fat and calcareous parts towards the middle of the mass; so that the parts purely aqueous alone occupy the external surface. The interior part, which then appears rough, is often changed into a buttery substance, and produces no fugary powder. That all the fat and fugary parts might be more equally distributed throughout the whole mass of milk, I suffered that newly taken from the cows to cool, and then poured it into broad shallow kettles.

ARTIFICIAL ASSES MILK. The receipt for making which, is as follows: take eighteen bruised snails, shaving of hart's-horn, pearl barley and eryngo root, of each one ounce, and six pints of water, boil them in a glazed earthen vessel to three pints; then strain the mixture, and add an ounce and a half of balsamic syrup. Let the patient take four ounces of this liquor, mixed with an equal quantity of milk from the cow, morning and evening. Med. Transact. vol. ii. p. 341.

MILK of Vegetables. For the same reason that milk of animals may be considered as a true animal-emulsion, the emulsive liquors of vegetables may be called vegetable milks. Accordingly emulsions made with almonds are commonly called milk of almonds. But besides this vegetable milk, which is in some measure artificial many plants and trees contain naturally a large quantity of emul

M I L

five or milky juices. Such are lettuce, spurge, fig-tree, and the tree which furnishes the elastic American resin. The milky juices obtained from all these vegetables derive their whiteness from an oily matter, mixed and dissolved in a watery or mucilaginous liquor. Most resinous gums were originally such milky juices, which afterwards become solid by the evaporation of their most fluid and volatile parts.

These natural milky juices have not been examined by any chymist. Such an examination would, however, procure much essential knowledge concerning vegetable œconomy. We should probably find examples of all kinds of oils reduced into milky juices; and this knowledge cannot fail of throwing much light on the nature of resins and gum resins.

MILK FEVER. For copious directions for the management of women in this dangerous disorder, see the *System of MIDWIFERY*, Part X. Sect. VI.

MILL, denotes a machine for grinding corn, &c. but, in a more general signification, is applied to all machines whose action depends on a circular motion. Of these there are several kinds, according to the various methods of applying the moving power; as *water-mills*, *wind-mills*, *mills* worked by horses, &c. See the *System of MECHANICS*, Sect. III. *Article Mills*, &c. Plate III.

MILLEPEDES, or **WOOD-LOUSE**, in entomology; a species of Oniscus. These insects are found in cellars, under stones, and in cold moist places; in the warmer countries they are rarely met with. Milipedes have a faint disagreeable smell, and a somewhat pungent, sweetish, nauseous taste. They have been highly celebrated in suppressions of urine, in all kinds of obstructions of the bowels, in the jaundice, weakness of sight, and a variety of other disorders. Whether they have any just titles to these virtues is greatly to be doubted: thus much is certain, that their real effects come far short of the character usually given them. For Classification, see the *System*, Order VII. Genus 84.

MILLET is reckoned by Pliny the most fertile of all grain; one grain of it produced three Roman sextaries. *Millet* is cooling, drying, and binding, somewhat windy, and not easily digested; a strong decoction of it, with figs and raisins, mixed with wine, and drank warm in bed, is a very good sudorific, though it is seldom used. *Millet*, by consent of authors both ancient and modern, is refrigerating and drying; it is of bad juice, difficult of digestion, binds the belly, and generates flatulencies; it is however well known to be a very grateful food to many nations at present. In former times it served to make bread, under a dearth of better corn, as we are assured by Dioscorides, Pliny, Calen, and others of the ancients. Among the Italians, says C. Bauhine, loaves are made of *millet*, which are yellow, and eaten hot by many, not out of necessity, but for their sweetness; but, when this bread is grown hard, it is quite black. Of the flour of millet and milk the Italians make fine cakes, which must be eaten as soon as dressed, or else they become glutinous and ungrateful to the taste. A pudding prepared of *millet*, boiled in milk with an addition of butter, and sugar sprinkled over it, is much in request among the Germans at present; and these puddings have been long ago introduced into England, and are still in fashion.

MILLING, in the manufactories, an operation called also *Fulling*. See *FULLING*.

MILT, or **MELT**, in natural history, the soft roe in fishes; thus called because it yields, by expression, a whitish juice resembling milk. The *milt* is properly the seed, or spermatie part of the male fish. The *milt* of a carp is reckoned a choice bit. It consists of two long whitish irregular bodies, each included in a very thin fine membrane. M. Petit considers these as the testicles of the fish wherein the seed is preserved: the lower part, next the anus, he takes for the vesiculae seminales. Vide *Mem. Acad. R. Scien.* anno 1733. p. 221. In the *milt* of a living cod-fish there are such incredible numbers of those small animalcules found, that in a drop of the juice of it, no more in quantity than a small grain of sand, there are contained more than ten thousand of them; and considering how many such quantities there are in the whole *milt* of one such fish, it is not exceeding the bounds of truth to affirm, that there are more animals in one *milt* of it, than there are living men at one time upon the whole face of the earth. However strange and romantic such a conjecture may appear, at first sight, a serious consideration and calculation, will make it appear very plain. A hundred such grains of sand as here mentioned will make about an inch in length; therefore in a cubic inch there will be a million of such sands.

The *milt* of one of these fishes is frequently about the quantity of fifteen cubic inches, it must therefore contain fifteen millions of quantities as big as one of these sands: and if there be ten thousand animals in each of those quantities, there must be, in the whole, a hundred and fifty thousand millions; which is a number vastly exceeding the number of mankind, even though we were to suppose the whole earth as populous as Holland. See *Philosophical Collections*, p. 4. See also the *System of ICHTHYOLOGY*, Sect. III. and the *System of COMPARATIVE ANATOMY*, Chap. III. Sect. II.

MINE, in natural history, a place under ground, where metals, minerals, or even precious stones, are dug up. As, therefore, the matter dug out of *mines* is various, the *mines* themselves acquire

M I N

various denominations: as *gold-mines*, *silver-mines*, *copper-mines*, *iron-mines*, *diamond-mines*, *salt-mines*, *mines of antimony*, of *alum*, &c. For *gold* and *silver-mines*, the richest and most celebrated are those of Peru and Chili in America. *Iron-mines* are more abundant in Europe than elsewhere. *Copper-mines* are chiefly found in Sweden, Denmark, and England. *Lead* and *tin-mines* abound most in England and Wales. *Quicksilver-mines* in Hungary and Spain. *Diamond-mines* in the East Indies, and in the Braßils. *Salt mines* in Poland, &c. *Metallic-mines* are chiefly found in mountains; though the reason thereof does not appear. It is probable, plains may abound as much therewith, would people dig deep enough. But plains are commonly cultivated; and, beside, the water will scarce allow them to be dug. Add, that the metallic veins always run either horizontal or oblique; and for that reason are easiest found on the sides of eminences.

According to Dr. Nicols's observations upon mines, they seem to be, or to have been, the channels through which the waters pass within the earth, and, like rivers, have their small branches opening into them, in all directions. Most mines have streams of water running through them: and when they are found dry, it seems to be owing to the waters having changed their course, as being obliged to it, either because the load has stopped up the ancient passages, or that some new and more easy ones are made. Mines, says Dr. Shaw, are liable to many contingencies; being sometimes poor, sometimes soon exhaustible, sometimes subject to be drowned, especially when deep, and sometimes hard to trace. Yet there are many instances of mines proving highly advantageous for hundreds of years: the mines of Potosi are to this day worked with nearly the same success as at first; the gold mines of Cremnitz have been worked almost these 1000 years; and our Cornish tin mines are extremely ancient. The neat profit of the silver alone, dug in the Misnian silver-mines in Saxony, is still, in the space of eight years, computed at a thousand six hundred and forty four million, besides seventy-three tons of gold. Many mines have been discovered by accident; a torrent first laid open a rich vein of the silver mine at Friburgh in Germany; sometimes a violent wind, by blowing up trees, or overturning the parts of rocks, has discovered a mine; the same has happened by violent showers, earthquakes, thunder, the firing of woods, or even the stroke of a ploughshare or a horse's hoof.

But the art of mining does not wait for these favourable accidents, but directly goes upon the search and discovery of such mineral veins, ores, or sands, as may be worth the working for metal. The principal investigation and discovery of mines depends upon a particular sagacity, or acquired habit of judging from particular signs, that metallic matters are contained in certain parts of the earth, not far below its surface. The principal signs of a latent metallic vein seem reducible to general heads; such as, 1. The discovery of certain mineral waters. 2. The discolouration of the trees or grass of a place. 3. The finding of pieces of ore on the surface of the ground. 4. The rise of warm exhalations. 5. The finding of metallic sands, and the like. All which are so many encouragements for making a stricter search near the places where any thing of this kind appears; whence rules of practice might be formed for reducing this art to a greater certainty. But when no evident marks of a mine appear, the skilful mineralist usually bores into the earth, in such places as, from some analogy of knowledge, gained by experience, or by observing the situation, course, or nature of other mines, he judges may contain metal.

MINE, in the military art, denotes a subterraneous canal or passage, dug under the wall or rampart of a fortification, intended to be blown up by gun-powder. For a copious description of which, see the *Article WAR*.

MINERAL, in natural history, is used in general for all fossil bodies, whether simple or compound, dug out of a mine; from whence it takes its denomination.

MINERAL Waters. All waters naturally impregnated with any heterogeneous matter which they have dissolved within the earth may be called *mineral waters*, in the most general and extensive meaning of that name; in which therefore are comprehended almost all those that flow within or upon the surface of the earth, for almost all these contain some earth or selenites. But waters containing only earth or selenites are not generally called *mineral*, but *hard* or *crude-waters*.

Hard waters, which are simply selenitic, when tried by the chymical proofs, shew no marks of an acid or of an alkali, nor of any volatile, sulphureous, or metallic matters. Waters which contain disengaged calcareous earth, change the colour of syrup of violets to a green; and those that contain selenites, being mixed with a solution of mercury in nitrous acid, form a turbid mineral; and when a fixed alkali is added, they are rendered turbid, and a white sediment is precipitated. These waters also do not dissolve soap well. From these we may know, that any water which produces these effects is a hard, earthy, or selenitic water. The waters impregnated with gas are also hard.

Although the waters of the sea and saline springs be not generally enumerated amongst mineral waters, they might nevertheless be justly considered as such: for besides earthy and selenitic matters, they also contain a large quantity of mineral salts. We shall therefore consider them as such in this article. *Mineral waters*, or

MIN

or metallic substances, are dissolved by chymical trials. As many of these waters are employed successfully in medicine, they are also called *medicinal waters*.

Mineral waters receive their peculiar principles by passing through earths containing salts, or pyritous substances that are in a state of decomposition. Some of these waters are valuable from the quantity of useful salts which they contain, particularly of common salt, great quantities of which are obtained from these waters; and others are chiefly valued for their medicinal qualities. The former kind of mineral waters is an object of manufacture, and from them is chiefly extracted that salt only which is most valuable in commerce.

Many of these waters have been accurately analysed by able chymists and physicians. But notwithstanding these attempts, we are far from having all the certainty and knowledge that might be desired on this important subject: for this kind of analysis is perhaps the most difficult of any in chymistry. Almost all mineral waters contain several different substances, which being united with water may form with each other numberless compounds. Frequently some of the principles of mineral waters are in so small a quantity, that they can scarcely be perceived; although they may have some influence on the virtues of the waters and also on the other principles contained in the water. The chymical operations used in the analysis of mineral waters, may sometimes occasion essential changes in the substances that are to be discovered. And also, these waters are capable of suffering very considerable changes by motion, by rest, and by exposure to air.

Probably also the variations of the atmosphere, subterranean changes, some secret junction of a new spring of mineral or of pure water, lastly the exhaustion of the minerals whence waters receive their peculiar principles, are causes which may occasionally change the quality of mineral waters. We need not therefore wonder that the results of analyses of the same mineral waters made by different chymists, whose skill and accuracy are not questioned, should be very different. The consequences of what we have said on this subject are, That the examination of mineral waters is a very difficult task; that it ought not to be attempted but by profound and experienced chymists; that it requires frequent repetitions, and at different times; and lastly, that no fixed general rules can be given concerning these analyses.

As this matter cannot be thoroughly explained without entering into details connected with all the parts of chymistry, we shall here mention only the principal results, and the most essential rules, that have been indicated by the attempts hitherto made on this subject.

In some mineral waters certain volatile, spirituous, and elastic principles may be perceived, by a very sensible piquant taste: this principle is called the *gas* or *spirit of waters*. The waters which contain this principle are generally lighter than pure water. They sparkle and emit bubbles, at their spring, but especially when they are shook, and poured from one vessel into another. They sometimes break the bottles containing them, when they are well corked as fermenting wines sometimes do. When mixed with ordinary wine, they give to it the piquancy and sparkling quality of Champagne wine. This volatile principle, and all the properties of the waters dependent upon it, are lost merely by exposure to air, or by agitation. The waters containing this principle are distinguished by the name of *spirituous mineral waters*, or *acidulous waters*. For an account of the several mineral waters, their nature, qualities, &c. with the method of taking them, and the proper season, &c. see the article *WATER*.

MINERALOGY.

MINERALOGY is a science which comprehends the third kingdom of nature, the other two being the animal and the vegetable kingdoms. This science teaches us the properties of mineral bodies, and by it we learn how to characterise, distinguish, and class them into a proper order.

MINERALOGY seems to have been in a manner coeval with the world. Precious stones of various kinds appear to have been well known among the Jews and Egyptians in the time of Moses; and even the most rude and barbarous nations appear to have had some knowledge of the ores of different metals. As the science is nearly allied to chymistry, it is probable that the improvements both in chymistry and mineralogy have nearly kept pace with each other; and indeed it is but of late, since the principles of chymistry were well understood, that mineralogy has been advanced to any degree of perfection. The best way of studying mineralogy, therefore, is by applying chymistry to it, and not contenting ourselves merely with inspecting the outsides of bodies, but decomposing them according to the rules of chymistry. This method has been brought to the greatest perfection by Mr. Pott of Berlin, and after him by Mr. Cronstedt of Sweden. To obtain this end, chymical experiments in the large way are without doubt necessary: but as a great deal of the mineral kingdom has already been examined in this manner, we do not need to repeat all those experiments in their whole extent, unless some new and particular phenomena should discover themselves in those things we are examining; else the tediousness of those processes might discourage some from going farther, and

MIN

take up much of the time of others that might be better employed. An easier way may therefore be adopted, which even for the most part is sufficient, and which, though made in miniature, is as scientific as the common manner of proceeding in the laboratories, since it imitates that, and is founded upon the same principles. This consists in making the experiments upon a piece of charcoal with the concentrated flame of a candle directed through a blow-pipe. The heat occasioned by this is very intense; and the mineral bodies may here be burnt, calcined, melted, and scorified, &c. as well as in any great works.

For a description of the blow-pipe, the method of using it, the proper fluxes to be employed, and the different subjects of examination to which that instrument is adapted, see the system of *CHYMISTRY*, Part III. Introduction, where all those particulars are concisely detailed. The near relation between mineralogy and chymistry, renders it unnecessary to dwell long on the subject, especially as the essential principles are explained in the System of Chymistry, as well as under the respective articles in the alphabet, to each of which the reader is referred, as they occur in the following arrangement.

ARRANGEMENT of MINERAL BODIES.

The bodies belonging to the mineral kingdom are divided into four different classes:

Class I. *Earths*, or those substances which are not ductile, are mostly indissoluble in water or oil, and preserve their constitution in a strong heat.

Class II. *Salts*: These dissolve in water, and give it a taste; and when the quantity of water required to keep them in dissolution is evaporated, they concrete again into solid and angular bodies.

Class III. *Inflammables*, which can be dissolved in oils, but not in water, and are inflammable.

Class IV. *Metals*, the heaviest of all bodies: some of which are malleable, and some can be decomposed.

Here, however, it must be observed, that these classes are unavoidably blended one with another; and therefore some exceptions must be allowed in every one of them: for instance, in the first class, the calcareous earth is in some measure dissoluble in water, and pipe clay with some others diminish somewhat in their bulk, when kept for a long time in a calcining heat. In the third class, the calx of arsenic has nearly the same properties as salts; and there is no possible definition of salt that can exclude the arsenic, though at the same time it is impossible to arrange it elsewhere than among the semimetals. In the fourth class it is to be observed, that the metals and semimetals, perfect or imperfect, have not the same qualities common to them all; because some of them may be calcined, or deprived of their phlogiston, in the same degree of fire in which others are not in the least changed, unless particular artifices or processes are made use of: some of them also may be made malleable, while others are by no means to be rendered so. That the convex surface metals take after being melted, is a quality not particularly belonging to them, because every thing that is perfectly fluid in the fire, and has no attraction to the vessel in which it is kept, or to any added matter, takes the same figure; as we find borax, *sal fusibile microcosmicum*, and others do, when melted upon a piece of charcoal: therefore, with regard to all that has been said, it is hardly worth while to invent such definitions as shall include several species at once; we ought rather to be content with perfectly knowing them separately.

CLASS I. EARTHS.

EARTHS are those mineral bodies, not ductile, for the most part not dissoluble in water or oils, and which preserve their constitution in a strong heat.

The bodies which constitute the first class are here arranged according to their constituent parts, so far as hitherto discovered; and are divided into five orders. See the article *EARTH*.

ORDER I. CALCAREOUS EARTHS.

The properties of these are as follow:

1. Friability and falling into a fine white powder after calcination.
2. Partial solution in water, with which they contract great heat, and by sprinkling with water they fall more readily into powder.
3. Infusibility without addition.
4. They attract the fixed air from the vegetable and mineral alkalies and thus rendering them much more caustic, becoming at the same time mild themselves.
5. Solubility in all acids, except the vitriolic, tartarous and some anomalous vegetable acids.
6. Fusibility with borax and microcosmic salts. The fusion is attended with effervescence, and the result is a transparent and colourless glass.
7. With metalline calces they melt into a corrosive slag.
8. They imperfectly reduce the calces of lead and bismuth, and have even some effect upon those of copper and iron.

Calcareous earth is most commonly found in the form of limestone; hard, compact, and of various colours; under which general name may be comprehended all the different kinds of marbles. Near Bath, in England, is found a kind of grey stone, rather soft than hard. This contains calcareous earth in a mild state, and likewise some in a state of causticity: hence, when newly dug out

of the earth, it will dissolve sulphur, or make lime-water without any calcination. By attraction of fixed air from the atmosphere, it soon hardens after it has been dug up.

The Scotch marbles are of great variety and beauty; and the parts of the kingdom most unfit for cultivation are found to abound most in them. Affint in Sutherland has a kind of white statuary marble, which Mr. Williams says is the purest and best he ever saw. "I am persuaded (says he) there is none better, if any so good, in all Europe, and there is enough of it to serve all Britain; perfectly solid and pure, free from any blemishes, flaws or stains, and blocks or slabs to any size may be cut out: but there is bad access to it nor would it be easily quarried, there being a little cover above it, of a soft, loose, whitish lime-stone."

Near Blairgowrie in Perthshire, not far from the side of the high road, is an excellent, granulated, broad-bedded limestone, of a sugar-loaf texture, and as white as the finest statuary marble, which Mr. Williams supposes to be a good species of the true Parian marble, and that it requires only to be known and brought into use to become of great value. In the duke of Gordon's lands, in the forest of Glenavon, there is also a kind of marble composed of broad glittering grains like spangles, as large as the scales of fishes; but the situation is remote, and difficult of access.

In Lochaber, near the farm-houses on the north side of the ferry of Ballachylish, is a lime-stone or marble rock, of a beautiful green-grey colour, and a fine regular uniform grain or texture; capable of being raised in blocks or slabs of any size, and of receiving a fine polish. It is beautifully sprinkled with fine bright grains of mundic or pyrites, and likewise with grains or specks of beautiful lead ore of a fine texture.

About three miles south of Fort William, in the bed of a river, is a curious kind of marble with a black ground, flowered with white, like fine needle-work, or rather resembling the frost flowering upon glass windows in winter; and this flowering is not only on the outside, but quite through all parts of the body of the stone.

ORDER II. PONDEROUS EARTH.

Ponderous earth, (*Terra Ponderosa*): Chalk or calk. This is a particular kind of earth (like chalk in appearance, but with some very different properties) discovered in Sweden about 1774, which by its results with other bodies has some similarity to the known alkalis. It has not yet been found pure, but mixed with other substances: however, its great specific weight easily distinguishes it from the others, it being the heaviest of all earths.

1. Its specific gravity, when considerably purified by art, is 3.773. 2. This earth combines with aerial acid; and in this case effervesces with stronger acids. 3. With vitriolic acid it forms the ponderous spar, which is insoluble in water. 4. Its crystallization, after being combined with the nitrous, or with the muriatic acids, is hardly soluble; 5. But with acetic acid, it becomes deliquescent. 6. When pure, viz. without any mixture of acid or alkali, it does not vitrify in the fire. 7. If deprived of the aerial acid (fixed air) by calcination, it is then soluble in 900 times its weight of boiling water. This solution exposed to air, forms a cremor, like that of lime-water in the same circumstances, and like it changes also the vegetable colours. 8. Whilst combined with aerial acid, it is only soluble in about 1550 times its weight of water, chiefly if the water has been impregnated also with the same aerial acid. 9. It expels the caustic volatile alkali from ammoniacal salt. 10. Mixed with brimstone it produces a hepatic sulphur, whose solution in water is but incompletely decomposed either by the nitrous or the muriatic acid, on account of the great attraction between this earth and the acid of sulphur, which is so strong that it, 11. Separates this acid (the vitriolic) from the vegetable alkali. For a more particular description, see the System of CHYMISTRY, Part II. Chap II. throughout.

ORDER III. MAGNESIAN, MICACEOUS, AND ASBESTINE EARTHS.

Magnesian Earths.

MAGNESIA is a white, loose, and light earth, only known since the beginning of this century. It is generally found combined or mixed with other heterogeneous substances, as other simple earths are.

1. When pure its specific gravity is 2.330, and then, 2. It neither hardens, contracts, nor melts by the application of heat even by the solar rays. 3. But it melts easily with borax, or microcosmic salts; though it is scarcely affected by fixed alkalis or calces of lead. 4. Mixed with other earths, it produces by fire different hard masses. 5. It gives no causticity except to the volatile alkali: and, 6. Does not effervesce with any acid. 7. When mixed with water it shows a very small degree of heat, but without any effervescence. And when the water exceeds the weight of magnesia about 7.692 times, it is totally dissolved. 8 and 9. Being put in water and afterwards dried, it contains $\frac{1}{100}$ parts of its weight; though when saturated with aerial acid, it will absorb and retain after being dried $\frac{7}{100}$ parts of water. 10. This earth combined with aerial acid is more soluble in cold than in hot waters. 11. Combined with vitriolic acid it crystallizes into a bitter salt, known by the name of *Epson* and *Seydlitz* or *Schulz* salt, which is soluble in little more than its own weight of water. 12. With nitrous acid it forms a deliquescent salt. 13. With the muriatic or

No. 110.

the acetous acids it does not crystallize: and the mass being dried attracts humidity from the air. 14. It has a stronger attraction to the fluor acid than to any other (Berg.). and crystallizes with it into hexangular prisms whose ends are formed of two low pyramids, of three rhombs (*Romé de l'Isle*). 15. It is not precipitated from other acids by the vitriolic, as calcareous earth is. 16. According to Lavoisier and Macquer, when magnesia is calcined, it becomes phosphorescent. For a further account of its uses, properties, combinations, &c. see the System of CHYMISTRY, Part II. Chap. III. throughout.

ORDER IV. SILICEOUS EARTHS.

SILICEOUS earth is, of all others, the most difficult to describe and to distinguish perfectly; however it may be known by the following characters, which are common to all bodies belonging to this order.

1. In its indurated state it is hard, if not in regard to the whole, yet at least in regard to each particle of it, in a degree sufficient to strike fire with steel, and to scratch it, when rubbed against it, though the steel be ever so well tempered. 2. When pure, and free from heterogeneous particles, it does not melt by itself, neither in a reverberatory, nor in a blast furnace. 3. After being burnt, it does not fall to a powder, neither in the open air nor in water, as the calcarous earth does, but becomes only a little looser and more cracked by the fire, unless it has been very slowly, and by degrees, heated. 4. It excites no effervescence with acids. 5. In the fire it melts easiest of all to a glass with the fixed alkaline salt; and hence it has got the name of vitrescent, though this name is, properly speaking, less applicable to this order than to a great many other earths.

To the above we may add the following properties, from Bergman. 6. It is not soluble in any of the known acids, the fluor acid only excepted. But, 7. It may be dissolved by the fixed alkali, both in the dry and wet way. 8. If the fixed alkali is only half the weight of the siliceous earth it produces a diaphanous and hard glass: but when it is in a double or triple proportion, then the glass deliquesces of itself by attracting the humidity of the atmosphere. 9. It melts easily with borax; but, 10. With microcosmic salt it is more difficult, and requires a longer time to melt. 11. This earth has a great analogy to acids, as it is perfectly dissolved in that wonderful natural hot-water-spout above ninety feet high at Geyser, in Iceland, where by cooling it forms a siliceous mass. For a further account of its properties, &c. see the System of CHYMISTRY, Part II. Chap. V.

Genus 1. Gems, or precious Stones.

I. The Diamond.

Of all stones, it is the hardest. 1. Is commonly clear, or transparent; which quality, however, may, perhaps, only belong to its crystals, but not to the rock itself from which they have their origin. 2. Its specific gravity is nearest 3.500. When brought to Europe in its rough state, it is in the form either of round pebbles with shining surfaces, or of crystals, of an octoedral form. 3. Colourless, or diaphanous, or the diamond properly so called. But it also retains this name when it is tinged somewhat red or yellow. Being rubbed, it discovers some electrical qualities, and attracts the mastic.

Red; Ruby. *Adamas ruber*; *Rubinus*.---Which, by lapidaries and jewellers, is, in regard to the colour, divided into, 1. The ruby of a deep red colour inclining a little to purple. 2. Spinell, of a dark colour. 3. The balais, pale red, inclining to violet. This is supposed to be the mother of the rubies. 4. The rubicell, reddish yellow. However, all authors do not agree in the characters of these stones, see the System as referred to above. And, for a copious account of this valuable stone, see the article DIAMOND.

II. Sapphire is transparent, of a blue colour; and is, in hardness, next to the ruby, or diamond.

III. Topaz. 1. The pale yellow topaz; which is nearly uncoloured. 2. The yellow topaz. 3. Deep yellow, or gold-coloured topaz, or oriental topaz. 4. Orange-coloured topaz. 5. The yellowish green topaz, or *chrysolite*. 6. The yellowish green and cloudy topaz, the *chrysolite*. 7. Bluish green topaz, or the beryl. This varies in its colours; and is called, when *a.* of a sea-green colour, the *aqua-marine*. *b.* When more green the *beryl*. See the article SAPPHIRE.

IV. Emerald. Its chief colour is green and transparent. It is the softest of precious stones, and when heated it is phosphorescent, like the fluors. See the article EMERALD.

V. The amethyst is a gem of a violet colour, with great brilliancy, and as hard as the best kind of rubies or sapphires, from which it only differs by its colour. This is called the *oriental amethyst*; and is very rare: when it inclines to the purple, or rosy colour, it is more esteemed than when it is nearer to the blue. These amethysts have the same figure, hardness, specific gravity, and other qualities, as the best sapphires or rubies; and come from the same places, particularly from Persia, Arabia, Armenia, and the West Indies.

The amethyst called *occidental*, are of the same nature as rock crystals, and have the same gradations, viz. of a violet inclining to the purple or rosy colour, or inclining to the blue; very often they are semi-transparent, without any colour in one end, and violet towards the other. See the article AMETHYST.

VI. The garnet. This stone, when, transparent and of a fine colour, is reckoned among the gems; but it varies more than any, both in the form of its crystals and in its colour. See the article GARNET.

The garnet melts in the focus of a good burning glass into a brown mass, which is attracted by the loadstone; and this shows that iron enters considerably into its composition.

VII. Tourmalin; *Lapis electricus*. This is a kind of hard stone, lately brought into notice by its electrical properties. 1. Its form is a prism of nine sides of different breadths, mostly truncated, and seldom terminating in a pyramid at each end, which is either composed of three pentagons, or of nine triangles. 2. When heated in the fire, it gives signs of contrary electricity on the two opposite ends of their prismatic form. But many of these stones are not in the least electric. However, on being rubbed, they become electric in their sides, like other diaphanous gems. 3. It is as hard almost as the topaz, and strikes fire with steel. 4. It melts by itself in a strong fire, though with difficulty. 5. With the microcosmic salt it melts perfectly; but only in part with borax.

VIII. The opal, *Opalus*; the *girasole* of the Italians.---This is the most beautiful of all the flint kind, owing to the changeable appearance of its colours by reflection and refraction; and must therefore be described under both these circumstances.

Genus 2. Quartz.

This stone is very common in Europe, and easier to be known than described. It is distinguished from the other kinds of the siliceous order by the following qualities.

1. That it is most generally cracked throughout, even in the rock itself; whereby, 2. As well as by its nature, it breaks irregularly, and into sharp fragments. 3. That it cannot easily be made red-hot without cracking still more. 4. It never decays in the air. 5. Melted with pot-ashes, it gives a more solid and fixed glass than any other of the siliceous order. 6. It occurs in clefts, fissures, and small veins in rocks. It very seldom forms large veins, and still seldom whole mountains, without being mixed with heterogeneous substances.

Genus 3. Flint.

The flint forms a kind of intermediate substance between quartz and jasper; both which, however, it so nearly resembles, that it is not easy to point out such characters as shall readily distinguish it from them. We can only, therefore, speak of its properties comparatively.

1. It is more uniformly solid, and not so much cracked in the mass as the quartz; and, 2. It is more pellucid than the jasper. 3. It bears being exposed to the air without decaying better than the jasper, but not so well as the quartz. 4. It is better for making of glass than the jasper, but is not quite so good as quartz for that purpose.

5. Whenever there has been an opportunity in this matter of its shooting into crystals, quartz crystals are always found in it; just as if the quartz made one of its constituent parts, and had in certain circumstances been squeezed out of it: this is to be seen in every hollow flint, and its clefts, which are always filled up with quartz.

6. It often shows most evident marks of having been originally in a soft and slimy tough state like glue or jelly. See the System of Chymistry, Part II. Chap. V. the article FLINT.

Genus 4. Jaspers.

Jasper is a name given to all the opaque flints whose texture resembles dry clay, and which have no other known quality whereby they may be distinguished from other flints, except that they may be more easily melted in the fire; and this quality perhaps may proceed from the heterogeneous mixture, probably of iron.

Genus 5. Felt-spars.

Rhombic quartz has its name from its figure, but seems to be of the same substance as the jasper. We have not, however, ranked them together, for want of true marks to distinguish the different sorts of the flinty tribe from one another.

Genus 6. Garnet kinds.

The substances of this genus (which is considered by Cronstedt as an order) are analogous to gems; since all these are composed of the siliceous, calcareous, and argillaceous earths, with a greater or less proportion of iron. The opaque and black garnets contain about 20 hundredths of iron: but the diaphanous ones only two hundredths of their weight, according to Bergman. The garnets, properly so called, contain a greater quantity of siliceous earth than the others, and both are now justly ranked with the siliceous earths.

If the petty princes in those parts of the Indies, where precious stones are found, have no other power nor riches proportionable to the value of these gems, the reason of it is as obvious as of the general weakness of those countries where gold and silver abound, viz. because the inhabitants, placing a false confidence in the high value of their possessions, neglect useful manufactures and trade, which by degrees produces a general idleness and ignorance through the whole country. On the other hand, perhaps, some countries might safely improve their revenues by such traffic. In Saxony, for example, there might probably be other gems found besides aqua marines and topazes; or even a greater trade carried on

with these than at present, without danger of bad consequences, especially under the direction of a careful and prudent government.

ORDER V. THE ARGILLACEOUS EARTHS.

The principal character whereby these may be distinguished from other earths is, that they harden in the fire, and are compounded of very minute particles, by which they acquire a dead or dull appearance when broken.

The genus most worthy of notice in this order is the porcelain clay: the Kaolin of the Chinese. It is (1.) Pure. *a.* Diffusible in water. *b.* Coherent, dry and white. *c.* Friable and lean. (2.) Mixed with phlogiston. *d.* Diffusible in water. *b.* White and fat pipe clay. *c.* Of a pearl colour. *d.* Bluish grey. *e.* Grey. *f.* Black. *g.* Violet.

These earths are appropriated to a variety of uses; such as the making of pottery, bricks, and other articles too numerous to be mentioned.

For a more particular account of their property, uses, &c. see the System of Chymistry, Part II. Chap. IV. throughout.

CLASS II. SALTS.

By this name those mineral bodies are called which can be dissolved in water, and give it a taste; and which have the power, at least when they are mixed with one another, to form new bodies of a solid and angular shape, when the water in which they are dissolved is diminished to a less quantity than is required to keep them in solution; which quality is called *crystallisation*. See CRYSTALLISATION.

In regard to the principal known circumstances or qualities of the mineral salts, they are divided into

1. Acid salts, or mineral acids.
2. Alkaline salts, or mineral alkalies.

ORDER I. ACID SALTS.

For the characters, properties, and phenomena of these, see the System of CHYMISTRY, Part I. Chap. V. throughout.

Till of late no more mineral acids were known than the vitriolic and marine; the boracic or sedative salt being reckoned as produced artificially: but later discoveries have proved that we may reckon at least eleven mineral acids; out of which only two or three have been found in an uncombined state. Those hitherto known are the following, viz. the vitriolic, the nitrous, the marine, the sparry, the arsenical, the molybdenic, the tungstic, the phosphoric, the boracic, the succinic, and the aerial.

I. The vitriolic acid. See the System, Part I. Chap. V. Sect. II.

II. Nitrous acid. This acid is by some excluded from the mineral kingdom, because they suppose it to be produced from putrefaction of organic bodies. But these bodies, when deprived of life, are again received amongst fossils, from whence their more fixed parts were originally derived. For the nature of this acid, see the System, Part I. Chap. V. Sect. III.

III. Acid of common or sea-salt. See the System, Part I. Chap. V. Sect. IV.

For the properties, &c. of the other species of acids, see them as they occur in order in the same System and Chapter as referred to for those above specified---For an account of acids, as appertaining to the doctrine or science of air, see the System of Aerology, Section II. throughout.

ORDER II. ALKALINE MINERAL SALTS.

For the characters, properties, and phenomena of these, see the article ALKALI; and the System of CHYMISTRY, Part I. Chap. IV. throughout.

New acids are daily detected; but no additions have been made to the three species of alkali long since known.

These alkaline salts are,
I. Vegetable fixed alkali.

Vegetable fixed alkali, deprived of every acid, is not found any where by itself; but it is sometimes met with in combination with the vitriolic acid or the muriatic, generally with the nitrous, rarely with the aerial. The fixed vegetable alkali (or *potasse* of Morveau), is of a powdery appearance, and of a dead white colour. When pure, it is much more caustic than the neutral salt; it forms with the aerial acid, and even corrodes the skin. See the System of CHYMISTRY, Part I. Chap. V. Sect. I.

II. Fossil fixed alkalis.

Alkali of the sea, or of common salt, has nearly the same qualities with the lixivious salt, which is prepared from the ashes of burnt vegetables. It is the same with the *sal soda*, or kelp: for the kelp is nothing else than the ashes remaining, after the burning of certain herbs that abound in common salt; but which common salt, during the burning of those vegetables, has lost its acid. For the properties of the fossil alkali, see the System of CHYMISTRY, Part I. Chap. IV. Sect. I.

III. Volatile mineral alkali perfectly resembles that salt which is extracted from animals and vegetables, under the name of *alkali volatile* or *sal urinsum*, and is commonly considered as not belonging to the mineral kingdom; but since it is discovered, not only in most part of the clays, but likewise in the sublimations at Solfatara, near Naples, it cannot possibly be quite excluded from the mineral kingdom. See the System, Part I. Chap. V. Sect. II.

ORDER III. NEUTRAL SALTS.

Acids united to alkalies form neutral salts. These dissolved in water

water are no ways disturbed by the addition of an alkali; and generally, by evaporation, concrete into crystals. If, by proper tests, they show neither acid nor alkaline properties, they are said to be *perfect* neutrals; but *imperfect*, when, from defect in quantity or strength of one ingredient, the peculiar properties of the other more or less prevail.

I. Vitriolated tartar, vitriolated vegetable alkali, or (as Morveau calls it) the *vitriol of pot-ash*, is a perfectly neutral salt, which results from the combination of the vitriolic acid with the vegetable fixed alkali. According to Bergman, it seldom occurs spontaneously in nature, unless where tracks of wood have been burnt down. See the System of Chymistry, Part I. Chap. V. Sect. II. Article 1.

It is easily obtained, by pouring the vitriolic acid on a solution of fixed vegetable alkali till it is saturated. Crystals of this neutral salt are then formed. This crystallisation succeeds better by evaporation than by cooling, according to Mongez. See the System, Part I. Chap. V. Sect. III. Art. 1.

The taste of this salt is disagreeable, though somewhat resembling common salt.

II. Common nitre is known in commerce by the name of *salt-petre*, and is also called *prismatic nitre*, to distinguish it from the cubic nitre after-mentioned.—It is perfect neutral salt; resulting from the combination of the nitrous acid with the pure vegetable alkali. According to Bergman, it is formed upon the surface of the earth, where vegetables, especially when mixed with animal-substances, putrify.

III. Digestive salt, salt of Sylvius, is sometimes, though rarely, met with on the earth, generated perhaps, as professor Bergman observes, by the destruction of animal and vegetable substances. This salt is produced by a perfect combination of the vegetable alkali with marine acid. It has been wrongly confounded with common salt.

IV. Mild vegetable alkali was formerly considered as a pure alkali, known by the nature of *potash* and *salt of tartar*: but since the discovery of the aerial acid, it is very properly classed among the neutral salts, and ought to be called *aerated potasse*. It results from a combination of the vegetable alkali with the aerial acid, and is hardly ever found native, unless in the neighbourhood of woods destroyed by fire. On being exposed on a piece of charcoal, urged by the blow-pipe, it melts, and is absorbed by the coal; but, in the metallic spoon, it forms a glassy bead, which becomes opaque when cold.

V. Vitriolated acid saturated with mineral alkali; Glauber's salt is a neutral salt prepared by nature (as well as by art), containing more or less of iron, or of a calcareous earth; from which arises also some difference in its effects when internally used. It shoots easily into prismatic crystals, which become larger in proportion to the quantity of water evaporated before the crystallisation. See the System of CHYMISTRY, Chap. V. Sect. I. Art. 3.

VI. Cubic or quadrangular nitre rarely occurs but where marine plants putrify. According to Bowles, quoted by Kirwan, it is found native in Spain.

VII. Common salt, or sea salt, shoots into cubical crystals during the very evaporation; crackles in the fire, and attracts the humidity of the air. It is a perfectly neutral salt, composed of marine acid, saturated with mineral alkali. It has a saline but agreeable flavour. See the System, Part I. Chap. V. Sect. IV. Art. 1.

VIII. Borax is a peculiar alkaline salt, which is supposed to belong to the mineral kingdom, and cannot be otherwise described, than that it is dissoluble in water, and vitrescible; that it is fixed in the fire; and melts to a glass; which glass is afterwards dissoluble in water. See the article BORAX, and the System of Chymistry, Part I. Chap. V. Sect. VI.

IX. Mild mineral alkali is an imperfect neutral salt, and was formerly considered as a pure alkali; but the discovery of the aerial acid has shown the mistake.

X. Vitriolic ammoniac was called *secret salt of Glauber*, and is a combination of the volatile alkali with vitriolic acid. According to Bergman, it is scarcely found any where but in places where the phlogisticated fumes of vitriolic acid arise from burning sulphur, and are absorbed in putrid places by the volatile alkali.

XI. Nitrous ammoniac results from the combination of the nitrous acid with the volatile alkali. It is frequently found in the mother-liquor of nitre. When mixed with a fixed alkali, the volatile betrays itself by its smell.

XII. Native sal ammoniac. The muriatic (or marine) acid saturated with a volatile alkali. This is of a yellowish colour, and is sublimed from the flaming crevices, or fire-springs, at Solfatara, near Naples. See the System of CHYMISTRY, Part I. Chap. V. Sect. IV.

XIII. Aerated or mild volatile alkali. This neutral salt results from the combination of volatile alkali united to the aerial acid. It was formerly considered as a pure alkali.—But the discovery of the aerial acid (or fixed air) has shown it to be a true neutral salt, though imperfect: as it retains still all the properties of an alkali, though in a weaker degree, on account of its combination with the aerial acid, which is itself the most weak of all acids, and of course other stronger acids easily dislodge it from its base, and from various ammoniac salts.

ORDER IV. EARTHY NEUTRAL SALTS.

The compounds of earths and acids which possess solubility are decomposed and precipitated by mild, but not by phlogisticated alkalis. The most remarkable and useful article appertaining to this order is the gypsum, or plaster, which is not only found dissolved in various waters, but also in many places it forms immense strata. It is placed by all mineralogists among the earths, which it greatly resembles; but it rather belongs to the saline substances of the neutral kind, as appears by its constituent parts. When burnt, it generates heat with water, but in less degree than lime does. This salt has a particular taste, neither bitter nor astringent, but earthy, when applied to the tongue; and it is owing to it that some waters, chiefly from pumps and wells, are called hard waters, because they lie heavy on the stomach. It is unalterable whilst kept in a dry place; but on being exposed to a moist air, it is much altered, and suffers a kind of decomposition. When exposed to fire so as to lose the water off its crystallisation, it assumes a dead white colour; and it is then what we call plaster of Paris; but if the fire is too strong, it melts and vitrifies, after losing the vitriolic acid with which it is saturated. See GYPSUM and the System of Chymistry, Part I. Chap. I.

The most famous quarries of gypsum in Europe, are those of Montmartre, near Paris. It is found also in the vegetable kingdom.—Mr. Model found that the white spots in the root of rhubarb are a selenitical or gypseous earth. *Journal de Phys.* vol. vi. p. 14.) For the various combinations, &c. which form the other articles under the head of Earthy Neutral Salts, see the System of CHYMISTRY, Part II. throughout.

ORDER V. METALLIC SALTS.

The native salts belonging to this division may be distinguished by the phlogisticated alkali, which precipitates them all.

I. Vitriol of copper; blue vitriol is a combination of the vitriolic acid with copper, and is found in all *ziment waters*, as they are called. Its colour is a deep blue; and being long exposed to the air, it degenerates into a rusty yellow blue. Urged by the flame of the blow pipe on a piece of charcoal, it froths at first with noise, giving a green flame, and the metallic particles are often reduced to a shining globule of copper, leaving an irregularly figured scoria. But with borax the scoria is dissolved, and forms a green glass.

II. Muriatic copper, or marine salt of copper, has been found in Saxony, in the mine of Johngeorgenstadt. 1. It is of a greenish colour, and foliated texture. 2. It is moderately hard. 3. Sometimes it is transparent and crystallised.

III. Aerated iron is a combination of the aerial acid with iron; and is found in the light chalybeate waters, where it is dissolved by an excess of this acid.

IV. Vitriol of zinc, vitriolated zinc, or white vitriol. This neutral metallic salt results from the combination of vitriolic acid with zinc. It is sometimes found native, mixed with vitriol of iron, and in the form of white hairy crystals; or in a stalactical form in the mines of Hungary, or as an efflorescence on ores of zinc. It is also found dissolved in mineral waters, and generally with some proportion of vitriols of iron and copper. Bergman says, it is sometimes produced by the decomposition of pseudogalena, or black-jack; but this rarely happens, because this substance does not readily decompose spontaneously. But that in common use is most prepared at Goslar, from an ore which contains zinc, copper, and lead, mineralised by sulphur and a little iron. The copper is first separated as much as possible: the remainder after torrefaction and distillation is thrown red hot into water and lixiviated. It is never free from iron. See the System of CHYMISTRY, Part III. Chap. I. Sect. V.

ORDER VI. TRIPLE SALTS.

The neutral salts hitherto enumerated are such as are composed of two ingredients only; but sometimes three or more are so united as not to be separated by crystallization. The vitriols that we are acquainted with are hardly ever pure; and two or three of them sometimes are joined together.

Sometimes likewise it happens that neutral salts join earthy salts, and earthy salts metallic ones. Bergman generally distinguishes compound salts according to the number of their principles, whether the same acid be joined to several bases, or the same base to different acids; or, lastly whether several menstrua and several bases are joined together. Hence arise salts triple, quadruple, &c. which the diligence of after-times must illustrate.

CLASS III. MINERAL INFLAMMABLE SUBSTANCES.

To this class belongs all those subterraneous bodies that are dissoluble in oils, but not in water, which they repel; that catch flame in the fire; and that are electrical.

1. Inflammable air, fire damp, is an aeriform substance easily known by its property of inflaming when mixed with twice or thrice its bulk of common atmospheric air; and it is asserted to be the real phlogiston almost pure.

It admits considerable varieties, according to the nature of the substances from which it is produced, and often gives different residuums upon combustion, some of which are of the acid kind. If it is produced from charcoal, it yields aerial acid or fixed air: from solutions of metallic substances, in the vitriolic nitrous, or marine

MIN

marine acids it yields these respective acids, as M. Lavoisier asserts. See the System of AEROLOGY, Sect. VI. throughout.

Mr. Scheele is of opinion, that every inflammable air is composed of a very subtle oil. This coincides with the idea entertained by Chymists of their phlogiston; and is confirmed by the fact, of its being naturally found in those springs from whence issues petrol, whose exhalation are very inflammable. The residuum, which remains in the atmosphere after the combustion of inflammable air, is extremely noxious to animals. Doctor Priestley takes it to be a combination of phlogiston with pure air, and on this account calls it *phlogisticated air*. But M. Lavoisier, on the contrary, considers it to be a primitive substance of an unchangeable nature, and gives it the singular name of *atmospheric mephitic*. See the System of AEROLOGY, Sect. IV. and XIII.

2. Hepatic air seems to consist of sulphur, held in solution in vitriolic or marine air. It is inflammable when mixed with three quarters of its bulk of common air. Nitre will take up about half the bulk of this air; and when saturated with it, will turn silver black: but if strong dephlogisticated nitrous acid be dropped into this water, the sulphur will be precipitated. See the System of AEROLOGY, Sect. XII.

3. Phlogiston combined with aerial acid; black lead, or wadd. *Plumbago*. See the article BLACK-LEAD and the System of CHYMISTRY, Part III. Chap. 2. Sect. III. and the article PHLOGISTON.

It is found, *a*. Of a steel-grained and dull texture. It is naturally black, but when rubbed it gives a dark lead colour. *b*. Of a fine scaly and coarse-grained texture; coarse black lead.

4. Mineral tallow was found in the sea on the coasts of Finland in the year 1736. Its specific gravity is 0.770; whereas that of tallow is 0.969. It burns with a blue flame, and a smell of grease, leaving a black viscid matter, which is with more difficulty consumed.

5. Ambergris is commonly supposed to belong to the mineral kingdom, although it is said to have doubtful marks of its origin.

a. It has an agreeable smell, chiefly when burnt: *b*. Is consumed in an open fire: *c*. Softens in a slight degree of warmth, so as to stick to the teeth like pitch. *d*. It is of a black or grey colour, and of a dull or fine grained texture. The grey is reckoned the best, and is sold very dear. This drug is brought to Europe from the Indies. It is employed in medicine; and also as a perfume. For a copious account for the article AMBERGRIS.

6. Amber is dug out of the earth, and found on the sea-coasts. According to the experiments of M. Bourdelin, it consists of an inflammable substance, united with the acid of common salt, which seems to have given it its hardness.

It is supposed to be of vegetable origin, since it is said to be found together with wood in the earth. By distillation it yields water, oil, and a volatile acid salt, which the above mentioned author has thought to be the acid of common salt united with a small portion of phlogiston. Insects, fish, and vegetables, are often found included in it, which testify its having once been liquid. It is more transparent than most of the other bitumens; and is doubtless the substance which first gave rise to *electrical experiments* (on account of the power it possesses of attracting little bits of straw, or of other light substances, when rubbed.)

The greatest quantity of European amber is found in Prussia; but it is, besides, collected on the sea-coast of the province of Skone, and at Biorko; in the lake Malaren in the province of Upland; as also in France and in Siberia. It is chiefly employed in medicine and for making varnishes. See the article AMBER.

7. Rock-oil is an inflammable mineral substance, or a thin bitumen, of a light brown colour, which cannot be decomposed but is often rendered impure by heterogeneous admixtures. By length of time it hardens in the open air, and then resembles a vegetable resin; in this state it is of a black colour, whether pure or mixed with other bodies.

8. Jet is a very compact bitumen, harder than asphaltum, always black, and susceptible of a good polish. It becomes electrical when rubbed; attracts light bodies like the yellow amber; and it swims on water. It seems to be nothing else than a black amber, or succinum; but specifically lighter, on account of the greater portion of bitumen that enters into its composition. When burned it emits a bituminous smell.

9. Mineral phlogiston united with pure calcareous earth forms the fetid or swine spar. United with calcareous, argillaceous, ponderous, and siliceous earth and vitriolic acid, forms liver-stone: With an argillaceous earth, forms pit or stone coal, of a black colour, and of a shining texture: it burns with a flame, and is mostly consumed in the fire; but leaves, however, a small quantity of ashes.

Those fossil substances, which furnish fuel for the various purposes of human life, are distinguished by the name of *coals*, on account of their being a succedaneum for wood and other vegetable productions, which when dry or of an oleaginous kind serve for the same uses.

10. The mineral phlogiston or bitumen united with the vitriolic acid, forms sulphur or brimstone. See the article SULPHUR and the System of CHYMISTRY, Part I. Chap. I. Sect. II.

MIN

11. Mineral phlogiston mixed with metallic earths. This is not found in any great quantity: in regard to its external appearance, it resembles pit-coal; and the fat substance contained in it, at times, partly burns to coal, and partly volatilises in a calcining heat.

CLASS IV. METALLIC SUBSTANCES.

METALS are those minerals which, with respect to their volume, are the heaviest of all known bodies. Some of them are malleable; and some may be decomposed; and, in a melting heat, be brought back again to their former state by the addition of the phlogiston they had lost in their decomposition.

All the metallic substances contain phlogiston; and when, to a certain degree; deprived of it, fall into a powder like an earth; but their attractions for phlogiston are different. Most of them, when melted in a common way, and exposed to the air, have an earthy crust formed upon the surface, which cannot again be reduced to metal without the addition of some inflammable matter. For a more particular account of the nature, properties, &c. of Metallic Substances in general, see the System of CHYMISTRY, Part III. Introduction.

ORDER I. GOLD.

This is esteemed the principal and first among metals; and that partly for its scarcity, but chiefly for its qualities; for which see the System of CHYMISTRY, Part III. Chap. VII. Sect. I. For an account of the places where it is found in greatest quantities, with the methods of extracting it from the ore, &c. see the Article GOLD.

ORDER II. SILVER.

This is the most precious of all metals, except gold. For its peculiar qualities, uses, &c. see the System of CHYMISTRY, Part III. Chap. II. Sect. VII. For the places where it is found, the manner of assaying it, &c. see the Article SILVER.

ORDER III. PLATINA.

This metal, which is a recent discovery, possesses many of the properties of gold. The name seems to be a diminution of plated Silver, expressing its most obvious appearance which is that of a silver coloured metal. For its properties, uses, &c. see the System of CHYMISTRY, Part III. Chap. II. Sect. VIII. For a copious general account, see the Article PLATINA.

ORDER VI. MERCURY or QUICKSILVER.

Is distinguished from all other metals by its liquidity. For its properties, combinations, uses, &c. see the System of CHYMISTRY, Part III. Chap. II. Sect. II. For its uses, see also the Article MERCURY.

ORDER V. TIN,

Is an intermediate metal, between lead and silver; it is very soft and light: for its other properties, see the System of CHYMISTRY, Part III. Chap. II. Sect. V. For the places where it is found, see the Article TIN.

ORDER VI. LEAD,

Is the heaviest of metals, except gold, platina, and mercury. For its other properties as well as uses in the arts, manufactures, &c. see the System of CHYMISTRY, Part III. Chap. II. Sect. I.

ORDER VII. COPPER

Is the lightest of all metals, except iron and tin; and the hardest except iron. For its peculiar properties, uses, &c. see the System of CHYMISTRY, Part III. Chap. II. Sect. IV. For the methods of procuring it from the ore and assaying it, see the Article COPPER.

ORDER VIII. IRON,

Is the lightest of all metals, except tin; and the hardest and most elastic except platina. For an account of its various states, effects, ores, attraction by the magnet, uses, &c. see the System of CHYMISTRY, Part III. Chap. II. Sect. III. For the method of its combination, so as to form steel, see the Article IRON.

ORDER IX. BISMUTH,

Is usually found in tin mines, and sometimes in silver mines. Its weight and colour discover it to be of a mercurial or metallic nature. For its properties, ores, alloys, &c. see the System of CHYMISTRY, Part III. Chap. I. Sect. III. See also the Article BISMUTH.

ORDER X. ZINC,

Is of a brilliant white colour, approaching to blue. It is also called *spelter* and *tutenag*. For its ores, analysis, properties, uses, &c. see the System of CHYMISTRY, Part III. Chap. I. Sect. V. For its medicinal Properties, see the Article ZINC.

ORDER XI. ANTIMONY,

Is a mineral substance, which has much engaged the attention of alchemists. For an account of its ores, processes, preparations, uses, &c. see the System of CHYMISTRY, Part III. Chap. I. Sect. IV. For a further description, see the Article ANTIMONY.

ORDER XII. ARSENIC,

In its metallic state, is nearly of the same colour as lead; and is poisonous, especially in the form of a pure calx or glass. For its properties and uses, and the symptoms which characterize its poison, see the System of CHYMISTRY, Part III. Chap. I. Sect. I. See also the Article ARSENIC.

ORDER XIII. COBALT,

Is confined in the bowels of the earth, with sulphur, arsenic, and other metallic substances. For its properties, uses, &c. see the

the System of CHYMISTRY, Part III. Chap. II. Sect. II. See also the Article COBALT.

ORDER XIV. MANGANESE.

Is a mineral of a greyish or blackish colour, and placed by most naturalists among the iron ores. For its ores, reduction, properties and uses, see the System of CHYMISTRY, Part III. Chap. I. Sect. VI.

MINERVA, or **PALLAS**, in Pagan worship, the goddess of sciences and of wisdom, sprung completely armed from Jupiter's brain. Minerva is usually represented by the poets, painters, and sculptors, completely armed, with a composed but agreeable countenance, bearing a golden breast plate, a spear in her right hand, and her ægis or shield in the left, on which is represented Medusa's head encircled with snakes, and her helmet was usually entwined with olives.

MIRACLE, is defined by Dr. Samuel Clarke, to be a work effected in a manner different from the common and regular method of providence, by the interposition either of God himself, or some intelligent agent superior to man. It has been much controverted, whether true miracles can be worked by any less power than the immediate power of God; and whether, to complete the evidence of a miracle, the nature of the doctrine pretended to be proved by it is necessary to be taken into the consideration. The above learned author undertakes to set this matter in a clear light, as follows. In respect to the power of God, and the nature of the things themselves, all things that are possible at all, are equally easy to be done: it is at least as great an act of power to cause the sun to move at all, as to cause it at any time to stand still; yet this latter we call a *miracle*, the former not.

What degrees of power God may reasonably be supposed to have communicated to created beings or subordinate intelligences, is impossible for us to determine: therefore a miracle is not rightly defined to be such an effect as could not have been produced by any less power than the divine omnipotence. There is no instance of any miracle in scripture, which, to an ordinary spectator, would necessarily imply the immediate operation of original, absolute, and undivided power. All things that are done in the world, are done either immediately by God himself, or by created intelligent beings, matter not being at all capable of any laws or powers whatsoever; so that all those things which we say are the effects of the natural powers of matter and laws of motion, are properly the effects of God acting upon matter continually and every moment, either immediately by himself, or mediately by some created intelligent beings. Consequently it is no more against the course of nature for an angel to keep a man from sinking in the water, than for a man to take a stone from falling in the air, by overpowering the law of gravitation; and yet the one is a miracle, the other not so. The only possible ways by which a spectator may certainly and infallibly distinguish whether miracles be the works either immediately of God himself, or of some good angel employed by him; or whether, on the contrary, they are the works of evil spirits, are these: if the doctrine attested by miracles, be in itself impious, or manifestly tending to promote vice; then, without all question, the miracles, how great soever they may appear to us, are neither worked by God himself, nor by his commission. If the doctrine itself be indifferent, and at the same time there be worked other miracles more or greater than the former, then that doctrine which is attested by the superior power must necessarily be believed to be divine: this was the case of Moses and the Egyptian magicians. If, in the last place, the doctrine attested by miracles tends to promote the honour of God, and the practice of righteousness among men; and yet nevertheless be not in itself demonstrable, nor could without a revelation be discovered to be actually true, and there is no pretence of more and greater miracles to contradict it, which is the case of the doctrine and miracles of Christ; then the miracles are unquestionably divine, and the doctrine must, without all controversy, be acknowledged as an immediate and infallible revelation from God.

The lord Bacon observes, that a miracle was never wrought by God to convert an atheist, because the light of nature might have led him to confess a God; but miracles, says he, are designed to convert idolaters and the superstitious, who have acknowledged a Deity, but erred in the manner of adoring him; because no light of nature extends so far as fully to declare the will and true worship of God.

MIRROR, a name for a looking-glass, or any polished body, whose use is to form the images of distant objects by reflection of the rays of light. See System of OPTICS, Part II. throughout, and plate I.

Mirrors are either plain, convex, or concave. The first reflect the rays of light in a direction exactly similar to that in which they fall upon them, and therefore represent bodies of their natural magnitude. The convex ones make the rays diverge much more than before reflexion, and therefore greatly diminish the images of those objects which they shew: while the concave ones, by collecting the rays into a focus, not only magnify the objects they shew; but will burn very fiercely when exposed to the rays of the sun; and hence they are commonly known by the name of *burning mirrors*. See *BURNING GLASS*.

In ancient times the mirrors were made of some kind of metal; No 110.

and from a passage in the Mosaic writings we learn that the mirrors used by the Jewish women were made of brass. The Jews certainly had been taught to use that kind of mirrors by the Egyptians; from whence it is probable, that brazen mirrors were the first kind used in the world. Any kind of metal, indeed, when well polished, will reflect very powerfully; but of all others silver reflects the most, though it hath been in all countries too expensive a material for common use. Gold also is very powerful; and metals, or even wood, gilded and polished, will act very powerfully as burning mirrors. Even polished ivory, or straw nicely plaited together, will form mirrors capable of burning, if on a large scale. Since the invention of glass, and the application of quicksilver to it, became generally known, it hath been universally employed for those plain mirrors used as ornaments to houses; but in making reflecting telescopes, they have been found much inferior to metalline ones. It doth not appear that the same superiority belongs to the metalline burning mirrors, considered merely as burning glasses; since the mirror with which Mr. Macquer melted platina, though only 22 inches diameter, and which was made of quicksilvered glass, produced much greater effects than M. Vilette's metalline speculum, which considerably exceeded it in size. It is very probable, however, that this mirror of Mr. Vilette's was by no means so well polished as it ought to have been: as the art of preparing the metal for taking the finest polish hath but lately been discovered and published in the Philosophical Transactions by Mr. Mudge.

MISANTHROPY, *μισανθρωπια*, formed of *μισος*, *hatred*, and *ανθρωπος*, a *man*, a general dislike or aversion to man, and mankind. In which sense it stands opposed to *philanthropy*, or the love of mankind.

MISCARRIAGE. For the causes, and methods of prevention, see the System of MIDWIFERY, Part II. Sect. I. II. and III.

MISSIONARIES, such ecclesiastics as are sent by any Christian church into Pagan or infidel countries, to convert the natives, and establish the Christian religion among them. There were in France, and are in other Popish countries, several congregations of missionaries, whose principal end was to be employed on missions, and to inspire into the young clerks that spirit of piety and devotion which is necessary for the worthy discharge of their ministry. Such were the congregations of the priests of the mission, the Eudists, the missionaries of Lyons, and some others. The most remarkable of these congregations was that of the priests of the mission, which consisted of secular clergy; who make four simple vows, of poverty, chastity, obedience, and perseverance. Their habit was distinguished from that of other ecclesiastics only by a linen-collar four fingers broad, and by their wearing a little tuft of beard.

MITTIMUS, in law, a writ by which records are ordered to be transferred from one court to another; sometimes immediately, as out of the king's bench into the exchequer; and sometimes by a certiorari into the chancery; and from thence, by a mittimus, into another court. **MITTIMUS** is also used for a precept in writing, directed by a justice of peace to a gaoler, for the receiving and safe keeping a felon, or other offender, by him committed to the goal. This is a warrant under the hand and seal of the justice, containing the cause of the commitment of the offender.

MIXT, or **MIXT BODY**, in chymistry, that which is compounded of different elements or principles.

MIXTURE, a compound, or assemblage of several different bodies in the same mass. Simple mixture consists only in the simple apposition of parts of different bodies to each other. Thus, when powders of different kinds are rubbed together, the mixture is only simple, and each of the powders retains its particular characters. In like manner, when oil and water are mixed together, though the parts of both are confounded, so that the liquor may appear to be homogeneous, we cannot say that there is any more than a simple apposition of the parts, as the oil and water may very easily be again separated from each other. But the case is very different when bodies are chymically mixed; for then one or both bodies assume new properties, and can by no means be discovered in their proper form without a particular chymical process adapted to this purpose. Hence chymical mixture is attended with many phenomena which are never observed in simple mixtures; such as heat, effervescence, &c. To chymical mixture belongs the union of acids and alkalies, the amalgamation of metals, solution of gums, &c. and upon it depend many of the principal operations of chymistry.

MODULE, in architecture, a certain measure taken at pleasure, for regulating the proportions of columns and the symmetry or distribution of the whole building. Architects usually choose the diameter or semidiameter of the bottom of the column for their module; and this they subdivide into parts or minutes. See the System, Part II. Sect. V. with the plates annexed.

MOHAIR, in commerce, the hair of a kind of goat, frequent about Angora in Turkey; the inhabitants of which city are all employed in the manufacture of camlets made of this hair. Some give the name mohair to the camlets or stuffs made of this hair: others there are two kinds; the one smooth and plain; the other watered like tabbies: the difference between the two only consists

in this, that the latter is calendered, the other not. There are also mohairs both plain and watered, whose woof is of wool, cotton, or thread.

MOISTURE. See **HUMIDITY**. The moisture of the air has considerable effects on the human body. For the quantity and quality of the food, and the proportion of the meat to the drink, being given, the weight of a human body is less, and consequently its discharges greater in dry weather than in wet weather; which may be thus accounted for; the moisture of the air moistens the fibres of the skin, and lessens perspiration by lessening their vibratory motion. When perspiration is thus lessened by the moisture of the air, urine, indeed, is by degrees increased, but not equally. See Dr. Bryan Robinson's *Diff. on the Food and Discharges of the Human Bodies*, p. 68. seq.

MOLARES, in anatomy, the *grinders*; an epithet given to the large teeth; as serving, like mill-stones, to grind the food. See the *System*, Part I. Sect. II. Art. 3.

MOLE. The English name of a species of the Genus *Talpa*, in *Mammalia*. For description, see **TALPA**. For representation, see Plate VI. Genus XVIII. Species I.

MOLLUSCA, in the Linnæan system of vermeology, is the denomination of the second genus of *vermes*, or worms. These are simple naked animals, not included in a shell, but furnished with limbs, and comprehending eighteen subordinate genera and one hundred and ten species. See **VERMEOLOGY**.

MOLOCH, a false god of the Ammonites, who dedicated their children to him, by making them "pass through the fire," as the scriptures express it. There are various opinions concerning this method of consecration. Some think, the children leaped over a fire sacred to Moloch; others, that they passed between two fires; and others, that they were really burnt in the fire, by way of sacrifice to this god. There is foundation for each of these opinions. For, first, it was usual among the pagans to lustrate or purify with fire; and, in the next place, it is expressly said, that the inhabitants of Sepharvaim burnt their children in the fire to Anamalech and Adramelech; much such deities as Moloch of the Ammonites.

Moses, in several places, forbids the Israelites to dedicate their children to this god, as the Ammonites did, and threatens death and utter extirpation to such persons as were guilty of this abominable idolatry. And there is great probability that the Hebrews were much addicted to the worship of this deity: since Amos, and after him St. Stephen, reproaches them with having carried along with them into the wilderness the tabernacle of their god Moloch.

Solomon built a temple to Moloch upon the mount of Olives; and Manasseh, a long time after, imitated his impiety, by making his son pass through the fire in honour of Moloch. It was chiefly in the valley of Tophet and Hinnom, to the east of Jerusalem, that the Israelites paid their idolatrous worship to this false god of the Ammonites.

MOLOSSES, **MOLASSES**, or **MELASSES**, that gross, yet fluid matter remaining of sugar, after refining, and which no boiling will bring to a consistence more solid than that of syrup; hence also called *syrup of sugar*. Properly, molasses are only the sediment of one kind of sugar called *chypre*, or brown sugar, which is the refuse of other sugars not to be whitened, or reduced into loaves. Molasses are much used in Holland among poor people, for the preparation of tobacco, and also instead of sugar. There is a kind of brandy or spirit made of molasses, but by some held exceedingly unwholesome.

MOLOSSES spirit, a very clean and pure spirit, much used in England, and made from molasses, or common treacle dissolved in water, and fermented in the same manner as malt or the common malt spirit. If some particular art is not used in the making this, it will not prove so vinous as the malt spirit, but more flat and less pungent and acid, though otherwise much cleaner tasted, as its essential oil is of a less nauseous flavour. Whence if good fresh wine leys, abounding in tartar, be duly fermented in the solution made thin for that purpose, the spirit will by that means become much more vinous and brisk, and approach more to the nature of the foreign spirits.

MOMENTUM, in mechanics, signifies the same with impetus, or the quantity of motion in a moving body; which is always equal to the quantity of matter multiplied into the velocity. For the general laws of motion, see the *System*, Sect. II. and the article **MOTION**.

MOMUS, in fabulous history, the god of raillery; or the jester of the celestial assembly, and who ridiculed both gods and men.

MONADELPHIA, in botany, the sixteenth class of plants, whose stamina, or male parts, on account of their filaments running in among one another, are all formed into one body. Though authors in general have kept this class of plants together, they have been much divided in their opinions, as to the characters or parts of them, by which they should divide them into genera. Some have had recourse, on this occasion, to the seed-vessel; others, finding that insufficient, have con-

sulted the leaves. Linnæus uses the cup of the flower on this occasion, which is a very essential part, in this class of plants, and sufficiently different in the different genera. It is observed that all the plants of this class are mucilaginous and emollient, and have great virtues as diuretics, &c. The common marsh-mallow deservedly stands at the head of these, and is common in the prescriptions of the physicians on these occasions, as well as in many of the shop compositions, as the syrup of marshmallows and the like. See the *System*, Sect. V. Class XVI. and Plate V. with the explanation.

MONANDRIA, in botany, the first class of plants which have hermaphrodite flowers, with only one stamen each. The word is formed of the Greek *monos*, single, and *andros*, male. See the *System*, Sect. V. Class I. Plate IV. with the explanation.

MONARCHY, *μοναρχία*, a large state governed by one: or a state where the supreme power is lodged in the hands of a single person. The word comes from the Greek *monarchia*, one who governs alone; formed of *monos*, solus, and *arche*, imperium, government. Of the three forms of government, viz. democracy, aristocracy, and monarchy, the last is the most powerful, all the sinews of government being knit together, and united in the hand of the prince; but then there is imminent danger of his employing that strength to improvident or oppressive purposes. A democracy is the best calculated to direct the end of a law, and an aristocracy to invent the means by which that end shall be obtained, and a monarchy is most fit for carrying those means into execution. The most ancient monarchy was that of the Assyrians, which was founded soon after the deluge.

Of monarchies, some are absolute and despotic, where the will of the monarch is uncontrollable; as Denmark, &c. others are limited, where the prince's authority is restrained by laws, and part of the supreme power lodged in other hands; as in England. See **GOVERNMENT** and **PARLIAMENT**. Some monarchies, again, are hereditary, where the succession devolves immediately from father to son; and others are elective, where, on the death of the monarch, his successor is appointed by election; as in Poland.

MONASTERY, a convent, or house, built for the reception and entertainment of monks, mendicant friars, or nuns, whether it be an abbey, priory, &c. Monasteries are governed by different rules, according to the different regulations prescribed by their founders. The first regular and perfect monasteries were founded by St. Pachomius in Egypt: but St. Basil is generally considered as the great father and patriarch of the eastern monks; since, in the fourth century, he prescribed rules for the government of the monasteries, to which the Anchorites and Cenobites, and the other ancient fathers of the deserts, submitted. In like manner St. Benedict was styled the patriarch of the western monks. He appeared in Italy towards the latter end of the fifth century, and published his rule, which was universally received throughout the west. St. Augustine being sent into England by St. Gregory the pope, in the year 596, to convert the English, he at the same time introduced the monastic state into that kingdom; which made such progress there, that, within the space of 200 years, there were thirty kings and queens who preferred the religious habit to their crowns, and founded stately monasteries, where they ended their days in retirement.

The houses belonging to the several religious orders, which obtained in England and Wales, were cathedrals, colleges, abbeys, priories, preceptories, commandries, hospitals, friaries, hermitages, chantries, and free chapels. These were under the direction and management of various officers. The dissolution of houses of this kind began so early as the year 1312, when the templars were suppressed; and in 1323, their lands, churches, advowsons, and liberties, here in England, were given, by 17 Ed. II. stat. 3. to the prior and brethren of the hospital of St. John at Jerusalem. In the year 1390, 1437, 1441, 1459, 1497, 1505, 1508, and 1515, several other houses were dissolved, and their revenues settled on different colleges in Oxford and Cambridge. Soon after the last period, cardinal Wolsey, by licence of the king and pope, obtained a dissolution of above thirty religious houses, for the founding and endowing his colleges at Oxford and Ipswich. About the same time a bull was granted by the same pope to cardinal Wolsey, to suppress monasteries, where there were not above six monks, to the value of eight thousand ducats a year, for endowing Windsor, and King's College in Cambridge; and two other bulls were granted to cardinals Wolsey and Campeius, where there were less than twelve monks, and to annex them to the greater monasteries; and another bull to the same cardinals to enquire about abbeys, to be suppressed, in order to be made cathedrals. Although nothing appears to have been done in consequence of these bulls, the motive which induced Wolsey, and many others, to suppress these houses, was the desire of promoting learning; and archbishop Cranmer engaged in it with a view of carrying on the Reformation. There were other causes that concurred to bring on their ruin: many of the religious were loose and vicious; the monks were generally thought to be, in their hearts, attached to the pope's

pope's supremacy; their revenues were not employed according to the intent of the donors; many cheats in images, feigned miracles, and counterfeit relics, had been discovered, which brought the monks into disgrace; the Observant friars had opposed the king's divorce from queen Catharine; and these circumstances operated, in concurrence with the king's wanting a supply, and the people's desire to save their money, to forward a motion in parliament, that, in order to support the king's state, and supply his wants, all the religious houses might be conferred upon the crown, which were not able to spend above 200*l.* a year; and an act was passed for that purpose, 27 Henry VIII. *c.* 28. By this act about three hundred and eighty houses were dissolved, and a revenue of 30 or 32,000*l.* a year came to the crown; besides about 100,000*l.* in plate and jewels. The suppression of these houses occasioned discontent, and at length an open rebellion: when this was appeased, the king resolved to suppress the rest of the monasteries, and appointed a new visitation, which caused the greater abbeys to be surrendered apace; and it was enacted by 31 Hen. VIII. *c.* 13. that all monasteries, &c. which have been surrendered since the fourth of February, in the twenty-seventh year of his majesty's reign, and which hereafter shall be surrendered, shall be vested in the king. The knights of St. John of Jerusalem were also suppressed by the 32 Hen. VIII. *c.* 24. The suppression of these greater houses by these two acts, produced a revenue to the king of above 100,000*l.* a year, besides a large sum in plate and jewels. The last act of dissolution in this king's reign was the act of 37 Hen. VIII. *c.* 4. for dissolving colleges, free chapels, chantries, &c. which act was farther enforced by 1 Ed. VI. *c.* 14. By this act were suppressed ninety colleges, a hundred and ten hospitals, two thousand three hundred and seventy-four chantries and free chapels. The number of houses and places suppressed from first to last, so far as any calculations appear to have been made, seems to be no less than 47,721.

But as there were probably more than one person to officiate in several of the free chapels, and there were other houses which are not included within this account, perhaps they may be computed in one general estimate at about 50,000. As there were pensions paid to almost all those of the greater monasteries, the king did not immediately come into the full enjoyment of the whole revenues: however, by means of what he did receive, he founded six new bishoprics, viz. those of Westminster (which was changed by Queen Elizabeth into a deanry, with twelve prebends and a school), Peterborough, Chester, Gloucester, Bristol, and Oxford. And in eight other sees he founded deanries and chapters, by converting the priors and monks into deans and prebendaries, viz. Canterbury, Winchester, Durham, Worcester, Rochester, Norwich, Ely, and Carlisle. He founded also the colleges of Christ-church in Oxford, and Trinity in Cambridge, and finished King's college there. He likewise founded professorships of divinity, law, physic, and of the Hebrew and Greek tongues, in both the said universities. He gave the house of Grey Friars, and St. Bartholomew's hospital, to the city of London; and a perpetual pension to the poor knights of Windsor, and laid out great sums in building and fortifying many ports in the channel. It is observable, upon the whole, that the dissolution of their houses was an act, not of the church, but of the state: in the period preceding the Reformation, by a king and parliament of the Roman catholic communion, in all points except the king's supremacy; to which the pope himself, by his bulls and licenses, had led the way. See Tanner's Notitia Monastica.

MONASTIC, something belonging to monks, or the monkish life. The monastic profession is a kind of civil death, which in all worldly matters has the same effect with the natural death.

MONEY, a piece of metal marked for coin, with the arms of a prince or state, who make it circulate or pass, at a fixed rate, for things of different value; to facilitate the business of commerce. It may be defined an universal medium, or common standard, by comparison with which the value of all merchandize may be ascertained; or, it is a sign, which represents the respective value of all commodities. Metals are well calculated for this sign, because they are durable, and are capable of many subdivisions; and a precious metal is still better calculated for this purpose, because it is the most portable. A metal is also the most proper for a common measure, because it can easily be reduced to the same standard in all nations; and every particular nation fixes on its own impression, that the weight and standard, wherein consists the intrinsic value, may both be known by inspection only. And as money is the medium of commerce, it is the king's prerogative, as the arbiter of domestic commerce, to give it authority, or make it current. It is evident, that, as the quantity of precious metals increases, *i. e.* the more of them there is extracted from the mine, this universal medium, or common sign, will sink in value, and become less precious. Above a thousand millions of bullion are calculated to have been imported into Europe

from America within less than three centuries, and the quantity is daily increasing; the consequence is, that more money must be given now for the same commodity than was given a hundred years ago. And if any accident was to diminish the quantity of gold and silver, their value would proportionably rise.

The æra of the invention of money is not easy to be settled. There is no room to doubt, but that, in the earliest ages, the ordinary way of traffic among men was, by trucking, or exchanging commodity for commodity. Thus, in Homer, Glaucus's golden armour was valued at one hundred oxen; and Diomedes's armour at ten.

But in course of time it was found necessary, in the way of commutative justice, to have some common measure, or standard, according to which all other things should be estimated. See the article EXCHANGE. This, as some gather from Josephus, was first invented by Cain; though the first tidings we hear of it are, in the time of Abraham, who paid four hundred shekels for a burying place.

On the value money now stands, it may be divided into *real*, or *imaginary*.

Real MONEY, includes all coins, or species, of gold, silver, copper, and the like; which have course in commerce, and do really exist. Such are guineas, crowns, pistoles, pieces of eight, ducats, &c.

The degrees of goodness are expressed in gold by carats, and in silver by penny-weights, &c. for there are several reasons for not coining them pure, and without alloy. See the articles GOLD and SILVER.

Among the ancient Britons, iron rings, or, as some say, iron plates, or tin plates and rings, were used for money; among the Lacedæmonians, iron bars. Seneca observes, that there was anciently stamped money of leather, *corium forma publica impressum*; and the same thing was put in practice by Frederick II. at the siege of Milan; to say nothing of an old tradition among ourselves, that, in the confused time of the barons' wars, the like was done in England. In 1360, king John of France, who agreed to pay our Edward III. for the ransom of his person three millions of gold crowns, was reduced to the necessity of paying for the necessaries of his household in leather money, in the middle whereof there was a little nail of silver. The Hollanders, we know, coined great quantities of pasteboard in the year 1574. Numa Pompilius made money of wood and leather; nor does it appear, that the Romans were much acquainted with the art of striking money in metal, during the time of their kings. There is reason to believe, that both gold and silver money were very early in use in Egypt and Asia, and thence soon afterwards introduced into Carthage and Greece. From Greece it was brought to Rome, and thence gradually westward into all the Roman provinces. The first silver money coined by the Romans was in the year of Rome 484, and their first gold money in 546.

With regard to the materials of English money, Sir Edward Coke lays it down, that the money of England must either be of gold or silver; and none other was ever issued by the royal authority till 1672, when copper farthings and halfpence were coined by king Charles the second, and ordered by proclamation to be current in all payments, under the value of six-pence and not otherwise. But this copper coin is not upon the same footing with the other in many respects, particularly with regard to the offence of counterfeiting it.

After the arrival of the Romans in this island, the Britons imitated them, coining both gold and silver with the images of their kings stamped on them; when the Romans had subdued the kings of the Britons, they also suppressed their coins, and brought in their own, which were current here from the time of Claudius to that of Valentinian the younger, this being about the space of five hundred years.

Mr. Camden observes, that the most ancient English coin he had known, was that of Ethelbert, king of Kent, the first Christian king in the Island; in whose time all money accounts began to pass by the names of pounds, shillings, pence, and mancusæ. The penny seems borrowed from the Latin *pecunia*, or rather from *pendo*, on account of its just weight, which, till king Edward the Third's reign contained as much silver as about three pence of our money: these were coarsely stamped with the king's image on the one side, and either the mint master's name, or the city's where it was coined, on the other: five of these pence made their scilling, probably so called from *scillingus*, which the Romans used for the fourth part of an ounce; forty of these scillings made their pound, and four hundred of these pounds were a legacy, or a portion for a king's daughter; as appears by the last will of king Alfred.

Though the coining of money be a special prerogative of the king, yet the ancient Saxon princes communicated it to their subjects; inasmuch, that in every good town there was, at least, one mint, but at London eight; at Canterbury four for the king, two for the archbishop, one for the abbot at Winchester; six at Rochester; at Hastings two, &c.

The Norman kings continued the same custom of coining only

MON

only pence, with the prince's image on one side, and on the other the name of the city where it was coined, with a cross so deeply impressed that it might be easily parted, and broken into two halves, which, so broken, they call half-pence; or into four parts, which they called *farthings*, or *FARTHING*S.

About the year 1320, the states of Europe first began to coin gold; and, among the rest, our king Edward III. The first pieces he coined were called *Florentes*, as being coined by Florentines; afterwards he coined nobles; then rose-nobles, current at six shillings and eight pence; half-nobles, called *halfpennies*, at three shillings and four pence of gold; and quarters at twenty pence, called *farthings of gold*. The succeeding kings coined rose-nobles, and double rose-nobles, great sovereigns, and half Henry nobles, angels, and shillings.

King James I. coined units, double crowns, Britain crowns; then crowns, half-crowns, &c.

IMAGINARY MONEY, or **MONEY of Account**, is that which has never existed, or, at least, which does not exist in real species, but is a denomination invented, or retained to facilitate the stating of accounts, by keeping them still on a fixed footing, not to be changed, like current coins, which the authority of the sovereign sometimes raises, or lowers, according to the exigencies of state. Of which kinds are, *pounds, livres, marks, maravedies*, &c.

MONEY-Bill, in parliamentary language, comprehend all bills by which money is directed to be raised upon the subject, for any purpose or in any shape whatsoever; either for the exigencies of government, and collected from the kingdom in general, as the *LAND-Tax*; or for private benefit, and collected in any particular district, as by turnpikes, parish-rates, and the like. With respect to these bills the commons are so reasonably jealous of their privilege of framing new taxes for the subject, that they will not suffer the other house to exert any other power but that of rejecting; they will not permit the least alteration or amendment to be made by the lords to the mode of taxing the people by bills of this nature.

MONGOOSE, or **MONGOOZ**, a species of the Genus *LEMUR*, in *MAMMALIA*. For the description of the Genus and several species, see *LEMUR*. For representation, see Plate II. Genus III. Species II.

MONK, a person who wholly dedicates himself to the service of religion, in some monastery, under the direction of particular statutes and rules. The most probable account of the original of the monks is, that in the Decian persecution, in the middle of the third century, many persons in Egypt, to avoid the fury of the storm, fled to the neighbouring deserts and mountains, where they not only found a safe retreat, but also more time and liberty to exercise themselves in acts of piety and divine contemplations; which sort of life became so agreeable, that, when the persecution was over, they refused to return to their habitations again, choosing rather to continue in those cottages and cells which they had made for themselves in the wilderness. From that time to the reign of Constantine, monachism was confined to the hermits or anachorites, who lived in private cells in the wilderness: but when Pachomius had erected *MONASTERIES*, other countries presently followed the example. See *ABBOT*. For a particular account of the present monastic orders, see *BENEDICTINES*, *CARME-LITES*, *DOMINICANS*, *FRANCISCANS*, &c.

MONKEY, the English name of a species of the Genus *Simia*, in *MAMMALIA*. For description, see *SIMIA*, for representation of the several families and species, see Plate I.

MONODON, a genus, the 7th order of *Mammalia*, called *Cete*. This genus has but one species called *monoceros*, or the *sea unicorn*; it has a long wreathed tooth in the upper jaw, which perforates the upper lip, and has the appearance of a horn; from this circumstance it has got the name of the *unicorn-fish*. It is of the whale kind. Sometimes it grows to 25 feet in length; but the usual size is from 16 to 20.

MONODY, in ancient poetry, a mournful kind of song, sung by a person all alone, to give vent to his grief. The word is derived from *μονος*, "alone," and *αῖδω*, "I sing."

MONOECIA, from *μονος*, "alone," and *οἶκος*, "a house," the name of the 21st class in Linnæus's sexual method. See *System of BOTANY*, Sect. IV and Plate IV.

MONOGYNIA, from *μονος*, "alone," and *γυνή*, "a woman," the name of the first order or subdivision in the first 13 classes of Linnæus's sexual method; consisting of plants which, besides their agreement in their classic character, generally derived from the number of their stamina, have only one stile, or female organ. See *System of BOTANY*, Sect. IV. and Plate IV.

MONOSYLLABLE, **MONOSYLLABUM**, a word of a single syllable; or, that consists of one or more letters which are pronounced together. The French language abounds in *monosyllables* more than any other. This renders it the more perplexing to foreigners, and yet the beauty of the language seems to consist in it. One of the best and smoothest lines in Malherbe consists of twelve *monosyllables*: speaking of Calista, he says,—*Et moi je ne voi rien quand je ne la voi pas*. In this the genius of the English tongue differs very much from the French, an uninterrupted series of *monosyllables* in the former having always an ill effect. This Mr. Pope both intimates and exemplifies in the same verse.

And ten low words oft creep in one dull line.

MOO

MONSOON, a regular or periodical wind, in the East Indies, blowing constantly the same way, during six months of the year, and the contrary way the remaining six. In the Indian ocean, the winds are partly *general*, and blow all the year round the same way, as in the Ethiopic ocean; and partly *periodical*, i. e. half the year blow one way, and the other half near on the opposite points, and those points and times of shifting, differ in different parts of this ocean. These latter are what we call *monsoons*. The shifting of these *monsoons* is not all at once: and in some places the time of the change is attended with calms, in others with variable winds, and particularly those of China, at ceasing to be westerly, are very subject to be tempestuous; and such is their violence, that they seem to be of the nature of the West Indian *HURRICANES*, and render the navigation of those seas very unsafe at that time of the year. See the article *HURRICANE*. These tempests the seamen called the *breaking up of the monsoons*. *Monsoons*, then, are a species of what we otherwise call *TRADE-winds*. They take the denomination *monsoon* from an ancient pilot, who first crossed the Indian sea by means hereof. Though others derive the name from a Portuguese word, signifying *motion*, or change of wind, and sea. See the article *WIND*.

MONSTER, **MONSTRUM**, a birth or production of a living thing, degenerating from the proper and usual disposition of parts, in the species it belongs to. As, when there are too many members, or too few; or some of them are extravagantly out of proportion, either on the side of defect or excess. See the *System of MIDWIFERY*, Part VIII. Sect. II.

The French Academicians have of late disputed whether *monsters*, that is creatures born with their organs preternaturally formed or situated, supernumerary or defective, were originally so formed in their first stamina; or whether this deformity has been owing to some accidental change upon them. The arguments for these opinions, are remarks upon particular histories of such *monsters*, which we cannot abridge, and therefore must refer to the *Mémoires de l'Acad. des Sciences*, 1733, 1734, 1738, 1739.

MONTH, in the computation of time, the twelfth part of the year. There are divers kinds of years, and months, according to the particular luminary by whose revolutions they are determined, and the particular purposes they are destined for; as *solar months*, *lunar months*, *astronomical months*, &c.

Solar MONTH, is the space of time wherein the sun moves through one entire sign of the ecliptic. Hence, if regard be had to the sun's true motion, the *solar months* will be unequal; since the sun is longer in passing through the summer signs, than through those of the winter. But as he constantly travels through all the twelve in 365 days, 5 hours, and 49 minutes, the quantity of a mean month will be had by dividing that number by 12. On this principle the quantity of a *solar month* will be found 30 days, 10 hours, 29 minutes, 5 seconds. See the *System of ASTRONOMY*, Sect. III. and IV. and Plate III. Fig. 2 and 3.

Lunar MONTHS are either *synodical*, *periodical*, or *illuminative*.

Lunar synodical MONTH, called also absolutely *lunar month*, and *lunation*, is the space of time between two conjunctions of the moon with the sun; or between two new moons. The quantity of the *synodical month* is 29 days, 12 hours, 44', 3", 11".

Lunar periodical MONTH, is the space of time wherein the moon makes her round through the zodiac; or wherein she returns to the same point. The quantity of this month is 27 days, 7 hours, 43', 8". The ancient Romans made use of *lunar months*, and made them alternately 29 and 30 days: and they marked the days of each month by three terms, viz. *calends*, *nones*, and *ides*.

Lunar illuminative MONTH, is the space from the first time of the moon's appearance after new moons, to her first appearance after the new moon following. Hence as the moon appears sometimes sooner after the new moon, and sometimes later; the quantity of the *illuminative month* is not always the same. By this month the Turks and Arabs reckon.

Astronomical or natural MONTH, is that measured by some exact interval corresponding to the motion of the sun, or moon. Such are the lunar and solar months before mentioned. Where note, that these months can be of no use in civil life, where it is required that the months begin and end on some certain day. For this reason, recourse is had to another form of months.

MONUMENT, **monumentum**, of *monere*, to advise, advertise, in architecture, a building destined to preserve the memory of the person who raised it, or of him for whom it was raised: such are, a triumphal arch, a mausoleum, a pyramid, &c.

The **MONUMENT**, absolutely so called among us, denotes a magnificent pillar, designed by Sir Christopher Wren, erected by order of parliament, in memory of the burning of the city of London, anno 1666, in the very place where the fire began. This pillar was begun in 1671, and finished in 1677. It is of the Doric order, fluted, 202 feet high from the ground, and fifteen feet in diameter, of solid Portland stone, with a stair-case in the middle, of black marble, containing 345 steps. The lowest part of the pedestal is 28 feet square, and its altitude 40 feet; the front being enriched with curious basso relievos. It has a balcony within 32 feet of the top, where is a curious and specious blazing urn of gilt brass.

MOOD, or **MODE**, in logic, called also *Syllogistic Mood*, is a proper

proper disposition of the several proportions of a syllogism, in respect of quantity and quality. See the System, Part III. Sect. IV.

Mood, or *Mode*, in grammar, is used to signify the different manners of conjugating verbs agreeably to the different actions or affections to be expressed; as shewing, commanding, wishing, &c. Hence arise five moods; viz. the *indicative*, *imperative*, *optative*, *subjunctive*, and *infinitive*. See the System, Part. II. Class III. Article V.

MOON, *Luna*, δ , in astronomy, one of the heavenly bodies, usually ranked among the planets; but with more propriety accounted a satellite, or secondary planet. The Moon is an attendant on our earth, which she respects as a centre, and in whose neighbourhood she is constantly found: inasmuch as, if viewed from the sun, she would never appear to depart from us by an angle greater than ten minutes. For an explanation of the phenomena, phases, motions, and every other particular relative to this subject, see the System, Sect. III. and IX.

MOOSE-Deer, one of the English names of a species of the genus *Cervus*, in mammalia. For a description of the genus and several species, see *CERVUS*. For a representation of this species, see Plate VIII. Genus XXIX. Species II.

MORAI, is the name given at Otaheite, in the South Sea, to their burying-grounds, which are also places of worship. "The foundation was of rock stones, which were also squared. In the middle of the top stood an image of a bird, carved in wood; near it lay the broken one of a fish, carved in stone. The whole of this pyramid made part of one side of a spacious area or square, 660 feet by 354, which was walled in with stone, and paved with flat stones in its whole extent. About an hundred yards to the west of this building was another paved area or court, in which were several small stages raised on wooden pillars, about seven feet high, which are called by the Indians *ewattas*, and seem to be a kind of altars, as upon these are placed provisions of all kinds, as offerings to their gods. On some of them were seen whole hogs, and on others the skulls of above fifty, besides the skulls of many dogs. The principal object of ambition among the natives is to have a magnificent morai. The male deities (for they have them of both sexes) are worshipped by the men; and the female by the women; and each have morais to which the other sex is not admitted, though they have also morais common to both." See *Banks's Geography*, Page 55 to 58.

MORALS, or *Moral Philosophy*, is the science of manners or duty; which it traces from man's nature and condition, and shews to terminate in his happiness. In other words, it is, The knowledge of our duty and felicity; or, The art of being virtuous and happy. It is denominated an art, as it contains a system of rules, for becoming virtuous and happy. Whoever practises these rules, attains an habitual power or facility of becoming virtuous and happy. It is likewise called a science, as it deduces those rules from the principles and connections of our nature, and proves that the observance of them is productive of our happiness. It is an art and a science, of the highest dignity, importance, and use. Its object is man's duty, or his conduct in the several moral capacities and connections which he sustains. Its office is to direct that conduct; to shew whence our obligations arise, and where they terminate. Its use, or end, is the attainment of happiness; and the means it employs are rules for the right conduct of our moral powers.

Moral Philosophy has this in common with Natural Philosophy: that it appears to nature or fact; depends on observation; and builds its reasonings on plain uncontroverted experiments, or upon the fullest induction of particulars of which the subject will admit. We must observe, in both these sciences, how nature is affected, and what her conduct is in such and such circumstances. Or, in other words, we must collect the appearances of nature in any given instance; trace these to some general principles, or laws of operation; and then apply these principles or laws to the explaining of other phenomena. Therefore Moral Philosophy enquires, not how man might have been, but how he is, constituted? not into what principles or dispositions his actions may be artfully resolved; but from what principles and dispositions they actually flow? not what he may, by education, habit, or foreign influence, come to be, or do; but what, by his nature, or original constituent principles, he is formed to be and do? We discover the office, use, or destination of any work, whether natural or artificial, by observing its structure, the parts of which it consists, their connection or joint action. It is thus we understand the office and use of a watch, a plant, an eye, or hand. It is the same with a living, creature, of the rational or brute kind. Therefore, to determine the office, duty, or destination of man; or, in other words, what his business is, or what conduct he is obliged to pursue; we must inspect his constitution, take every part to pieces, examine their mutual relations one to the other, and the common effort or tendency of the whole.

The behests of morals are contained in the Christian Scheme, which clearly and fully lays open the connections of our nature, both material and immaterial, and future as well as present. What an ample and beautiful detail does it present of the duties we owe to God, to society, and ourselves, promulgated, in the

most simple, intelligible, and popular manner; divested of every partiality of sect or nation, and adapted to the general state of mankind! With what bright and alluring examples does it illustrate and recommend the practice of those duties; and with what mighty sanctions does it enforce that practice! How strongly does it describe the corruptions of our nature; the deviations of our life from the rule of duty, and the causes of both! How marvellous and benevolent a plan of redemption does it unfold, by which those corruptions may be remedied; and our nature restored from its deviations to transcendent heights of virtue and piety! Finally, what a fair and comprehensive prospect does it give us of the administration of God, of which it represents the present state only as a small period, and a period of warfare and trial! How solemn and unbounded are the scenes which it opens beyond it! The resurrection of the dead, the general judgment, the equal distribution of rewards and punishments to the good and bad; and the full completion of divine wisdom and goodness in the final establishment of order, perfection, and happiness! How glorious then is that *Scheme of Religion*, and how worthy of affection as well as of admiration, which, by making such discoveries, and affording such assistances, has disclosed the unfading fruits and triumphs of *Virtue*, and secured its interests beyond the power of *Time* and *Chance*!

MORASS, a marsh, fen, or low moist ground, which receives the waters from above, without having any descent to carry them off again. See *BOG*; and for the method of draining, see the System of *AGRICULTURE*, Sect. VIII.

MORBID, among physicians, signifies "diseased or corrupt;" a term applied either to an unsound constitution, or to those parts or humours that are affected by a disease.

MORSE, or *Sea-horse*, the English name of a species of the genus *Tricheus*, in mammalia. For a description, see *TRICHEUS*. For a representation, see Plate II. Genus VI. Species I.

MORTALITY, a term frequently used to signify a contagious disease, which destroys great numbers of either men or beasts.

Bills of MORTALITY, are accounts or registers specifying the numbers born, married, and buried, in any parish, town, or district. In general, they contain only these numbers; and, even when thus limited, are of great use, by shewing the degrees of healthiness and prolificness, and the progress of population in the places where they are kept. It is therefore much to be wished that such accounts had been always correctly kept in every kingdom, and regularly published at the end of every year. We should then have had under our inspection the comparative strength of every kingdom, as far as it depends on the number of inhabitants, and its increase or decrease at different periods. But such accounts are rendered more useful when they include the ages of the dead, and the distempers of which they have died. In this case they convey some of the most important instructions, by furnishing us with the means of ascertaining the law which governs the waste of human life, the values of annuities dependent on the continuance of any lives, or any survivorship between them, and the favourableness or unfavourableness of different situations to the duration of human life. See the System of *ANNUITIES*.

MORTAR, a composition of lime, sand, &c. mixed up with water; serving as a cement to bind the stones, &c. of a building. The ancients had a kind of *mortar* so very hard and binding, that after so long a duration as to this time it is next to impossible to separate the parts of some of their buildings; though there are some who ascribe that excessive strength to time, and the influence of certain properties in the air, which is, indeed, found to harden some bodies very surprisingly. See the article *CEMENT*.

MORTGAGE, in law, an obligation, whereby lands or tenements of a debtor are pawned or bound over to the creditor for money, or other effects, borrowed; peremptorily to be the creditor's for ever, if the money be not repaid at the day agreed on. The creditor holding such land on such agreement, is in the mean time called tenant in mortgage. He who lays the pawn or gage, is called the mortgager; and he that takes it, the mortgagee. If a mortgage includes excessive usury, it is prohibited by statute 37 Henry VIII.

If a man borrows of another a specific sum (e. g. 200l.) and grants him an estate in fee, on condition that if he, the mortgager, shall repay the mortgagee the said sum of 200l. on a certain day, mentioned in the deed, that then the mortgager may re-enter on the estate so granted in pledge; or, as is now the more usual way, that the mortgagee shall reconvey the estate to the mortgager; in this case the land, which is so put in pledge, is by law, in case of nonpayment at the time limited, for ever dead, and gone from the mortgager; and the mortgagee's estate in the land is then no longer conditional, but absolute. But as it was formerly a doubt whether, by taking such estate in fee, it did not become liable to the wife's dower, and other incumbrances, of the mortgager (though that doubt has been long ago over-ruled by our courts of equity) it therefore became usual to grant only a long term of years, by way of mortgage;

M O R

with condition to be void on repayment of the mortgage-money; which course has been since continued, principally because, on the death of the mortgagee, such term becomes vested in his personal representatives, who alone are entitled in equity to receive the money lent, of whatever nature the mortgage may happen to be. As soon as the estate is created, the mortgagee may immediately enter on the lands; but is liable to be dispossessed, upon performance of the condition, by payment of the mortgage-money at the day limited. And, therefore, the usual way is to agree that the mortgager should hold the land till the day assigned for payment; when, in case of failure, whereby the estate becomes absolute, the mortgagee may enter upon it, and take possession, without any possibility, at law, of being afterwards ejected by the mortgager, to whom the land is now for ever dead. But here again the courts of equity interpose; and, though a mortgage be thus forfeited, and the estate absolutely vested in the mortgagee, at the common law, yet they will consider the real value of the tenements compared with the sum borrowed; and, if the estate be of greater value than the sum lent thereon, they will allow the mortgager, at any reasonable time, to recal and redeem his estate; paying to the mortgagee his principal, interest, and expences; for, otherwise, in strictness of law, an estate worth 1000l. might be forfeited for nonpayment of 100l. or a less sum. This reasonable advantage, allowed to mortgagers, is called the *equity of REDEMPTION*. And this enables the mortgager to call on the mortgagee, who has possession of his estate, to deliver it back, and account for the rents and profits received, on payment of his whole debt and interest; thereby turning the *mortuum* into a kind of *vivum vadium*. But, on the other hand, the mortgagee may either compel the sale of the estate, in order to get the whole of his money immediately, or else call upon the mortgager to redeem his estate presently; or, in default thereof, to be for ever *foreclosed* from redeeming the same; i. e. to lose his equity of redemption without possibility of recal.

MORTIFICATION, *Necrosis*, in medicine, a total extinction of the natural heat of the body, or a part thereof. Some define mortification a disease wherein the natural juices of any part quite lose their proper motion; and by that means fall into a fermentative one, and corrupt and destroy the texture of the part.

The indications of cure are to confirm the strength, or to raise and maintain the vital heat a little above the natural healthy degree, to prevent the ingress of the putrid matter into the veins, and to check and remove the putrefaction that is formed. The bark is the only known specific; however, the use of it is not to be indiscriminately admitted in every case; in habits that are lax and feeble, no objections can occur to prohibit it; but in inflammatory habits, nitre, or mineral acids, should accompany it if given, and great caution is necessary before it is prescribed. If the inflammation is considerable, the mineral acids are more proper than the bark. If the pulse is strong, large, and hard, and the extremities of the body are warm, the urine red and high-coloured, the circulation is sufficiently strong, and need not be increased; but if the pulse is weak, and the symptoms indicate a defective vital heat, cordials will be necessary. Mr. Potts observes, that a mortification proceeds from a circulation that is too rapid or too languid: in the first case, bleeding and diluters, and in the second, cordials and invigorating medicines, must be prescribed. If a putrid *scurvy* affects the patient, administer such medicines as will oppose it: or, if any other disorder attends, the proper means must be made use of by which it may speedily be removed.

There are two species, or rather degrees, of mortification: the one called a *gangrene*, which is a mortification in its first or beginning state; the other, a *sphacelus*, which is a perfect or finished mortification.

In cases of a perfect *sphacelus*, or mortification, where the parts are become absolutely dead, and wholly without sense, and soft, so as to retain the impression of one's fingers' ends, and are plainly fetid and corrupted, all the medicines in the world will be ineffectual to restore the part to its life and sense again; and all that remains to be done is the one miserable remedy of preserving the rest of the body, by cutting off that part, to prevent the mortification from spreading further. A different method, is to be taken, however, in this operation, according to the degree of the symptoms, and the nature of the part affected.

If only some extremity of the foot, tarsus, metatarsus, or instep, or only the bare skin and fat, are *sphacelated*, which is sometimes the case, the whole foot is not to be amputated in that case, but, preserving the limb entire, the surgeon is only to remove that part which is vitiated; and that is frequently best of all done by suppuration; or if not to be effected by that means, may be attempted by the caustic. When it is to be done by suppuration, that is to be brought on as fast as possible; and when it is done, the crust or eschar of the ulcer is to be separated from the sound part with proper caution.

To hasten effectually a suppuration in these cases, nothing is so serviceable as the making numerous long and deep scarifica-

tions near the sound parts: and afterwards the incised parts are to be well anointed with the common digestive ointment, and after that treated with the balsamic cataplasms and fomentations in common use on the like occasions.

A fomentation, also very serviceable in these cases, is made by mixing, in a quart of decoction of scordium, or of barley-water, vinegar of rue six ounces, spirit of wine with Venice treacle four ounces, and an ounce or two ounces of common salt: this is to be applied, hot, with compresses, to the part, and frequently repeated, till it is seen that the disorder spreads no farther; which is known to be the case, when we see the tumour of the vitiated parts subside, and the edges of the sound parts become tumid all round; and, on the second or third day after this, a suppuration is usually formed, and the sound parts gradually become separated from the vitiated. After this, to soften and promote a speedy separation of the eschar, the following cataplasm is always found highly serviceable: Take of scordium two handfuls; mallows, marshmallows, and henbane, of each one handful; lavender-flowers, half a handful; let these be boiled to the consistence of a cataplasm in vinegar, or oxycrate; and when in that state, add to them three ounces of flour of linseed, one ounce of linseed oil, and two ounces of sal ammoniac. This is to be applied warm over the whole, and retained in a proper degree of heat as long as shall be found necessary, by means of a brick boiled in water, and applied wrapped in a linen cloth, or some other like means. After these methods have been used, and the whole surrounding skin is generally tumidified with redness, a crust, or eschar, is then formed by degrees, and the sound flesh begins to separate from the rest; by this we know that the disorder has done spreading, and that an entire separation of the vitiated parts will very shortly follow.

When this separation shews itself beginning, it must be promoted as much as possible, by dressing the part with the common digestive, either alone, or mixed with Venice treacle, which must be retained on between the sound and dead parts. To make way for this, it is sometimes necessary to divide them by the lancet; and when that is done, and the dressing has been applied, the before-described cataplasm should be again laid on, warm; and in all the succeeding dressings, whatever is found loose of the dead part must be carefully removed. And if it be necessary, from the adhesion of the vitiated parts to the sound, to use the scissars, or scalpel, to divide them, this is always to be done with very little, either of pain or of danger; it will then be proper to dress the part with the digestive, and a plaster of diachylon, or the like, over it, till the corrupted parts are entirely call off, and the ulcer appears perfectly well cleansed, and then the cure is easily perfected in the common way.

This is the gentler and more common method: some surgeons, however, from the tediousness of it, have recourse directly, in these cases, to the caustic. They anoint either the edges only; or else the whole of the corrupted part, every day, with butter of antimony, or the caustic stone liquified, till the living parts are surrounded by a sort of eschar, applying afterwards the cataplasms before-described, or others of the same kind, to prevent the disorder from spreading; and to make the corrupted parts separate from the sound, the corrosive lixivium of Boerhaave is greatly in repute, and much used on these occasions. It is made of three ounces of very strong quicklime, mixed with nine ounces of pot-ashes, first ground separately to powder, and afterwards mixed, adding a little water; they are then to be put into a glass vessel, and set in a cellar to run *per deliquium*.

As soon as they are found to become fluid, the matter must be put into a filtre of coarse paper, and the clear liquor that runs through must be kept for use. It is to be used by dipping a brush or feather into it, and rubbing it over the part affected once or twice a day; or fine linen rags may be wetted with it, and applied all over the part; not forgetting, however, at the same time, the use of the before-ordered cataplasm: this application is to be continued till the corrupted part begins to call off in crusts or scales; and when this is the case, it must be dressed with the common digestive, and, when perfectly cleansed, healed with a vulnerary balsam.

Finally, when the *sphacelus* is so deeply affixed in any part of the upper or lower extremity that it has penetrated through the muscles, as far as the bone, and has either resisted the force of all medicines, or the proper time for applying them has been neglected; in this case, to preserve the rest of the body, the injured part must be amputated.

MORTMAIN, or ALIENATION in Mortmain (*in mortu manu*) is an alienation of lands or tenements to any corporation, sole or aggregate, ecclesiastical or temporal; but these purchases having been chiefly made by religious houses, in consequence whereof, the lands became perpetually inherent in one dead hand, this hath occasioned the general appellation of *mortmain* to be applied to such alienations, and the religious houses themselves to be principally considered in forming the statutes of mortmain: in deducing the history of which statutes, it will be matter of curiosity to observe the great address and subtle contrivance

M O S

M O V

evance of the ecclesiastics in eluding, from time to time, the laws in being, and the zeal with which successive parliaments have pursued them through all their finesses; how new remedies were still the parents of new evasions; till the legislature at last, though with difficulty, hath obtained a decisive victory.

Yet still it was found difficult to fet bounds to ecclesiastical ingenuity: for when they were driven out of all their former holds, they devised a new method of conveyance, by which the lands were granted, not to themselves directly, but to nominal trustees, to the use of the religious houses; thus distinguishing between the possession and the use, and receiving the actual profits, while the seisin of the land remained in the nominal trustee, who was held by the courts of equity (then under the direction of the clergy) to be bound in conscience to account to his *beneficiary* for the rents and emoluments of the estate. And it is to these inventions that our practitioners are indebted for the institution of uses and trusts, the foundation of modern conveyancing. But, unfortunately for the inventors themselves, they did not long enjoy the advantage of their new device; for the statute 25 Richard II. c. 5, enacts, that the lands which had been purchased to uses should be amortised by licence from the crown, or else be sold to private persons; and that for the future uses shall be subject to the statutes of mortmain, and forfeitable like the lands themselves. And whereas the statutes had been eluded by purchasing large tracts of land adjoining to churches, and consecrating them by the name of *church-yards*, such subtle imagination is also declared to be within the compass of the statutes of mortmain. And civil or lay corporations, as well as ecclesiastical, are also declared to be within the mischief, and of course within the remedy provided by those salutary laws. And, lastly, as during the times of popery, lands were frequently given to superstitious uses, though not to any corporate bodies; or were made liable in the hands of heirs and devisees to the charge of obits, chauntries, and the like, which were equally prenicious in a well governed state as actual alienations in mortmain: therefore at the dawn of the Reformation, the statute 23 Henry VIII. c. 10, declares, that all future grants of lands for any purposes aforesaid, if granted for any longer term than twenty years, shall be void.

As it was apprehended from recent experience, that persons on their death-beds might make large and improvident dispositions even for these good purposes, and defeat the political ends of the statutes of mortmain; it is therefore enacted by the statute of 9 Geo. II. c. 36, that no lands or tenements, or money to be laid out thereon, shall be given for, or charged with, any charitable uses whatsoever, unless by deed intended, executed in the presence of two witnesses twelve calendar months before the death of the donor, and enrolled in the court of chancery within six months after its execution (except stock in the funds, which may be transferred within six months previous to the donor's death) and unless such gift be made to take effect immediately, and be without power of revocation: and that all other gifts shall be void. The two universities, their colleges, and the scholars upon the foundation of the colleges of Eton, Winchester, and Westminster, are excepted out of this act; but such exemption was granted with this proviso, that no college shall be at liberty to purchase more advowsons than are equal in number to one moiety of the fellows or students upon the respective foundation.

MOSCHUS, in mammalia, a genus of quadrupeds, of the order *Pecora*, having no horns; the canine teeth of the upper jaw are solitary and exserted. There are three species: 1. The muschiferus, or musk animal, hath been considered by some authors as a stag, a roebuck, a goat; and by others as a large chevrotain, a species of antelope; but M. Buffon hath determined it to be an ambiguous animal, participating of the nature of all these, but differing effectually from every one of them, and from all other animals. It is of the size of a small roebuck, but has no horns; it has long coarse hair, a sharp muzzle, and tusks like those of a hog. The hair of the musk is softer than in most animals, and exceedingly light and rare: for, being split, they appear to be made up of little bladders, like those in the plumb or stalk of a quill; so that it is something betwixt a common hair and a quill. On each side of his lower chop, almost under the corner of his mouth, there is a peculiar tuft, about three-fourths of an inch long, of short, thick, and hard hairs, or rather bristles, of equal length, as in a scrubbing-brush. The musk-bladder, or bag which holds the perfume, is on the belly, near the navel. It is about three inches long, and two over; standing out from the belly one inch and a half, and before the groin as much. The creature hath 26 teeth; 16 in the lower chop; of which there are eight little cutters before; behind, four grinders on each side, rugged and continuous, with as many grinders in the upper jaw. From the testimony of a number of travellers, it appears that the perfume is produced only in the body of the male. The female of this animal hath indeed a pouch of the same kind near the navel, but the humour secreted in it has not the same odour; and this tumour of the male is not filled with musk except in the rutting season:

at other times the quantity of this humour is smaller, and its odour weaker. See MUSK; and for representation, see Plate VIII. Genus XXVIII. Species I. 2. The grammia, or gramma, or Guinea antelope, is a most beautiful animal, with straight black horns, slender and sharp pointed, not three inches long, and slightly annulated at the base. Its height is about eighteen inches: the ears are large, and the eyes dusky; below the eyes is a large cavity, into which exudes a strong scented oily liquid; between the horns is a tuft of black hairs. The colour of the neck and body is brown, mixed with an ash-colour, and a tinge of yellow; the belly is white; the tail short, white beneath, and black above. Dr. Herman Grimm tells us, that the fat, viscid, yellow humour, which is secreted in the cavities above the eyes of this animal, has an odour that participates of musk and castoreum; but M. Vossmaer remarks, that in his live subject this viscid matter has no odour of any kind. 3. The pygmæus has feet narrower than a man's finger, and is found in Africa and Asia.

MOSQUE, a temple or place of religious worship among the Mahometans. All mosques are square buildings, generally constructed of stone. Before the chief gate there is a square court paved with white marble; and low galleries round it, whose roof is supported with marble pillars. In these galleries the Turks wash themselves before they go into the mosque. In each mosque there is a great number of lamps; and between these hang many crystal rings, ostrich's eggs, and other curiosities, which, when the lamps are lighted, make a fine show. As it is not lawful to enter the mosque with stockings or shoes on, the pavements are covered with pieces of stuff sewed together, each wide enough to hold a row of men kneeling, sitting, or prostrate. The women are not allowed to enter the mosque, but stay in the porches without.

Most of the mosques have a kind of hospital belonging to them, in which travellers, of what religion soever, are entertained three days. Each mosque has also a place called a *tarbe*, which is the burying-place of its founders; within which is a tomb six or seven feet long, covered with green velvet or fatten; at the ends of which are two tapers, and round it several seats for those who read the Koran, and pray for the souls of the deceased.

MOTACILLA, in ornithology, a genus belonging to the order *Passeres*. The most remarkable species are: The alba, or white wagtail, which frequents the sides of ponds and small streams, and feeds on insects and worms. The head, back, and upper and lower side of the neck, as far as the breast, are black; in some the chin is white, and the throat marked with a black crescent: the breast and belly are white: the quill-feathers are dusky; the coverts black, tipped and edged with white. The tail is very long, and always in motion. Mr. Willoughby observes, that this species shifts its quarters in the winter; moving from the north to the south of England during the season. In spring and autumn it is a constant attendant on the plough, for the sake of the worms thrown up by that instrument. For a representation, see Plate III. Genus XI.

The sutoria, or taylor-bird, is a native of the East Indies. It is remarkable for the art with which it makes its nest, seemingly in order to secure itself and its young in the most perfect manner possible, against all danger from voracious animals. It picks up a dead leaf, and sews it to the side of a living one; its slender bill is the needle, and its thread is formed of fine fibres; the lining is composed of feathers, gossamer, and down; its eggs are white, the colour of the bird light-yellow; its length three inches; and its weight only three-sixteenths of an ounce; so that the materials of the nest and its own size are not likely to draw down a habitation depending on so slight a tenure.

MOTION, primarily so called, or *Local Motion*, is a continued and successive change of place; or that state of a body whereby it corresponds successively to several different places; or is present successively in different parts of space. In this sense the doctrine and laws of motion make the subject of mechanics, or statics.

General Laws of MOTION, are those laws of nature which bodies in motion observe, or which regulate and determine the operations of moving bodies. On these, as a superstructure, rests the whole fabric of *Mechanics*, and *Mathematical Philosophy*.

In the System of MECHANICS, Sect. II. we have given the necessary definitions, postulata, and axioms.

Animal MOTION, is that whereby the situation, figure, magnitude, &c. of the parts, members, &c. of animals are changed. Under these motions come all the animal functions; as *respiration*, *circulation of blood*, *excretion*, *walking*, &c. Animal motions are usually divided into two species; viz. *Spontaneous* and *natural*. *Spontaneous*, or *Muscular Motion*, is that performed by means of the muscles, at the command of the will; hence also called *voluntary motion*. *Natural*, or *Involuntary Motion*, is that effected without such command of the will; by the mere mechanism of the parts. Such the motion of the heart and pulse; the peristaltic motion of the intestines, &c.

MOVEMENT, in mechanics, a machine that is moved by clock-work. *Perpetual Movement*. Many have attempted to find

find a perpetual movement, but without success; and there is reason to think, from the principles of mechanics, that such a movement is impossible; for, though, in many cases of bodies acting upon one another, there is a gain of absolute motion, yet the gain is always equal in opposite directions; so that the quantity of direct motion is never increased. To make a perpetual movement, it appears necessary that a certain system of bodies, of a determined number and quantity, should move in a certain space for ever, and in a certain way and manner; and for this there must be a series of actions returning in a circle, otherwise the movement will not be perpetual; so that any action by which the absolute quantity of force is increased, of which there are several sorts, must have its corresponding counter-action, by which the gain is destroyed, and the quantity of force restored to its first state. Thus by these actions there will never be any gain of direct force to overcome the friction and resistance of the medium; so that every motion being diminished by these resistances, they must at length languish and cease.

MOULD, or *Mold*, in agriculture, that kind of earth every where obvious to the surface of the ground; called also natural or mother earth. For an account of the nature and properties of this earth, see the *System of AGRICULTURE*, Sect. I.

MOULDINESS, a term applied to bodies which corrupt in the air, from some hidden principle of humidity therein; and whose corruption shews itself by a certain white down, or lanugo, on their surface. The *mouldiness*, when viewed with a microscope, affords a curious spectacle; being a kind of meadow, out of which arise herbs and flowers: some only in the bud, others full blown, and others decayed: each having its little root, stalk, and other parts: the figure whereof may be seen in Hook's *Micrographia*. The same may be observed of the *mouldiness* which gathers on the surface of liquid bodies. Mr. Bradley observed this *mouldiness* in a melon accurately, and found the vegetation of these little plants to be exceedingly quick. Each plant had its seeds in great abundance, which did not seem to be three hours before they began to shoot up; and in six hours more the new plant was complete and mature, and the seed ready to fall. When the fruit had been covered with a mould for six days, its vegetative quality began to abate, and it was entirely gone in two days more; then came on a putrefaction, and the fleshy parts of the melon yielded nothing but a stinking water, which began to have a gentle motion on its surface; and in two days' time maggots appeared, which in six more laid themselves up in their bags, where they continued four days, and then came out flies. These maggots were owing to the eggs of flies deposited in the putrefaction.

MOUNTAIN, *Mons*, a part of the earth rising to a considerable height above the level of the surrounding surface. The origin of mountains is variously assigned by philosophers: some will have them coeval with the world, and created along with it. Others, among whom is Dr. Burnet, will have them to take their rise from the deluge; urging, that the extreme irregularity and disorder visible in them, plainly shew, they do not come immediately out of the hand of God, but are the wrecks of the old world broken into the abyss. See the article *DELUGE*: and for the opinion of divers philosophers, ancient and modern, on the subject at large, see the article *EARTH*. Others, again, allege from history, that the foundations of many hills being gradually destroyed, the hills themselves have subsided, and sunk into plains: whence they conclude, that where the corruption is natural, the generation is so too.

It appears to many, that some mountains must have been generated gradually, and have grown up in process of time, from the sea-shells, &c. found in many of them; which they suppose may be accounted for from a violent wind blowing the sand, &c. into huge heaps, which are afterwards made into a mass by the rain, &c. Some among the divines tell us that the earth was created perfectly even; and that when God separated the water from the land, he dug channels in the earth; and with the earth scooped out he threw up the mountains: but whether all the mountains be sufficient to fill all the channels of the ocean, they must decide.

The origin of mountains, according to Mr. Ray, seems to have been explosions by means of subterraneous fires; and it is very probable that they have all vast hollows beneath them: that this might have been the means used at the creation, to make the dry land appear, is no way dissonant to reason, since history proves that fires have raged in subterraneous caverns under the seas, and there is no natural impossibility in fire's subsisting in such caverns, even when the earth was all over covered with water, as at the first creation.

Mountains appear, to many, defects and blemishes in the earth; but they are truly of the utmost use, and necessary to the well-being both of man and other animals. Many creatures live but in particular situations; and even the tops of the highest and the coldest mountains are only places wherein some creatures, as well birds as quadrupeds, will live: of this kind are the ibex and chamois among beasts, and the lagopus among birds.

They serve as screens to keep off the cold and nipping blasts of the northern and eastern winds; they also serve for the production of a great number of vegetables and minerals, which are not found in any other soil; they enable us to keep those mines dry, which furnish the most useful metals; besides, the long ridges and chains of lofty and topping mountains, being generally found to run from east to west, serve to stop the evacuation of the vapours towards the poles, without which they would run from the hot countries, and leave them destitute of rain.

Mr. Ray adds, that they condense those vapours, like alembic heads, into clouds; and so by a kind of external distillation, give origin to springs and rivers; and, by amassing, cooling, and condensing them, turn them into rain; and, by that means, render the fervid regions of the torrid zone habitable. Thus the more we consider nature, the more we must admire her works; and what seems to be defect or blemish in them, on a slight view, often proves, on more just observation, a great benefit and beauty. In history, we have instances of mountains travelling considerable distances. To measure the height of a mountain, see *ALTITUDE*, &c. Though there is another way used by Dr. Halley in the measure of Snowdon hill in Wales, by means of a *barometer*, the different height of whose mercury at the top and bottom of the mountain gives its perpendicular altitude; accounting eighty-two feet perpendicular ascent for every inch varied in the height of the mercury.

The difficulty of breathing on the tops of high mountains is a thing so plainly felt, that there are none, who have ever been in the way of making the experiment, who are not well convinced of the certainty of the fact. Acosta describes what he felt on the tops of the high mountains of Pariacaca very judiciously. The mountains of Armenia, and that particularly on which Noah's ark is supposed to have rested, have been also made famous on the like accounts; though the snows that lie on the tops of these mountains make it impracticable to ascend their tops: the people who climb as high as they can, always find that they breathe with more difficulty, and are compelled to fetch their breath oftener, than when on the plains; and on travellers complaining of this, their guides always tell them that it is a known thing, and is what every body suffers there.

The mountains in Languedoc and the Pyreneans have the same effect. People of curiosity have sometimes remained hours on the summit of these mountains, and always found the same sort of difficulty in breathing; but it is possible that this may be owing to the exhalations of certain steams from the earth in these places, less loaded with a weight of air than below; and this appears the more probable, as in going up the mountain Teneriffe, if many people are in company, and ascend different ways, some usually bear it better than others; and the very complexions of these are turned yellow by the exhalations, which are very plainly perceived by their smell and sharpness; while others, who ascend to the same height by different tracks, escape.

The most remarkable mountain in the world, in shape, is that called the *needle mountain*, or the *inaccessible mountain*, in Dauphiny. This is a vast hill, placed, as it were, bottom upwards, or set on its summit on the earth with its broad base elevated in the air; it is about a thousand paces in circumference at the bottom, and is about two thousand at the top. On the centre of the plain at the top, there stands another, small and very narrow, but very high hill.

It obtained the name of the *needle*, as it got the other, by its being supposed impracticable to the ascent of any one, by reason of its projecting so greatly outwards. Some hardy persons, however, once ventured to climb it, and found at the top a number of the chamois, animals by no means qualified for climbing, and which doubtless had never either ascended or descended the mountain, and which must be supposed to have bred there for many ages, though it is very difficult to account for their first getting to the place. *Hist. Acad. Par. 1700.*

Attraction of MOUNTAINS. This is a late discovery, and a very considerable confirmation of Sir Isaac Newton's theory of universal gravity. According to the Newtonian system, an attractive power is not only exerted between those large masses of matter which constitute the sun and planets, but likewise between all comparatively smaller bodies, and even between the smallest particles of which they are composed. Agreeably to this hypothesis, a heavy body, which ought to gravitate, or tend towards the centre of the earth, in a direction perpendicular to its surface, supposing the said surface to be perfectly even and spherical, ought likewise, though in a less degree, to be attracted, and tend towards a mountain, placed on the earth's surface: so that a plumb-line, for instance, of a quadrant, hanging in the neighbourhood of such a mountain, ought to be drawn from a perpendicular situation, in consequence of the attractive power of the quantity of matter of which it is composed, acting in a direction different from that exerted by the whole mass of matter in the earth, and with a proportionably inferior degree of force.

Though

Though Sir Isaac Newton had long ago hinted at an experiment of this kind, and had remarked, "that a mountain of an hemispherical figure, three miles high and six broad, would not, by its attraction, draw the plumb-line two minutes out of the perpendicular:" yet no attempt to ascertain this matter, by actual experiment, was made till about the year 1738; when the French academicians, particularly Messrs. Bouguer and Condamine, who were sent to Peru to measure a degree under the equator, attempted to discover the attractive power of Chimborazo, a mountain in the province of Quito. According to their observations, which were, however, made under circumstances by no means favourable to an accurate solution of so nice and difficult a problem, the mountain Chimborazo exerted an attraction equal to eight seconds. Though this experiment was not, perhaps, sufficient to prove satisfactorily even the reality of an attraction, much less the precise quantity of it; yet it does not appear that any steps have been since taken to repeat it.

Through the munificence of his Britannic majesty, the royal society was enabled to undertake the execution of this delicate and important experiment; and the astronomer royal was chosen to conduct it. After various enquiries, the mountain Schehallien, situated nearly in the centre of Scotland, was pitched upon, as the most proper for the purpose that could be found in this island. The observations were made by taking the meridian, zenith, distances of different fixed stars near the zenith, by means of a zenith sector of ten feet radius; first on the south, and afterwards on the north, side of the hill, the greatest length of which extended in an east and west direction.

It is evident that if the mass of matter in the hill exerted any sensible attraction, it would cause the plumb-line of the sector, through which an observer viewed a star in the meridian, to deviate from its perpendicular situation, and would attract it contrary ways at the two stations, thereby doubling the effect. On the south-side the plummet would be drawn to the northward, by the attractive power of the hill placed to the northward of it; and on the north-side, a contrary and equal deflection of the plumb-line would take place, in consequence of the attraction of the hill, now to the southward it. The apparent zenith distances of the stars would be affected contrarily; those being increased at the one station which were diminished at the other; and the correspondent quantities of the deflection of the plumb-line would give the observer the sum of the contrary attractions of the hill, acting on the plummet at the two stations; the half of which will, of course, indicate the attractive power of the hill.

The various operations requisite for this experiment lasted about four months; and from them it appears that the sum of the two contrary attractions of the mountain Schehallien, in the two temporary observations which were successively fixed half-way up the hill (where the effect of its attraction would be greatest) was equal to $11'' 6$. From a rough computation, founded on the known law of gravitation, and on an assumption that the density of the hill is equal to the mean density of the earth, it appears that the attraction of the hill should amount to about the double of this quantity. From thence it was inferred, that the density of the hill is only about half the mean density of the earth. It does not appear, however, that the mountain Schehallien has ever been a volcano, or is hollow; as it is extremely solid and dense, and seemingly composed of an entire rock.

The inference drawn from these experiments may be reduced to the following:

1. It appears, that the mountain Schehallien exerts a sensible attraction; therefore, from the rules of philosophizing, we are to conclude that every mountain, and, indeed, every particle of the earth, is endued with the same property, in proportion to its quantity of matter.
2. The law of the variation of this force, in the inverse ratio of the squares of the distances, as laid down by Sir Isaac Newton, is also confirmed by this experiment. For if the force of attraction of the hill had been only to that of the earth as the matter in the hill to that of the earth, and had not been greatly increased by the near approach to its centre, the attraction thereof must have been wholly insensible. But now, by only observing the mean density of the earth to be double to that of the hill, which seems very probable, from other considerations, the attraction of the hill will be reconciled to the general law of the variation of attraction in the inverse duplicate ratio of the distances, as deduced, by Sir Isaac Newton, from the comparison of the motion of the heavenly bodies with the force of gravity at the surface of the earth; and the analogy of nature will be preserved.

3. We may now, therefore, be allowed to admit this law, and to acknowledge that the mean density of the earth is, at least, double of that at the surface; and, consequently, that the density of the internal parts of the earth is much greater than near the surface. Hence also, the whole quantity of the matter in the earth will be, at least, as great again as if it had been all composed of matter of the same density with that at the sur-

face; or, will be about four or five times as great as if it were all composed of water. This conclusion, Mr. Maskelyne adds, is totally contrary to the hypothesis of some naturalists, who suppose the earth to be only a great hollow shell of matter; supporting itself from the property of an arch, with an immense vacuity in the midst of it. But, were that the case, the attraction of mountains, and even smaller inequalities in the earth's surface, would be very great, contrary to experiment, and would affect the measures of the degrees of the meridian much more than we find they do; and the variation of gravity, in different latitudes, in going from the equator to the poles, as found by pendulums, would not be near so regular as it has been found by experiment to be.

4. As mountains are, by these experiments, found capable of producing sensible deflections of the plumb-lines of astronomical instruments, it becomes a matter of great importance, in the mensuration of degrees in the meridian, either to choose places where the irregular attractions of the elevated parts may be small, or where, by their situation, they may compensate or counteract the effects of each other.

MOURNING, a particular dress or habit, worn to signify grief, on some melancholy occasion. The modes of *mourning* are various in various countries; as also are the colours that obtain for that end. In Europe, the ordinary colour for *mourning* is black; in China it is white; in Turkey, blue or violet; in Egypt, yellow; in Ethiopia, brown. The ancient Spartan and Roman ladies mourned in white; and the same colour obtained formerly in Castile, on the death of their princes. Herrera observes, that the last time it was used was in 1498, at the death of prince John. Kings and cardinals always mourn in purple. Each people pretend to have their reasons for the particular colour of their *mourning*: white is supposed to denote purity; yellow, that death is the end of human hopes, in regard that leaves when they fall, and flowers when they fade, become yellow; brown denotes the earth, whither the dead return; black, the privation of life, as being the privation of light: blue expresses the happiness which it is hoped the deceased does enjoy; and purple or violet, sorrow on the one side, and hope on the other, as being a mixture of black and blue. *Mourning*, among the ancients, was expressed various ways, as, by tearing their clothes, by wearing sackcloth, laying aside crowns, and every other mark of joy. Plutarch, in his Life of Cato, relates that, from the time of his leaving the city with Pompey, he neither shaved his head, nor, as usual, wore the crown or garland. Sometimes public grief was testified by a general fast.

MOUSE, the English name of the genus *Mus*. For a description of the genus, and the several species belonging to it, see the article *Mus*.

MOUTH, in anatomy, a part of the face, consisting of the lips, the gums, the insides of the cheeks, the palate, the salivary glands, the os hyoides, the uvula, and the tonsils. For a description of these several parts, see the *Sytem*, Part III. Sect. XIII.

MUCILAGE, in pharmacy, is, in general, any viscid or glutinous liquor. *Mucilage* also imports the liquor which principally serves to moisten the ligaments and cartilages of the articulations; and is supplied by the mucilaginous glands.

MUCOUS Glands, are three glands which empty themselves into the urethra, so called from the tenacity of the liquor which they separate. See the *Sytem* of ANATOMY, Part III. Sect. XV. Art. I.

MUCUS, a mucilaginous liquor secreted by certain glands, and serving to lubricate many of the internal cavities of the body. In its natural state, it is generally limpid and colourless; but, from certain causes, will often assume a thick consistence and whitish colour, like pus. As it is sometimes of very great importance, in medicine, to distinguish these two fluids from each other, this was lately proposed as the subject of a prize-disputation, by the *Æsculapian Society* of Edinburgh. The prize was gained by Mr. Charles Darwin, student of medicine, from Litchfield. The conclusions drawn from these experiments were,

1. Pus and mucus are both soluble in the vitriolic acid, though in very different proportions, pus being, by far, least soluble.
2. The addition of water to either of these compounds, decomposes it. The mucus, thus separated, either swims in the mixture, or forms large flocculi in it; whereas the pus falls to the bottom, and forms, on agitation, an uniform turbid mixture.
3. Pus is diffusible through a diluted vitriolic acid, though mucus is not. The same also occurs with water, or with a solution of sea-salt.
4. Nitrous acid dissolves both pus and mucus. Water, added to the solution of pus, produces a precipitate, and the fluid above becomes clear and green; while water and the solution of mucus form a turbid dirty-coloured fluid.
5. Alkaline lixivium dissolves, though sometimes with difficulty, mucus, and generally pus.
6. Water precipitates pus from such a mixture, but does not mucus.
7. Where alkaline lixivium does not dissolve pus, it still distinguishes it from mucus, as it then prevents its diffusion through water.
8. Coagulable lymph is neither soluble in concentrated nor diluted vitriolic acid.
9. Water produces no change, on a solution of serum in alkaline lixivium, until after long standing, and then only a very slight sediment

MUG

sediment appears. 10. Corrosive sublimate coagulates mucus, but does not pus.

From the above experiments it appears that strong vitriolic acid and water, diluted vitriolic acid, and caustic alkaline lixivium and water, will serve to distinguish pus from mucus; that the vitriolic acid can separate it from coagulable lymph, and alkaline lixivium from serum.

Hence, when a person has any expectorated matter, the composition of which he wishes to ascertain, let him dissolve it in vitriolic acid, and in caustic alkaline lixivium; and let him add pure water to both solutions. If there be a fair precipitation in each, he may be assured that some pus is present; but if there be a precipitation in neither, it is a certain test that the mixture is entirely mucus: if the matter cannot be made to dissolve in alkaline lixivium, by time and trituration, we have also reason to believe it to be pus.

MUFFLE, in metallurgy, is an arched cover, resisting the strongest fire, and made to be placed over copels and tests, in the operation of assaying, to preserve them from the falling of coals or ashes into them; though, at the same time, of such a form as not to hinder the action of the air and fire on the metal, nor prevent the inspection of the assayer.

MUFTI, the chief of the ecclesiastical order, or primate of the Mussulman religion. The authority of the mufti is very great in the Ottoman empire; for even the Sultan himself, if he would preserve any appearance of religion, cannot, without hearing his opinion, put any person to death, or so much as inflict any corporal punishment. In all actions, especially criminal ones, his opinion is required, by giving him a writing, in which the case is stated under feigned names; which he subscribes with the words, *He shall, or, Shall not, be punished*. Such outward honour is paid to the mufti, that the grand signior himself rises up to him, and advances seven steps to meet him when he comes into his presence. He alone has the honour of kissing the sultan's left shoulder, whilst the prime vizier kisses only the hem of his garment. When the grand signior addresses any writing to the mufti, he gives him the following titles: *To the esad, the wisest of the wise, instructed in all knowledge, the most excellent of excellents, abstaining from things unlawful, the spring of virtue and of true science, heir of the prophetic doctrines, resolver of the problems of faith, revealer of the orthodox articles, key of the treasures of truth, the light to the doubtful allegories, strengthened with the grace of the supreme Legislator of mankind, may the most high God perpetuate thy virtues!* The election of the mufti is solely in the grand signior, who presents him with a vest of rich fables, &c. If he is convicted of treason, or any great crime, he is put into a mortar, kept for that purpose in the Seven Towers at Constantinople, and pounded to death.

MUGIL, the Mullet, in ichthyology, a genus of fishes belonging to the order *Abdominales*. The lips are membranaceous, the inferior one being carinated inwards; they have no teeth; the branchiostegic membrane has seven crooked rays; the opercula are smooth and round; and the body is of a whitish colour. There are two species, distinguished by the number of rays in the back-fin. The mullet is justly ranked, by Aristotle, among the *pisces littorales*, or those who prefer the shores to the full sea. The barbatus, or red mullet, was highly esteemed by the Romans, and bore an exceeding high price. The capricious epicures of Horace's days valued it in proportion to its size; not that the larger were more delicious, but that they were more difficult to be got. The price that was given for one in the time of Juvenal and Pliny is a striking evidence of the luxury and extravagance of the age:

Mullum sex millibus emit
Æquantem sane paribus festertia libris. JUV. Sat. IV.
The lavish slave

Six thousand pieces for a mullet gave,
A festerce for each pound. DRYDEN.

But Asinius Celer, a man of consular dignity, gave a still more unconscionable sum; for he did not scruple bestowing 8000 nummi, or 64l. 11s. 8d. for a fish of so small a size as the mullet: for, according to Horace, a *mullus trilibris*, or one of 3lb. was a great rarity: so that Juvenal's spark must have had a great bargain in comparison of what Celer had. Mulletts are found in great plenty on several of the sandy coasts of our island, and haunt, in particular, those small bays that have influxes of fresh water. They come in great shoals, and keep rooting, like hogs, in the sand or mud, leaving their traces in form of large round holes. These fish sometimes swarm on the coasts of the Mediterranean. Near Martegues, in the South of France, abundance of mulletts are taken in weres, made of reeds, placed in the shallows. Of the milts of the males, which are called *alletants*, and of the roes of females, which are called *botar*, is made botargo. The materials are taken out entire, covered with salt for four or five hours, then pressed a little between two boards or stones, washed, and, at last, dried in the sun for 13 or 14 days. The mullet is an excellent fish for the table, but, at present, not a fashionable one.

MUL

MULATTO, a name given, in the Indies, to those who are begotten by a Negro man on an Indian woman; or by an Indian man on a Negro woman. The word is originally Spanish, *matala*, formed of *mula*, or *mule*, as being begotten by two different species. Those begotten of a Spanish woman and Indian man, are called *metis*; and those begotten of a savage, by a *metis*, are called *jambos*. These are all very different in colour, and in their hair.

MULE, in the system of mammalia, a mongrel quadruped, generated between an ass and a mare, and sometimes between a horse and a she-ass; but the signification of the word is commonly extended to every kind of animal produced by a mixture of two different species. There are two kinds of these animals; one from the he-ass and mare, the other from the horse and the she-ass. We call them indifferently *mules*, but the Romans distinguish them by proper appellations. The first kind are the best and most esteemed: as being larger, stronger, and having the least of the ass in their disposition. The largest and stoutest asses, and the fairest and finest mares, are chosen in those countries where these creatures are most in use; as in Spain, Italy, and Flanders. In the last especially, they succeeded in having very stately mules, from the size of their mares, some of them 16, and some 17 hands high, which are very serviceable, as sumpter-mules, in the army. But, since the Low Countries are no longer under the dominion of Spain, they breed fewer mules. These creatures are very much commended for their being stronger, surer-footed, going easier, being more cheaply maintained, and lasting longer, than horses. They are commonly of a black-brown, or quite black, with that shining list along the back and across the shoulders which distinguishes asses. In former times they were much more common in this country than at present. But they are commonly found to be vicious, stubborn, and obdurate, to a proverb. According to Linnæus, the mule is a variety of the second species *Affinus*, belonging to the genus *Equus*. See the article *EQUUS*.

MULES, among gardeners, denote a sort of vegetable monsters, produced by putting the farina fecundans of one species of plant into the pistil or utricle of another. The carnation and sweet-william being somewhat alike in their parts, particularly their flowers, the farina of the one will impregnate the other: and the seed, so enlivened, will produce a plant different from either. An instance of this we first had in Mr. Fairchild's garden, at Hoxton; where a plant is seen neither sweet-william nor carnation, but resembling both equally: this was raised from the seed of a carnation that had been impregnated by the farina of the sweet-william. These couplings being not unlike those of the mare with the ass, which produce the *mule*, the same name is given them: and they are, like the others, incapable of multiplying their species.

This gives us a hint for altering the property and taste of any fruit, by impregnating one tree with the farina of another of the same class; e. g. a codlin with a pearmain, which will occasion the codlin, so impregnated, to last a longer time than usual, and to be of a sharper taste. Or, if the winter-fruits be fecundated with the dust of the summer kinds, they will ripen before their usual time. And, from these accidental couplings of the farina of one with another, it may possibly be, that, in an orchard, where there is a variety of apples, even the fruit gathered from the same tree differ in their flavour, and in the season of maturity. It is also from the same accidental coupling that the numberless varieties of fruits and flowers, raised every day from seed, proceed.

MULLET, or *Mollet*, in heraldry, a bearing in form of a flat, or rather of the rowel of a spur, which it originally represented. The mullet has but five points; when there are six, it is called a *star*: though others make this difference, that the mullet is, or ought to be, always pierced, which a star is not. The mullet is usually the difference, or distinguishing mark, for the fourth son, or third brother, or house. See the System, Sect. V. Plate II.

MULTIPLICATION, in general, the act of increasing the number of any thing. *Multiplication* in arithmetic, is a rule by which any given number may be speedily increased, according to any proposed number of times. *Multiplication*, in algebra. For a full explanation and definition of the terms and rules appertaining to the two foregoing articles, see the System of ARITHMETIC, Chap. II. Sect. III. and the System of ALGEBRA, Sect. I. and Sect. II. Art. III.

MULTIPLYING, in the ancient æconomy, the producing of one's like. Mankind multiplied at a prodigious rate before the flood. Rabbits, fish, and most insects, multiply incredibly the single milt of a cod, examined with M. Leewenhœck's microscope, was found to contain more ova than there are animals on the face of the earth. See the System of ICHTHOLOGY, Sect. III. M. Dodart has several discourses on the multiplication of plants, in the Memoirs of the Royal Academy of Sciences. He has examined the beech-tree, particularly, with this view, and found its increase to surpass all imagination.

MULTIVALES.

MULTIVALVES, in conchology, the name of the first order of shell-fish, distinguished from the univalves, which consist of only one shell, and the bivalves, which consist of two, by their consisting of three or more shells. For a description of the several genera of this order, together with the species belonging to each genus, see the *System of CONCHOLOGY*, Order I.; for classification, see the *Synoptical Table*.

MUMMY, a carcase, or body, embalmed or dried in the manner of the ancient Egyptians. Properly speaking, *mummy* is not the flesh of the deceased, but the composition wherewith it is embalmed; but in common acceptation, *mummy* is also used for the body. The preparation of *mummy* is of so old a standing, that it was in use in Egypt before the time of Moses. The coffin in which the *mummy* is contained was to be of fycamore wood, which is found to keep sound for the space of three thousand years; but the tree, properly thus called, was very different from our fycamore. *Mummy* is said to have been first brought into use in medicine by a Jewish physician, who wrote, that flesh thus embalmed was good for the cure of divers diseases, and particularly for bruises, to prevent the blood gathering and coagulating. The Turks prevent the exportation of *mummy* into Europe as much as possible. There are two kinds of bodies denominated mummies. The first are only carcases, dried by the heat of the sun, and by that means kept from putrefaction; these are frequently found in the dry sands of Lybia. Some say, they are the bodies of deceased people buried there on purpose to keep them entire without embalming; others, that they are the carcases of travellers, &c. who have been overwhelmed with clouds of sand raised by the hurricanes frequent in those deserts. Be that as it will, these mummies are of no use in medicine, and are only preserved as curiosities.

The second kind of mummies are bodies taken out of the pits or catacombs near Cairo, wherein the Egyptians deposited their dead after embalming. See the *ARTICLES CATACOMB* and *EMBALMING*. These constitute the *mummy* once so much valued, and to which such extraordinary virtues are ascribed. It is said, that all the *mummy* sold in the shops, whether brought from Venice or Lyons, or even directly from the Levant by Alexandria, is factitious, and the work of certain Jews, who, knowing the value the Europeans set on the Egyptian *mummy*, counterfeit it by drying carcases in ovens, after having prepared them with powder of myrrh, caballin, aloes, Jews' pitch, black pitch, and other coarse or unwholesome drugs. The French charletans, it seems, have likewise got the art of preparing mummies. Their method is simple enough: out of the carcase of a person hanged, they take the brain and entrails, and dry the rest in an oven, steeping it in pitch, and other drugs; and this they sell for right Egyptian *mummy*. There are found at this time, in Poland, a kind of natural mummies, or human bodies, preserved without the assistance of art. These lie in considerable numbers, in some of the vast caverns of that country. They are dried, with the flesh and skin shrunk up almost close to the bones, and are of a blackish colour. In the wars which several ages ago laid waste that country, it was common for parties of the weaker side to retire into these caves, where their enemies, if they found it out, suffocated them by burning straw, &c. at the mouth of the cavern, and then left the bodies; which, being out of the way of injuries from common accidents, have lain there ever since. Paræus has a very curious treatise of mummies, wherein he shews the abuses thereof; and makes it appear that they can never be of any real medicinal use. Matthioli is of the same opinion, after Serapion. Both of these authors take even the Egyptian mummies to be no more than bodies embalmed with pissaphaltum.

MURÆNA, or *Eel*, in ichthyology; a genus of fishes, belonging to the order *Apodes*. The head is smooth: there are ten rays in the membranes of the gills; the eyes are covered with a common skin; and the body is cylindrical and slimy. There are seven species, distinguished by their fins, tail, &c. The most remarkable are,

1. The *Anguilla*, or common eel, is very frequent in all our fresh-water ponds, ditches, and rivers: according to Mr. Pennant, it is the most universal of fish, yet is scarce ever found in the Danube, though very common in the lakes and rivers of Upper Austria. There is scarce any animal the generation of which has puzzled the learned more than this. Aristotle first broached an opinion that eels were of no sex, nor did propagate their species like other animals; but were equivocally gendered of the mud: and as wild and absurd a system as this is, there have not been wanting many, even in these latter and more enlightened times, who have given into it. But there is now no room to doubt that all animals are produced by the copulation of parents like themselves; and the finding of eels in new ponds is easily accounted for from the above-mentioned circumstance of their migration. Dr. Plot, and many others, have given accounts of whole droves of them leaving one ditch or pond to go to another.

Though the learned world at this time generally allows that eels are produced like other animals, by parents of their own kind, yet there remain many doubts about the manner in which

the generation is performed. Some allow the eels to be like the generality of other animals, of different sexes in the different individuals; and others affirming that they are all hermaphrodites; each having the parts of generation of both sexes. Ron-delilius affirms that they are of both sexes; and Mr. Allen, who has given a very curious paper concerning them in the *Philosophical Transactions*, is of the same opinion; and both say, that the parts of the sexes may be discovered on a careful inspection; and some are found to be males, and others females: but these parts are, in both sexes, they say, buried in a large quantity of fat; and they are of opinion, that hence proceeded the mistake of Aristotle and his followers, who not being able to find those parts, concluded that they did not exist at all. Among those who allow the eel to be produced, like other animals, from animal-parents which have the sexes, some are of opinion that they are viviparous, and others that they are oviparous: but Mr. Chartwynd seems to have determined this controversy by observing that if the aperture under the belly of the eel, which looks red in the month of May, be cut open at that time, the young eels will be seen to come forth alive after the operation. M. Leewenhoeck says, that he found an uterus in every eel he examined: and therefore concludes, that they are hermaphrodites: and he supposes that they have no male parts of generation like those of other animals; but that the office of these is performed by a liquor analogous to the male seed of animals, which is contained in certain glands, situated on the inside of the uterus itself.

Eels have sometimes been met with in recent ponds, made at such a distance from any other water that we cannot reasonably suppose them to have migrated thither overland. But in these cases there is reason to believe that the ponds have been supplied with them by the aquatic fowl of prey, in the same manner as vegetation is spread by many of the land birds, either by being dropped, as they carry them to feed their young, or by passing quick through their bodies, as is the case with herons. These fish are extremely voracious, and destructive to the fry of others. No fish lives so long out of water as the eel: and it is extremely tenacious of life, inasmuch that its parts will move a considerable time after they are slayed and cut in pieces. They vary much in their colours, from a suttly hue to a light olive-green; and those which are called *silver-eels* have their bellies white, and a remarkable clearness throughout.

Besides these, there is a variety of this fish known in the river Thames by the name of *grigs*, and about Oxford by that of *grigs* or *gluts*. These are scarce ever seen near Oxford in the winter; but appear in spring, and bite readily at the hook, which common eels in that neighbourhood will not. They have a larger head, a blunter nose, thicker skin, and less fat, than the common sort: neither are they so much esteemed, nor do they often exceed three or four pounds in weight. Common eels grow to a large size, sometimes weighing 15 pounds; but that is extremely rare. Mr. Dale, indeed, in the *Philosophical Transactions*, and some others, bring instances of eels much exceeding that size; but Mr. Pennant suspects them to have been congers, since the enormous fish they describe have all been taken at the mouth of the Thames or Medway. The Romans held eels very cheap, probably on account of their likeness to snakes. On the contrary, the luxurious Sybarites were so fond of these fish, as to exempt from tribute of every kind those persons who sold them.

The *conger*, or conger-eel, grows to a vast size. Dr. Borlase informs us that they are sometimes taken near Mount's-bay of 100l. weight; and Mr. Pennant assures us that he has heard of some taken near Scarborough that were 10 feet and a half long, and 18 inches in circumference in the thickest part.

They differ from the common eel in the following particulars:

1. The colour in general is more dark.
2. Their eyes much larger in proportion.
3. The irides of a bright silver colour.
4. The lower jaw is rather shorter than the upper.
5. The side-line is broad, whitish, and marked with a row of small spots.
6. The edges of the dorsal and anal fins are black.
7. They have more bones than the common eel, especially along the back quite to the head.
8. They grow to a much larger size.

As to the distinction that Mr. Ray and other writers make of the small beards at the end of the nose, Mr. Pennant thinks it not to depended on, being sometimes found in both kinds, and sometimes entirely wanting. Probably, they generate like the fresh-water species. Innumerable quantities of what are supposed to be their fry, come up the Severn about the month of April, preceding the shads, which, it is conjectured, migrate into that river to on feed them: they are called *elvers*. They swarm during their season, and are taken in a kind of sieve made of hair-cloth, fixed to a long pole; the fisherman standing on the edge of the water during the tide, puts in his net as far as he can reach, and drawing it out again, takes multitudes at every sweep, and will take as many during one tide as will fill a bushel. They are dressed, and reckoned very delicate.

Congers are extremely voracious, preying on other fish, and on crabs at the time they have lost their shell, and are in a soft state.

M U R

state. They, and eels in general, are also particularly fond of carcases of any kind, being frequently found lodged in such as are accidentally taken up. These fish are an article of commerce in Cornwall; numbers are taken on that coast, and exported to Spain and Portugal, particularly to Barcelona. Some are taken by a single hook and line, but (because that way is tedious, and does not answer the expence of time and labour) they are chiefly caught by *bulters*, which are strong lines 300 feet long, with 60 hooks, each eight feet asunder, baited with pilchards or mackarel; the bulters are sunk to the ground by a stone fastened to them; sometimes such a number of these are tied together as to reach a mile. The fishermen are very fearful of a large conger, lest it should endanger their legs by clinging round them; they therefore kill them as soon as possible, by striking them on the navel. They are afterwards cured in this manner: They are slit, and hung on a frame till they dry, having a considerable quantity of fat, which it is necessary should exude before they are fit for use. It is remarkable that a conger of 100 weight will waste by drying to 24lb. the people therefore prefer the smallest, possibly because they are soonest cured. During the process there is a considerable stench; and it is said, that in the fishing villages the poultry are fed with the maggots that drop from the fish. The Portuguese and Spaniards use those dried congiers after they have been ground into a powder, to thicken and give a relish to their soups. They are sold for about 40 shillings the quintal, which weighs 126lb. A fishery of congiers, says Mr. Pennant, would be of great advantage to the inhabitants of the Hebrides. Perhaps they would at first undertake it with repugnancy, from their absurd aversion to the eel kind.

MURDER, or *Murther*, in law, is thus defined, or rather described, by Sir Edward Coke; "when a person, of sound memory and discretion, unlawfully killeth any reasonable creature in being, and under the king's peace, with malice aforethought, either express or implied." The best way of examining the nature of this crime will be by considering the several branches of this definition.

1. It must be committed by a person of sound memory and discretion: for lunatics or infants are incapable of committing any crime, unless in such cases where they shew a consciousness of doing wrong, and of course a discretion or discernment between good and evil.

2. Next, it happens that a person of such sound discretion unlawfully killeth. The unlawfulness arises from the killing without warrant or excuse: and there must also be an actual killing to constitute murder; for a bare assault, with intent to kill, is only a great misdemeanor, though formerly it was held to be murder. The killing may be by poisoning, striking, starving, drowning, and a thousand other forms of death, by which human nature may be overcome. Of these the most detestable of all is poison; because it can of all others be the least prevented, either by manhood or forethought. And therefore, by the stat. 22 Hen. VIII. c. 9, it was made treason, and a more grievous and lingering kind of death was inflicted on it than the common law allowed; namely, *boiling to death*: but this act did not live long, being repealed by 1 Edw. VI. c. 12. There was also, by the ancient common law, one species of killing held to be murder, which may be dubious at this day, as there hath not been an instance wherein it has been held to be murder for many ages past, viz. bearing false witness against another, with an express premeditated design to take away his life, so as the innocent person be condemned and executed. The Gothic laws punished, in this case, both the judge, the witnesses, and the prosecutor: and, among the Romans, the *lex Cornelia de sicariis* punish the false witness with death, as being guilty of a species of assassination. And there is no doubt but this is equally murder in *foro conscientie* as killing with a sword; though the modern law (to avoid the danger of deterring witnesses from giving evidence upon capital prosecutions, if it must be at the peril of their own lives) has not yet punished it as such. If a man, however, does such an act, of which the probable consequence may be, and eventually is, death, such killing may be murder, although no stroke be struck by himself, and no killing may be primarily intended. If a man hath a beast that is used to do mischief, and he, knowing it, suffers it to go abroad, and it kills a man; even this is manslaughter in the owner; but if he had purposely turned it loose, though barely to frighten people, and make what is called sport, it is with us (as in the Jewish law) as much murder as if he had incited a bear or a dog to worry them. If a physician or surgeon gives his patient a portion or plaster to cure him, which, contrary to expectation, kills him, that is neither murder nor manslaughter, but misadventure; and he should not be punished criminally, however liable he might formerly have been to a civil action for neglect or ignorance; but it hath been holden, that if it be not a regular physician or surgeon who administers the medicine, or performs the operation, it is manslaughter at the least. Yet Sir Matthew Hale very justly questions the law of this determination; since physic and salves were in use before licensed physicians and surgeons: wherefore he treats this doctrine as apocryphal, and fitted only too gratify and flatter li-

M U R

centiates and doctors of physic; though it may be of use to make people cautious and wary how they meddle too much in so dangerous an employment. In order also to make the killing murder, it is requisite that the party die within a year and a day after the stroke received, or cause of death administered; in the computation of which the whole day upon which the hurt was done shall be reckoned the first.

3. Farther: The person killed must be "a reasonable creature in being, and under the king's peace," at the time of killing. Therefore to kill an alien, a Jew, or an outlaw, who are all under the king's peace or protection, is as much murder as to kill the most regular-born Englishman; except he be an alien-enemy, in time of war. To kill a child in its mother's womb, is now no murder, but a great misprision: but if the child be born alive, and dieth by reason of the potion or bruises it received in the womb, it seems, by the better opinion, to be murder in such as administered or gave them.

4. Lastly, the killing must be committed "with malice aforethought," to make it the crime of murder. This is the grand criterion, which now distinguishes murder from other killing: and the malice prepenſe, *malitia præcogitata*, is not so properly spite or malevolence to the deceased in particular, as any evil design in general; the dictate of a wicked, depraved, and malignant heart; *un disposition à faire un mal chose*: and it may be either express or implied in law. Express malice is when one, with a sedate, deliberate mind, and formed design, doth kill another; which formed design is evidenced by external circumstances discovering that inward intention; as lying in wait, antecedent menaces, former grudges, and concerted schemes to do him some bodily harm. This takes in the case of deliberate duelling, where both parties meet avowedly with an intent to murder; thinking it their duty, as gentlemen, and claiming it as their right, to wanton with their own lives and those of their fellow-creatures; without any warrant or authority from any power either divine or human, but in direct contradiction to the laws both of God and man, and therefore the law has justly fixed the crime and punishment of murder on them, and on their seconds also. Yet it requires such a degree of passive valour to combat the dread of even undeserved contempt, arising from the false notions of honour too generally received in Europe, that the strongest prohibitions and penalties of the law will never be entirely effectual to eradicate this unhappy custom, till a method be found out of compelling the original aggressor to make some other satisfaction to the affronted party, which the world shall esteem equally reputable as that which is now given at the hazard of the life and fortune, as well of the person insulted, as of him who hath given the insult. Also, if even upon a sudden provocation, one beats another in a cruel and unusual manner, so that he dies, though he did not intend his death, yet he is guilty of murder by express malice: i. e. by an express evil design, the genuine sense of *malitia*. As when a park-keeper tied a boy (that was stealing wood) to a horse's tail, and dragged him along the park; when a master corrected his servant with an iron bar, and a schoolmaster stamped on his scholar's belly, so that each of the sufferers died: these were justly held to be murders, because the correction being excessive, and such as could not proceed but from a bad heart, it was equivalent to a deliberate act of slaughter. Neither shall he be guilty of a less crime who kills another in consequence of such a wilful act as shews him to be an enemy to all mankind in general; as going deliberately, and with an intent to do mischief, upon a horse used to strike, or coolly discharging a gun among a multitude of people. So if a man resolves to kill the next man he meets, and does kill him, it is murder, although he knew him not; for this is universal malice. And if two or more come together to do an unlawful act against the king's peace, of which the probable consequence might be bloodshed; as to beat a man, to commit a riot, or to rob a park, and one of them kill a man; it is murder in them all, because of the unlawful act, the *malitia præcogitata*, or evil intended beforehand.

Also in many cases where no malice is expressed, the law will imply it; as, where a man wilfully poisons another: in such a deliberate act the law presumes malice, though no particular enmity can be proved. And if a man kills another suddenly, without any, or without a considerable, provocation, the law implies malice; for no person, unless of an abandoned heart, would be guilty of such an act upon a slight or no apparent cause. No affront, by words or gestures, only, is a sufficient provocation, so as to excuse or extenuate such acts of violence as manifestly endanger the life of another. But if the person so provoked had unfortunately killed the other, by beating him in such a manner as shewed only an intent to chastise and not to kill him, the law so far considers the provocation of contumelious behaviour, as to adjudge it only manslaughter, and not murder. In like manner, if one kills an officer of justice, either civil or criminal, in the execution of his duty, or any of his assistants endeavouring to conserve the peace, or any private person endeavouring to suppress an affray or apprehend a felon, knowing his authority, or the intention with which he interposes, the law will imply malice, and the killer shall be

be guilty of murder. It were endless to go through all the cases of homicide, which have been adjudged, either expressly or impliedly, malicious: these therefore may suffice as a specimen; and we may take it for a general rule, that all homicide is malicious, and of course amounts to murder, unless where justified by the command or permission of the law; excused on a principle of accident or self-preservation; or alleviated into manslaughter, by being either the involuntary consequence of some act not strictly lawful; or, if voluntary, occasioned by some sudden and sufficiently violent provocation. And all these circumstances of justification, excuse, or alleviation, it is incumbent upon the prisoner to make out to the satisfaction of the court and jury: the latter of whom are to decide whether the circumstances alleged are proved to have actually existed; the former, how far they extend to take away or mitigate the guilt. For all homicide is presumed to be malicious, until the contrary appeareth upon evidence.

The punishment of murder, and that of manslaughter, were formerly one and the same; both having the benefit of the clergy: so that none but unlearned persons, who least knew the guilt of it, were put to death for this enormous crime. But now, by several statutes, the benefit of the clergy is taken away from murderers through malice propense, their abettors, procurers, and counsellors. In atrocious cases it was frequently usual for the court to direct the murderer, after execution, to be hung upon a gibbet, in chains, near the place where the fact was committed; but this was no part of the legal judgment; and the like is still sometimes practised in the case of notorious thieves. But now, in England, it is enacted by statute 25 Geo. II. c. 37, that the judge, before whom any person is found guilty of wilful murder, shall pronounce sentence immediately after conviction, unless he sees cause to postpone it; and shall in passing sentence, direct him to be executed on the next day but one (unless the same shall be the Sunday, and then on the Monday following) and that his body be delivered to the surgeons to be dissected and anatomized; and that the judge may direct his body to be afterwards hung in chains, but in nowise to be buried without dissection. And during the short but awful interval between sentence and execution, the prisoner shall be kept alone, and sustained with only bread and water. But a power is allowed to the judge, upon good and sufficient cause, to respite the execution, and relax the other restraints of this act. See PARRICIDE and TREASON.

MURRAIN, or *Gargle*, a contagious disease among cattle. The symptoms are, hanging down and swelling of the head, abundance of gum in the eyes, rattling in the throat, a short breath, palpitation at the heart, staggering, a hot breath, and a shining tongue. In order to prevent this disease, the cattle should stand cool in summer, and have plenty of good water: all carcases should be speedily buried: and as the feeding of cattle in wet places, on rotten grass and hay, often occasions this disease, dry and sweet fodder should be given them. The antidote for this disease were equal parts of foot, gunpowder, brimstone, and salt, with as much water as would wash it down; a spoonful was the dose.

MUS, in the Linnæan System of Mammalia, the 24th Genus, and belonging to the 4th order *Glires*. There are twenty-one species; but we shall only enumerate the following, which are most remarkable: The procellus, or Guinea-pig, so called from its being supposed to come only from Guinea, is a native of Brazil as well as Guinea. Its form and proportion are too well known to need description. These animals are of such a hot constitution, that they copulate five or six weeks after birth. They acquire not, however, their full growth before the eighth or ninth month. But this increase of size consists only of fat; for the solid parts are fully unfolded before the age of six months. The females go with young only three weeks; the first litter consists of four or five; the second of five or six; and the succeeding ones of seven or eight, and sometimes of 10 or 12. The mother suckles her young 12 or 15 days; she banishes them as soon as she receives the male, which happens at farthest at three weeks after her delivery; and if any of them persist in following her, they are maltreated and killed by the male. As they breed so fast, their multitudes would be innumerable, if there were not so many enemies which destroy them. They cannot resist either cold or moisture; when cold, they assemble and crowd close together, in which case they often all perish together. They are also devoured in great numbers by cats, and many are killed by the males. Though perpetually throwing out urine, they never drink. They feed on all kinds of herbs; but especially on parsley, which they prefer to grain or bread; and they are likewise fond of apples and other fruits. They eat precipitately like the rabbit, little at a time, but very often; make a grunting noise like a little pig, and are very restless. No mention is made by natural historians of the manners of this animal in a wild state. Their skin is hardly of any value; and their flesh, though eatable, is not so good as to be much demanded: but it might be improved by keeping them in warrens, where they would have the benefit of the fresh air, and the liberty of choosing herbs

agreeable to their taste. Those kept in houses have nearly the same bad taste with warren-rabbits; and those kept in gardens during the summer, have an insipid, but less disagreeable flavour. For a representation, see Plate VII. Genus XXIV. Species I.

2. The aguti is about the size of a hare, has a short tail; four toes on the fore-feet, three on the hind ones; and a yellowish belly. According to M. Buffon, it is an animal peculiar to the southern parts of America, being never found in the Old World. It is common in Brazil, Guiana, St. Domingo, and all the islands; and seems to require a warm climate in order to subsist and multiply. However, they can live in France, if kept in a dry place, and sheltered from winter frosts. The aguti is a very mischievous animal, and bites cruelly; he grunts like a pig; is very voracious; sits on his hind-legs, and holds his food with the fore-feet when he eats: hides what he cannot consume: hops like a hare, and runs very fast both on plain and rising grounds; but as his fore-legs are much shorter than the hind ones, he would tumble headlong if he did not slacken his course in descending. Both his eye and his ear are fine. The flesh of those which are fat and well fed is not very bad, though it be hard, and not very agreeable to the taste. They scald the aguti, and make him ready in the same manner as a pig. He is hunted with dogs. If taken young, he is easily tamed, and goes out and returns on his own accord. These animals commonly reside in the woods and hedges; where the females choose a place well covered and bushy, and there prepare a bed of leaves and hay for their young. They annually produce two or three, but generally two. Like the cats, they transport their young, two or three days after birth, into the hollows of trees, where they suckle them for a short time; the young are soon in a condition to follow their mother, and to search for food. See Plate VII. Genus XXIV. Species II.

5. The lemmus, or Lapland marmot, hath a short tail, five toes on both fore and hind feet, and the body is variegated with green and yellow. This creature, which is one of the most singular that we know of, is said to be a native of the mountains of Kolin in Lapland. They appear not every year; but at certain unforeseen periods they come in such numbers that they spread every where, and cover the whole surface of the earth. The arrival of the lemmings is considered as a terrible scourge, the effects of which it is impossible to avoid. They make dreadful devastations in the fields; lay waste the gardens; ruin the crops; and leave nothing, except what is shut up in houses, where they never enter. They bark nearly like small dogs. When attacked, they neither fear clubs nor halberds, but dart against those who strike them, outrageously biting, and fixing upon the weapons employed to kill them. When struck at with a stick, they seize it so forcibly with their teeth, that they allow themselves to be carried to a considerable distance without quitting their hold. They dig holes in the earth, and make roads like the moles in quest of roots. They sometimes make war and divide themselves into two armies along the lakes and meadows. Their enemies are foxes and ermines, who devour great numbers of them. The lemmings, like the rats, mutually destroy and eat each other, when pasture fails them; and this is the reason why their destruction is as sudden as their multiplication. At particular times they assemble together, and the whole die in company. They are very courageous, and defend themselves against all other animals. It is not certainly known whence they come. Upon the renewal of the grass they most of them die. In fine weather they take to the water in vast multitudes; but when a breeze of wind arises they are all drowned. The number of these animals is so prodigious, that when they die the air is infected, and produces many diseases. They even seem to infect the plants which they gnaw; for the pasture then kills the cattle. The flesh of the lemmings is not good to eat; and their skin, though the hair be fine, does not answer for making furs, because it is too thick. See Plate VII. Genus XXIV. Species V.

6. The paca, or spotted cavy, is an animal peculiar to the New World, particularly Brazil. It has a short tail, five toes on each foot, and three yellowish lines on each side. It resembles a pig of two months old; and its flesh is fat, and makes excellent food. Even the skin is eaten, like that of a pig. For these reasons this animal is in perpetual request. It is difficult for the hunters to take him alive. When surprised in his hole, which they lay open both before and behind, he defends himself, and even bites fiercely. His skin, though covered with coarse short hair, makes a very good fur, because it is regularly spotted on both sides. These animals produce often, and in great number: many of them are destroyed by men and beasts of prey, and yet the species is always numerous.

When kept in a wooden cage or box, this animal remains perfectly tranquil during the day, especially when plentifully supplied with food. He seems even to have an affection for his retreat as long as the day lasts: for, after feeding, he retires spontaneously into it. But when night approaches, by perpetual restlessness and agitation, and by tearing the bars of his prison with his teeth, he discovers a violent desire of getting out.

Nothing of this kind happens during the day, unless he has occasion for some natural evacuation; for he cannot endure the smallest degree of dirtiness in his little apartment; and when about to void his excrements, always retires to the most distant corner he can find. When his straw begins to smell, he often throws it out, as if he meant to demand fresh litter. This old straw he pushes out with his muzzle, and goes in quest of rags or paper to replace it. In a female cavy, the following extraordinary instance of cleanliness was observed. A large male rabbit being shut up with her when she was in season, she took an aversion to him the moment he voided his excrement in their common apartment. Before this she was very fond of him; licked his nose, ears, and body; and allowed him to take almost the whole food that was given her. But as soon as the rabbit had infected the cage with his ordure, she retired into the bottom of an old press, where she made a bed of paper and rags, and returned not to her old lodging, till she saw it neat, and freed from the unclean guest which had been presented to her.

The spotted cavy is easily accustomed to a domestic life. Unless industriously irritated, he is gentle and tractable. He is fond of adulation, and licks the hand of the person who caresses him. He knows those who take care of him, and readily distinguishes their voices. When gently stroked on the back, he stretches himself out, lies down on his belly, by a small cry expresses his acknowledgement, and seems to ask a continuance of the favour. When seized in a rough manner, however, he makes violent efforts to escape. See Plate VII. Genus XXIV. Species VI.

7. The marmota, or marmot, has a short hairy tail, round ears, and gibbous cheeks. It is found only on the tops of the highest mountains, and is more subject to be rendered torpid by cold than any other. In the end of September, or beginning of October, he retires into his hole, from which he comes not out till the beginning of April. The place of their abode is well lined with moss and hay, of which they make ample provision during the summer. They dwell together, and work in common at their habitations, where they pass three-fourths of their lives. Thither they retire during rain, or upon the approach of danger. They make no provision for winter; nor have they in that season any occasion for them, as lying asleep all that time. As soon as they perceive the first approaches of the sleeping season, they set to work in shutting up the two entrances of their habitation; and this they perform with such labour and solidity, that it is easier to dig the earth any where else than in the parts they have fortified. They are at this time very fat, weighing sometimes 20 pounds; and they continue to be plump for three months; but afterwards they gradually decay, and are extremely emaciated at the end of winter. When discovered in their retreats, they are found rolled up in the form of a ball, covered with hay; and they are carried off in so torpid a state that they may be killed without seeming to feel pain. The fattest are chosen for eating, and the young ones for taming. When taken young, they may be rendered nearly as tame as our other domestic animals. They learn to seize a stick, to dance, to perform various gesticulations, and to obey the voice of their master. Like the cat, the marmot has an antipathy against dogs. When he begins to be familiar in the house, and perceives that he is protected by his master, he attacks and bites dogs of the most formidable kind. Though not so large as a hare, he is stouter, and his strength is aided by a peculiar suppleness and dexterity. With his fore-teeth, which are pretty long, he bites most cruelly: he attacks not, however, either dogs or men, unless previously irritated. If not prevented, he gnaws furniture and stuffs; and when confined, pierces even through wood. His voice resembles the murmuring of a young dog when caressed or in a sporting humour: but, when irritated or frightened, he makes a whistling noise, so loud and piercing, that it hurts the ear. The marmots eat every thing presented to them; as flesh, bread, fruit, roots, pot-herbs, may-bugs, grasshoppers, &c. but milk and butter they prefer to every other aliment. Milk is also the only liquor that is agreeable to them; for they rarely drink water. They produce but once a year, and the litter generally consists of three or four. The growth of their young is very quick; they live only nine or ten years; and the species is neither numerous nor much diffused. The marmot would make very good eating, if it had not always a disagreeable flavour, which cannot be concealed but by strong seasoning. See Plate VII. Genus XXIV. Species VII.

8. The monax, or marmot of Canada, has a hairy tail, an ash-coloured body, roundish ears, and four toes on the fore-feet, and five on the hind one. It is a native of America, and differs very little from the former. Its flesh is good and well tasted. See Plate VII. Genus VII. Species VIII.

9. The cricetus, hamster, or German marmot, is the most famous as well as the most destructive of all the rats. It has a tail of a moderate length, round ears, a black belly, and reddish sides, with three white spots. This creature sleeps during the winter like the marmots; when in a torpid state, neither respiration nor any kind of feeling can be perceived. The heart, however, beats 15 times in a minute, which has been discovered

by opening the chest. The blood continues to be fluid, but the intestines are not irritable; even an electrical shock does not awake him: in the open air he never becomes torpid. When dug up in his state of torpidity, this animal is found with his head bent under his belly between the two fore-legs, and those behind rest upon his muzzle. The eyes are shut; and when the eye-lids are forced open, they instantly close again. The members are stiff, like those of a dead animal, and the whole body feels as cold as ice. When dissected during this state, he seems to feel very little: sometimes indeed he opens his mouth, as if he wanted to respire; but his lethargy is too strong to admit of his awakening entirely. This lethargy hath been ascribed solely to a certain degree of cold; which indeed may be true with regard to dormice, bats, &c. But experience shews that in order to render the hamster torpid, he must also be excluded from all communication with the external air; for when he is shut up in a cage filled with earth and straw, and exposed in winter to a degree of cold sufficient to freeze the water, he never becomes torpid: but when the cage is sunk four or five feet under ground, and well secured against the access of the air, at the end of eight or ten days he is equally torpid as if he had been in his own burrow. If the cage is brought up to the surface, he will awake in a few hours, and resume his torpid state when put below the earth. The experiment may be repeated with the same success as long as the frost continues. We have a further proof that the absence of the air is one of the causes of torpidity in the hamster; for when brought up from his hole in the coldest weather, and exposed to the air, he infallibly awakes in a few hours. This experiment succeeds as well in the night as in the day; which shews that light has no share in producing the effect. It is curious to observe the hamster passing from a torpid to an active state. He first loses the rigidity of his members, and then makes a profound respiration, but at long intervals. His legs begin to move, he opens his mouth, and utters disagreeable and rattling sounds. After continuing these operations for some time, he opens his eyes, and endeavours to raise himself on his legs. But all these movements are still reeling and unsteady, like those of a man intoxicated with liquor. He, however, reiterates his efforts till he is enabled to stand on his legs. In this attitude he remains fixed, as if he meant to reconnoitre and repose himself after his fatigue; but he gradually begins to walk, eat, and act in his usual manner. It is probable that when the hamster is in his hole, this change is performed imperceptibly, and that he feels more of the inconveniences which arise from a sudden and forced reviviscence.

The hamster is a very mischievous animal; and so exceedingly fierce that he seems to have no other passion but rage. In consequence of this, he attacks every other animal that comes in his way, without regarding the superior size or strength of his antagonist; nay, as if he was ignorant of the method of saving himself by flight, he allows himself to be beat to pieces with a stick, rather than yield. If he seizes a man's hand, he must be killed before he quits his hold. When the hamster perceives a dog at a distance, he begins with emptying his cheek-pouches, if they happened to be filled with grain, and which are so capacious as to hold a quarter of a pint English. He then blows them up so prodigiously, that the size of the head and neck greatly exceeds that of the body. Lastly, he raises himself on his hind-legs and in this attitude darts on his enemy. If he catches hold, he never quits it but with the loss of life. But the dog generally seizes him behind, and strangles him. This ferocious temper prevents the hamster from being at peace with any other animal. He even makes war against his own species, not excepting the females.

The hamsters copulate about the end of April; when the males enter the apartment of the females, where they remain only a few days. If two males happen to meet in the same hole, a furious combat ensues, which generally terminates in the death of the weakest. The conqueror takes possession of the female; and both, though at every other period they persecute and kill each other, lay aside their natural ferocity during the few days their amours continue. They even mutually defend each other against aggressors; and if a hole is opened about this time, the female defends her husband with the utmost fury. The females bring forth twice or thrice every year. Their litter is never fewer than six, and more frequently from 16 to 18. Their growth is very rapid. At the age of 15 days they begin to dig the earth; and soon after, the mother banishes them from her habitation; so that at the age of about three weeks they are abandoned to their own management.

10. The terrestris, or short-tailed field-mouse. In winter most of these animals retire into the woods, where they feed upon filberts, acorns, and the seeds of trees. In particular years they appear in numbers so immense, that they would destroy every thing if they continued long: but they always kill and eat one another during a scarcity of provisions. They besides are devoured by the long-tailed field-mice, foxes, wild-cats, and weasels.

11. The amphibious, or water-rat, has a long hairy tail, but not palmated feet, as is said by Linnaeus. It is about the size of a rat, but in its manners resembles the otter much more than

than the rat. Like the otter, it frequents the fresh water, and is found on the banks of rivers, brooks, and pools. Gudgeons, minnows, blays, and the fry of carps, pikes, and barbel, are its ordinary food. It likewise eats frogs, water-insects, and sometimes the roots of plants. He swims with great ease, keeps long under water, and carries off his prey to be devoured on the grafs, or in his hole. He is sometimes surpris'd by the fishermen, when searching for cray-fish; and he endeavours to escape by biting their fingers, or leaping into the water. See Plate VII. Genus XXIV. Species XI.

12. The rattus, or common rat, is the most pernicious of any of our smaller quadrupeds. Meat, corn, paper, clothes, furniture, in short, every convenience of life, is a prey to this destructive creature. Nor are its devastations confined to these; for it will make equal havoc among poultry, rabbits, or young game; nay, it hath been known to gnaw the extremities of infants, when asleep. It is a domestic animal, residing very frequently in houses, barns, or granaries. In old country-houses, where grain is kept, and where the vicinity of barns and magazines facilitates their retreat, they often increase so prodigiously that the possessors are obliged to remove, and desert their habitations, unless the rats happen to destroy each other. This, however, frequently happens; for these creatures, when pinched for food, destroy each other. The rat was first introduced into America by the Europeans, in 1544, and is now the pest of all that continent.

The brown or Norway rat is much larger than the black kind; being nine inches from the end of the nose to the beginning of the tail; the length of the tail itself is the same; the usual weight 11 ounces. Notwithstanding its name, however, it is not known in Norway, nor in any part of Scandinavia. It was never known in Britain till about 45 years ago; and made its appearance in the neighbourhood of Paris only about 22 years ago. Mr. Pennant suspects that this rat came originally, in ships, from the East Indies; a large brown species being found there, called *bandicotes* by the natives, which burrow under ground. Barbot also mentions a species inhabiting the fields in Guinea, and probably the same with this. Wherever this creature has taken up its residence, it hath totally extirpated the black kind: however, it is to be feared we shall reap little benefit by the exchange; for the Norway rat hath the same disposition, with greater abilities for doing mischief than the common kind. It burrows, like the water-rat, in the banks of rivers, ponds, and ditches; it takes the water very readily; and swims and dives with great celerity: like the black species, it preys on rabbits, poultry, and all kinds of game. It increases most amazingly fast, producing from 14 to 18 young at a time. Its bite is not only severe but dangerous; the wound being immediately attended with great swelling, and is a long time in healing. These creatures are so bold as to turn upon those who pursue them, and fasten on the stick or hand of such as offer to strike them. See Plate VII. Genus XXIV. Species XII.

13. The musculus, or common mouse, has the same instinct, and the same constitution and natural dispositions with the rat, differing only in the mere circumstances of size and strength. He hath many enemies, from whom he can escape only by his agility and minuteness. Owls, birds of prey, cats, weasels, and even rats, make war upon the mice, so that they are destroyed by millions; yet the species still subsists by its amazing fecundity. They bring forth at all seasons, and several times in the year: the litter generally consists of five or six; and in less than 15 days the young disperse, and are able to provide for themselves. Aristotle tells us, that, having shut up a pregnant mouse in a vessel, along with plenty of grain, he found, in a short time after, 120 mice, all sprung from the same mother. See Plate VII. Genus XXIV. Species XIII.

14. The avellanarius, or dormouse, is equal in size to the former, but of a plumper appearance; the nose is more blunt. Dormice inhabit woods, or very thick hedges; forming their nests in the hollow of some low tree, or near the bottom of a close shrub: they form little magazines of nuts, and eat in an upright posture, like the squirrel. The consumption of their food, however, during the rigour of the season, is but small; for they sleep most of the time, retiring into their holes: at the approach of winter, they roll themselves up, and become torpid. Sometimes they experience a short revival in a warm sunny day; when they take a little food, and relapse into their former state. These animals seldom appear far from their retreats, or in any open place; for which reason they seem less common in Britain than they really are. They make their nests of moss, grafs, and dead leaves; and bring usually three or four young at a time. See Plate VII. Genus XXIV. Species XIV.

15. The quercinus, or garden-squirrel, has a long hairy tail, with a black ring under the eyes. It is a native of the south of Europe, where it lives chiefly in woods, though it sometimes is found in gardens. They are very destructive to fruit, particularly peaches, which they seem to prefer to every other kind. They also eat peas, apricots, and plums; and when soft fruits

are not to be had, they will eat almonds, filberts, nuts, and even leguminous plants. They copulate in spring, and bring forth in summer. The litter consists of five or six young, which grow very quickly, but are not fertile till the next year. Their flesh is not eatable, but has the same disagreeable odour with the domestic rat.

16. The sylvaticus, or long-tailed field-mouse, measures, from the end of the nose to the setting-on of the tail, four inches and a half: the tail is four inches long. These animals are found only in fields and gardens; in some places they are called *bean-mice*, from the havoc they make among beans when first sown. They feed also on nuts, acorns, and grain, of which they amass quantities, not proportioned to their wants, but to the capacity of the place where it is deposited, inasmuch that a single animal will collect more than a bushel. The holes of the field-mice are generally a foot under ground, and often divided into two apartments; the one for living in with their young, and the other for a magazine. M. Buffon once kept a dozen of these mice in a cage, and furnished them with food every morning at eight o'clock. One day they were neglected for about a quarter of an hour, when one of their number was eaten up by the rest; next day another suffered the same fate; and in a few days only one remained: all the others had been killed, and partly devoured; and even the survivor himself had his feet and tail mutilated. These animals are very prolific, producing more than once a year, and bringing nine or ten at a birth. They generally make the nest for their young very near the surface, and often in a thick tuft of grafs. See Plate VII. Genus XXIV. Species XVII.

17. The jaculus, or jerboa, inhabits Barbary, Palestine, Egypt, and the deserts between Baffora and Aleppo. The head hath a great resemblance to that of the rabbit; but its eyes are larger, and its ears shorter, higher, and broader, in proportion to its size. The nose is flesh-coloured, and naked, and the muzzle is thick and short. The opening of the mouth is very small, the upper jaw broad, and the under jaw narrow and short. The teeth are like those of the rabbit; and the whiskers round the mouth are composed of long black and white hairs. The fore feet are extremely short, and never touch the ground; being used only as hands to convey the victuals to the mouth. These hands have four fingers armed with claws, and the rudiments of a fifth without any claw. In transporting themselves from place to place, they do not walk, or advance one foot before the other, but leap nimbly, to the distance of five or six feet from the ground. When reposing themselves, they sit on their knees, and sleep only during the day. They eat grain and herbage like the hare. This animal is eaten by the Arabs, who call it the *lamb of the children of Israel*. Bochart thinks it is the *Saphon* of Holy Writ, and displays a vast deal of learning on the subject. See Plate VII. Genus XXIV. Species XX.

MUSCÆ Volitantes, in optics, dark irregular veins and spots, seeming to fly before the eyes of many people, especially on looking at bright objects, such as white paper, the sky-light, the candle, &c. These have only the appearance of cobwebs, sometimes that of smoke, dust, &c. The resemblance of many of these spots to flies has given them the name of *muscæ volitantes*, q. d. *flies flying about*.

MUSCI, MOSSES, one of the seven families into which all vegetables are divided, by Linnaeus, in the *Philosophia Botanica*; viz. *Fungi, Algæ, Musci, Filices, Gramina, Palmæ, Plantæ*. The characteristics of these plants, according to the sexual system, are,

1. Tops, without filaments or threads. 2. The male-flower, constituted by the presence of the *anthera* or tops, placed apart from the female, either on the same or distinct roots. 3. The female-flowers deprived of the *pistillum*, or pointal. 4. The seeds devoid of both lobes (*cotyledones*) and proper coverings; so that they exhibit the naked embryo. See the System, Sect. IV. Art. IV. and Plate VI. with the explanation under the Article.

MUSCICAPA, or *Fly-Catcher*, in ornithology, a genus belonging to the order *Passeres*. The most remarkable species is the *grifola*, or spotted fly-catcher. It is a bird of passage, appears in the spring, breeds with us, and retires in August. It builds its nest on the sides of trees, towards the middle: Morton says, in the corners of walls where spiders weave their webs. Mr. Pennant has seen them followed by four or five young, but never saw their eggs. When the young can fly, the old ones withdraw with them into thick woods, where they frolic among the top branches; dropping from the boughs frequently, quite perpendicular, on the flies that sport beneath, and rise again in the same direction. For a representation, see Plate III. Genus XXXVIII.

MUSCLE, in anatomy. For a general account of the Muscles, see the System, Part II. Sect. II. under the general title. For a particular account, containing an enumeration of the several muscles, with the name, origin, insertion, and principle of each muscle, see the Table of MUSCLES throughout. For their representation, see Plate II. III. and IV. with the explanations at the end of Part II. of the System.

MUSCLES

M U S

MUSCLES of Vegetables. The muscles in animal bodies have been the subject of numerous dissertations; but those in vegetables have been less regarded. Mr. Tournefort, however, has plainly proved that many of the vessels of plants become, in the drying fibres, capable of tension; that in many plants there are great numbers of these fibres, which have all the same direction, and always act together, and can only shorten or contract themselves in one particular direction; wherefore the parts composed of these fibres are very properly compared to the muscles of animals. By the word *muscle*, we understand a part composed of fibres, so determinately arranged, that, by their contraction, they can only move the part in some certain and determinate manner; and in this, which seems the received sense of the word, there are many instances in which it may be applied to parts of plants, with the strictest justice.

MUSCLE, the English name of the *mytilus*, or *mytilus*, a genus of shell-fish, in vermology. For a description, see MYTILUS. For the shell, as forming a distinct branch of Natural History, see the System of CONCHOLOGY, Genus XVI.

Those who have eaten muscles, have sometimes, but very rarely, been affected with erysipelatous inflammations, cutaneous eruptions, insupportable itching all over the body, great restlessness and agitation; and though these complaints are easily removed, by oil, milk, and emetics, and have seldom or never proved mortal, yet they have an alarming aspect, and make the patient suffer grievously. Some authors have pretended that these noxious effects never have place but between the vernal and autumnal equinox; and M. Bennie, physician, at Antwerp, in a Memoir on this subject, seems inclined to adopt this opinion; for he recommends abstinence from muscles during the months of May, June, July, and August. The cause of these noxious effects in the muscles is, according to that author, altogether accidental. They are occasioned, he says, by a kind of *stella marina*, a little sea insect, pretty common about the mouth of the Scheldt, which sometimes lodges itself in the muscle, in quest of food, and whose spawn is so caustic and inflammatory, that, even when applied outwardly to the skin, it produces itchings and swellings, that are painful and disagreeable in a high degree.

The itching occasioned by touching the spawn of the *stella marina* is removed by vinegar; and this known fact induced Dr. Bennie to prescribe the internal use of vinegar, after bleeding, evacuations, and emetics. His method consists in recommending a large quantity of refreshing beverage, and, every hour, three ounces of vinegar diluted in water. This remedy, however, seems rather to confirm the opinion of those who impute the disorder in question to an unperceived commencement of putrefaction in the muscle; as vinegar is known to be a powerful antiseptic, and there is no sort of putrefaction more noxious and offensive than that of fish.

MUSEUM, a name which originally signified a part of the palace of Alexandria, which took up, at least, one-fourth of the city. This quarter was called the *museum*, on account of its being set apart for the muses, and the study of the sciences. Here were lodged and entertained the men of learning; who were divided into many companies or colleges, according to the sciences of which they were the professors; and to each of these houses or colleges was allotted a handsome revenue. The foundation of this establishment is attributed to Ptolemy Philadelphus, who here placed his library. Hence the word *museum* is now applied to any place set apart as a repository for things that have an immediate relation to the arts.

The museum at Oxford, called the *Ashmolean museum*, is a noble pile of building, erected at the expence of the university, at the west end of the theatre, at which side it has a magnificent portal, sustained by pillars of the Corinthian order. The front, which is to the street, extends about 60 feet, where there is this inscription over the entrance, in gilt characters: *Museum Ashmoleanum schola naturalis historiae, officina chymica*. It was begun in 1679, and finished in 1683, when a valuable collection of curiosities was presented to the university by Elias Ashmole, Esq. which were the same day deposited there; several accessions have been since made to the museum; among which are hieroglyphics, and other Egyptian antiquities, an entire mummy, Roman antiquities, altars, medals, lamps, &c. and a variety of natural curiosities.

The British Museum in London is a large, beautiful, and magnificent building, the noblest cabinet of curiosities in the world. The edifice was erected in 1677; and was called *Montague-house*, from having been the town residence of the dukes of Montague. In the year 1743, the British parliament passed an act for purchasing the museum of the late Sir Hans Sloane, and the collection of manuscripts of the late Lord Oxford, called the *Harleian library*, for the use of the public, by which it may be rendered of no less general benefit to trade, than to the advancement of natural knowledge and experimental philosophy. Twenty-six trustees were appointed and incorporated to provide a repository for those and some other collections, which repository was to be called the British Museum. These trustees elected 15 other trustees; and, having bought Montague-house, fitted it up for the reception of these collections: they also appointed officers

M U S

to superintend the museum; and having ordained certain statutes with respect to viewing the collection contained in it, the public were admitted to view it in 1757.

Fifteen persons are allowed to view it in one company; the time allotted is two hours; and when any number, not exceeding 15, are inclined to see it, they must send a list of their Christian names and surnames, professions, and places of abode, to the porter's lodge, in order to their being entered in the book; in a few days the respective tickets are made out, specifying the day and hour when they are to come; which, on being sent for, are delivered. If, by any accident, some of the parties are prevented from coming, it is proper they send their ticket back to the lodge, as nobody can be admitted with it but themselves. It is to be remarked, that the fewer names there are in a list, the sooner they are likely to be admitted to see it.

MUSES, certain fabulous deities among the Pagans, supposed to preside over the arts and sciences; for this reason it is usual for the poets, at the beginning of a poem, to invoke these goddesses to their aid. The muses were originally only fingers and musicians in the service of Osiris, or the great Egyptian Bacchus, under the instruction and guidance of his son Orus; but in succeeding times they were called daughters of Jupiter and Mnemosyne or Memory. These are the only Pagan divinities whose worship has been continued through all succeeding changes in the religion and sentiments of mankind. Professors of every liberal art, in all the countries of Europe, still revere them; particularly the poets, who seldom undertake the slightest work without invoking their aid. Sir Isaac Newton tells us, that the singing-women of Osiris were celebrated in Thrace by the name of the *muses*; and that the daughters of Pierus, a Thracian, imitating them, were celebrated by the same name. Diodorus Siculus informs us, that Alcman, of Messene, a lyric poet, who flourished in the 4th Olympiad, 670 years before Christ, makes them the daughters of Uranus and Terra. It has been asserted by some ancient writers, that, at first, they were only three in number; but Homer, Hesiod, and other profound mythologists, admit of nine.

In his hymn to Apollo, Homer says,

By turns the nine delight to sing.

And Hesiod, in his theogony, names them all. They are said severally to preside over some art or science, as music, poetry, astronomy, &c. By some they are called *virgins*, because the virtues of education appear unalterable: they are called *muses*, from a Greek word, which signifies to explain mysteries; because they have taught things the most curious and important to know, and which are above the comprehension of vulgar minds. Each of their names is said to include some particular allegory: *Cho*, for instance, has been thus called, because those who are praised in verse acquire immortal fame; *Euterpe*, on account of the pleasure accruing to those who hear learned poetry; *Thalia* implies for ever flourishing; *Melpomene*, that her melody insinuates itself into the inmost recesses of the soul; *Terpsichore* marks the pleasure which those receive who are versed in the liberal arts; *Erato* seems to indicate, that the learned command the esteem and friendship of all mankind; *Polyhymnia*, that many poets are become immortal, by the number of hymns which they have addressed to the gods; *Urania*, that those whom she instructs elevate their contemplations and celebrity to the heavens and the stars; and, lastly, the exquisite voice of *Calliope* has acquired her that appellation, as the inventress and guardian of eloquence and rhetoric.

An epigram of Callimachus gives the attributes of the muses in as many lines:

Calliope the deeds of heroes sings;
Great *Cho* sweeps to history the strings;
Euterpe teaches mimes their silent show;
Melpomene presides o'er scenes of woe;
Terpsichore the flute's soft power displays;
And *Erato* gives hymns the gods to praise;
Polyhymnia's skill inspires melodious strains;
Urania wife, the starry courts explains;
And gay *Thalia*'s glass points out where folly reigns.

This epigram does not, however, exactly correspond with the ideas of other poets, or of the ancient painters, in characterizing the attributes of the muses.

MUSHROOM, in botany. See AGARICUS, and the System of BOTANY, Sect. IV. Class XXIV. and Genus I.

Physicians have disputed much about the qualities of mushrooms; some considering them as a rich nourishment, and perfectly innocent, when properly chosen; and others asserting them to be extremely deleterious. Most of the fungi are, indeed, of a hurtful quality; and, with respect to the whole tribe, the esculent are very few. Esculent mushrooms are very nutritive, very readily alkalescent, and more so, without intermediate acescency, than any other vegetable: they are, therefore, a rich nourishment, and much akin to animal food; on which account they may be indulged in considerable quantity to strong persons. It requires, however, skill to distinguish this esculent kind; and very few, especially of those who are commonly employed to gather them, viz. the servants, have studied Clusius, or other authors who have been at the pains to distinguish them.

SYSTEM OF MUSIC.

INTRODUCTION.

MUSIC is the art of combining sounds in a manner agreeable to the ear. This combination may be either co-existing or successive: in the first case, it constitutes *harmony*; in the last *melody*. But though the same sounds, or intervals of sound, which give pleasure when heard in succession, will not always produce the same effect in harmony; yet the principles which constitute the simpler and more perfect kinds of harmony, are almost, if not entirely, the same with those of melody. By *perfect harmony*, we do not here mean those complex modifications of harmonic sound which are admired in practice; but that harmony which results from the coalescence of co-existing sounds, produced by vibrations, in the proportions of thirds, fifths, and octaves, or their duplicates. The principles on which Music is founded, and the rules by which it is conducted, constitute a science. The same maxims, when applied to practice, form an art: hence its first and most capital division is into *Theoretical* and *Practical* music. *Theoretical* music is, if we may be permitted to use the expression, the knowledge of the nature and use of those materials which compose it; or, in other words, of all the different relations between the high and low, between the harsh and the sweet, between the quick and the slow, between the strong and the weak, of which sounds are susceptible: relations which, comprehending all the possible combinations of music and sounds, seem likewise to comprehend all the causes of the impressions which their succession can make upon the ear, and upon the soul.

Practical music is the art of applying and reducing to practice those principles which result from the theory of agreeable sounds, whether co-existing or successive; or, in other words, to conduct or arrange sounds according to the proportions resulting from consonance, from duration and succession, in such a manner as to produce upon the ear the effect which the composer intends. This is the art which we call *composition*. With respect to the actual production of sounds by voices or instruments, which is called *execution*, this department is merely mechanical and operative; which, only presupposing the powers of founding the intervals true, of exactly proportioning their degrees of duration, of elevating or depressing sounds according to these gradations which are prescribed by the tone, and to the value required by the time, demands no other knowledge but a familiar acquaintance with the characters used in music, and a habit of expressing them with promptitude and facility.

Theoretical music is likewise divided into two departments, viz. the knowledge of the proportions of sounds or their intervals, and that of their relative durations; that is to say, of measure and time. The first is what, among the ancients, seems to have been called *harmonical* music. It shews in what the nature of air or melody consists; and discovers what is consonant or discordant, agreeable or disagreeable, in the modulation. It discovers, in a word, the effects which sounds produce in the ear by their nature and by their force, and by their intervals: which is equally applicable to their consonance and their succession.

The second has been called *rhythmical*, because it treats of sounds, with regard to their time and quantity. It contains the explication of their continuance, of their proportions, of their measures, whether long or short, quick or slow, of the different modes of time and the parts into which they are divided, that to these the succession of sounds may be conformed.

Practical music is likewise divided into two departments, which correspond to the two preceding. That which answers to *harmonical* music, and which the ancients called *melopée*, teaches the rules for combining and varying the intervals, whether consonant or dissonant, in an agreeable and harmonious manner. The second, which answers to the *rhythmical* music, and which they called *rhythmopée*, contains the rules for applying the different modes of time, for understanding the feet by which verses were scanned, and the diversities of measure; in a word, for the practice of the *rhythmus*. Music is at present divided more simply into *melody* and *harmony*; or, since the introduction of *harmony*, the proportion between the length and shortness of sounds, or even that between the distance of returning cadences, are of less consequence among us. For it often happens in modern languages, that the verses assume their measures from the musical air, and almost entirely lose the small share of proportion and quantity which in themselves they possess. By melody the successions of sounds are regulated in such a manner as to produce pleasing airs. Harmony consists in uniting to each of the sounds in a regular succession, two or more different sounds, which simultaneously striking the ear, sooth it by their concurrence. See HARMONY.

Music was originally formed to be the vehicle of poetry; and of consequence, though the voice might be supported and accompanied by instruments, yet music was never intended for instruments alone. We are told by ancient authors, that all the laws, whether human or divine, exhortations to virtue, the knowledge of the characters and actions of gods and heroes, the lives and achievements of illustrious men, were written in verse, and sung publicly by a choir to the sound of instruments; and it appears from the Scriptures, that such, from the earliest times, was the custom among the Israelites. Nor was it possible to find means more efficacious for impressing on the mind of man the principles of

morals, and inspiring the love of virtue. Perhaps, however, this was not the result of a premeditated plan; but, inspired by sublime sentiments, and elevation of thought, which in accents that were suited and proportioned to their celestial nature, endeavoured to find a language worthy of themselves, and expressive of their grandeur. It merits attention, that the ancients were so sensible of the value and importance of this divine art, not only as a symbol of that universal order and symmetry which prevails through the whole frame of material and intelligent nature, but as productive of the most momentous effects, both in moral and political life. Plato and Aristotle, who disagreed almost in every other maxim of politics, are unanimous in their approbation of music; as an efficacious instrument in the formation of the public character: and it was the general opinion, that whilst the gymnastic exercises rendered the constitution robust and hardy, music humanized the character, and softened those habits of roughness and ferocity by which men might otherwise have degenerated into savages.

The music now most generally celebrated and practised is that of the Italians, or their successful imitations. The English, from the invasions of the Saxons, to that more late, though lucid æra, in which they imbibed the art, and copied the manner of the Italians, had a music which neither pleased the soul, nor charmed the ear. The primitive music of the French deserves no higher panegyric. Of all the rude nations, the Scotch and Irish seem to have possessed the most affecting original music. The first consists of a melody characterized by tenderness: it melts the soul to a pleasing penitive languor. The other is the native expression of grief and melancholy. The primitive music of the Scots may be divided into the *martial*, the *pastoral*, and the *festive*. The first consists either in marches, which were played before the chieftains, in imitation of the battles which they fought, or in lamentations for the catastrophes of war, and the extinction of families. These wild effusions of natural melody preserve several of the rules prescribed for composition.

Thus far we have pursued the general idea of music. We shall, after the history, give a more particular detail of the science, from Monsieur D'Alembert.

HISTORY OF MUSIC.

The ancient history of music, even among the most cultivated nations, is now either so entirely lost, or so unhappily obscured, that we can make but few certain, and perhaps no satisfactory discoveries in it; and, as no annals could be transmitted to posterity of that music which prevailed among such people as are called *barbarous*, our accounts of it must be still less authentic and satisfactory than those of the former. Even at periods which are more recent, and may for that reason be thought more within the sphere of our investigation, were equally at a loss, both for the æras and the authors of some essential improvements in music. Yet those parts of its history, which are either already known, or may be discovered, if related at full length, with proper illustrations, would produce a work, little inferior in size to the whole extent of that *Encyclopædia*, of which it only constitutes a part. All therefore which can be expected from this preliminary account is, to give a short and cursory detail of its primary state, and its most important revolutions, so far as history will enable us, by enlightening our researches, to accomplish this design; but, if our accounts are thought concise and imperfect, we shall all along direct the views of our readers to sources which may prove more copious and more adequate to their curiosity.

It has been pretended by Father Kircher, and others, that music prevailed in Egypt before it was known in Greece. The origin of instrumental music appears to have been at a period much prior to the date of authentic history; and when we look for its epoch or its discoverer, we are carried at once into the wild regions of fable and mythology. The god Mercury, or Hermes, is said to be the inventor of the lyre, by distending strings of different tensions and diameters, upon the shell of a tortoise, which he found upon the shore. The first exhibition of the flûta, or shepherd's pipe, is ascribed to Pan; but of these beings, and their actions, little or nothing can be ascertained with proper evidence. We must therefore content ourselves with such later accounts as merit any degree of confidence.

The Grecian lyre, Fig. 12, in the plate of Miscellaneous Subjects, in its original state, seems to have been an instrument of the utmost simplicity: according to some, the Mercurian lyre consisted of three, and according to others, only of four strings. These being touched open, could only produce the same number of sounds, from whence we may easily conclude, that the powers of this instrument could not be very extensive. This tetrachord, as some say, was conjoined; others maintain that it was disjoined, and that its intervals were not even diatonic. It is however, allowed, that its two extremes produced an octave; and that the two intermediate strings divided it by a fourth on each side, with a tone in the midst, in the following manner: C. G. F. C. This is what Boëtius calls the tetrachord of Mercury. This System did not remain long confined to so small a number of sounds. Chorebus, the son of Athis, king of Lydia, added to it a fifth string; Hyagnis, a sixth; Terpander, a seventh, to equal the number of the planets; and at last, Lychaon of Samos, the eighth. Nichomachus, the Gerasenian, attributes this eighth chord to Pythagoras, the ninth to Theophrastus of Piereus,

*

8 G

afterwards

MUSIC.

afterwards the tenth to Hyfsteus of Colophon. The system of the Greeks was insensibly extended, as well above as below, till it reached, and even surpassed, the compass of a disdiapason, or double octave; a series which they call a *perfect System*, and which was likewise termed the *greatest* and the *most unchangeable*; because, between its two extremes, which betwixt themselves formed a perfect consonance, were contained all the simple, the double, the direct, or the inverted chords, every particular system, and according to them the greatest intervals which can take place in melody. This whole system consists of four tetrachords, three conjoined and one disjoined; and of a single note redundant, which was added below the whole, to complete the double octave.

In Rousseau's Musical Dictionary, Plate II. fig. 12. will be found a table of the general system amongst the Greeks. The curious may also consult those of Meibomius, placed at the front of the works of Aristoxenus. Such, in its perfection, was the general system of the Greeks; which remained almost in the same state till the eleventh century, the time when Guy d'Arezzo made considerable changes in it. He added below a new string, which he called *hypoproslambanomenē*, or "subadded," and above a fifth tetrachord. Besides this, he invented, as they say, a flat to distinguish the second sound of a conjunctive tetrachord from the first of the same tetrachord when disjunctive. For ascertaining with accuracy the diversity of intervals, Pythagoras, the philosopher of Samos, invented the monochord, or the different divisions of one single string, by which the consonances were produced, and found the same ratios which are given in the subsequent elements of music, in Malcolm's account of the scale, and in several other authors, unnecessary to be enumerated.

Had succeeding writers upon the science been more attentive to the real constitution of the scale, and the principles derived from a monochord, properly divided, we might have expected their account of the other phenomena in music to have been more precise and more perspicuous; but for a considerable time after that philosopher, the accounts of ancient music transmitted to us are either superficial and cursory, or unintelligible. The province to which our efforts are necessarily confined, directs our attention not so much to the history of those who cultivated the art, as to the art itself, and its various revolutions.

The discovery of the monochord and its divisions, was not the only speculation in music, peculiar to Pythagoras. He likewise thought the earth and seven planets, or solar system, resembled a musical diapason; and from thence formed the romantic idea of the music of the spheres. For a more satisfactory account of this celestial concert, the curious reader may peruse the *Somnium Scipionis*, a fragment of Cicero, and the *Observations upon Numbers*, by his commentator, Macrobius. Pythagoras, who taught in Italy, was the first who investigated the relations of sound by measuring a musical string, and observing the tones produced by the vibrations of its different parts, whilst the others were at rest. These he expressed by numbers, and thus ascertained the ratio which one sound bears to another. This investigation was afterwards carried farther, and delineated more distinctly, by Euclid; Nichomachus the Gerasenian lived A. C. 60. and wrote a book called *Introduction to Harmony*, which seems to be one of the clearest and most intelligible of the Greeks.

After exploring what can be known concerning the ancient music, from the theories and writings of those whose works have been transmitted to us, the forms and powers of their instruments occur next to be examined. These can only be collected from verbal descriptions, or from designs either expressed in colours or by sculpture. From these, modern musicians have not scrupled to form a most contemptible idea of practical music among the ancients. But are we sure, that the descriptions are perfectly complete and thoroughly understood? If they were, does there not still remain a possibility, that they might be tuned and handled in a manner productive of effects to which we are strangers? Of our instruments now in use, the difference between one manner of performing and another is so astonishing, that one should imagine it might render us cautious in forming any conclusions concerning instruments, which are perhaps neither perfectly described nor exactly delineated, described by authors of a period sufficiently distant to render the idioms of the language in which they wrote obscure. And though the forms exhibited in colours, or by sculpture, may be thought more intelligible; the exactness of their representations are much doubted.

From the following account of the construction and effects of several musical instruments invented by the ancients, and their progressive improvements, it will appear that they gave rise to some instruments in general use with the moderns.

The lyre of the Greeks may be considered as the parent of the fiducial or stringed instruments, and the successive improvements of these instruments merit peculiarly our attention, on account of their more immediate connection with the progressive state of music, which, in a great measure, depended on their modification, and also from these instruments having by the different degrees of tension and modes of tuning the strings suggested the first ideas of a system of music, as founded in the laws of nature, and connected with mathematical principles.

After increasing the power of the lyre, by increasing the num-

ber of strings, each of which produced but a single note, the next material improvement was to render each string susceptible of several notes, which was effected by adding a neck, by which each string, by taking different portions of it, might be made to produce different notes, more or less acute, as the vibrating part was more or less abridged. *Vide Fig. 3.*

After the decline of the Roman empire, about the year 600, in a manuscript in the monastery of St. Blasius, there are representations of several musical instruments then in use, and the Cithara, of a triangular form, like the Greek *delta*; *Fig. 4.* the Cithara Teutonica, or German, *fig. 5.* the monochord, with a bow, *fig. 6.* and the Cithara Anglica, or Harp, *fig. 8.*

About the era of the crusades, the Cithara of the ancients began to assume the appearance of the Guitar of more modern times, which is nothing more than an improvement of the former, by the addition of a finger-board, graduated by tones and semi-tones, which rendered the instrument more perfect in point of compass, though perhaps inferior in point of tone to more ancient instruments. *Vide fig. 7, 8, and 9.* the last of which was the figure of the Spanish guitar, about two centuries ago, and has continued with little or no alteration to this time.

The next great improvement in stringed instruments was the effecting a continuation of tone, by the invention of the bow. This instrument was wholly unknown to the ancients, at least as applied to practical music; it seems probable that it was by them applied to the monochord, which, though used in making musical experiments, can never be supposed capable of general use as a musical instrument, being totally incapable of harmony.

The introduction of the bow into general practice was with the Rebec, about the 11th century, and continued with progressive improvements to the last century. The Rebec, in its more simple state, was formed with two or three strings, *Vide fig. 10 and 11.* which deserves our attention, as being the parent of our modern violin, tenor and violincello.

The first improvement of the principle of the Rebec was, in the formation of viols, which took place about the beginning of the 12th century, and continued to the middle of the 16th century. These continued in general use to the middle of the 16th century.

About the year 1520 we find the first mention of violins, which however were not carried to any considerable degree of perfection until after the year 1601; shortly after which time its superior powers were discovered, and the instrument was carried to a degree of perfection which has not since been surpassed.

The tenor and violincello are exactly similar in principle to the violin, but upon a larger scale; the tenor being a medium between the violincello and violin.

Almost in every period since the restitution of literature, an important controversy has been agitated by virtuosi of different opinions in the theory of music. Some have maintained that harmony was, and others that it was not, known to the ancients. By some of these it was contended, that the knowledge of harmony naturally results from the knowledge of consonances; that by tuning their instruments the ancients must have been familiar to the various coalescences of sounds, and that of consequence they could not be ignorant of the pleasure which they produce. Several passages likewise from such dissertations or fragments as have escaped the rage of time, are collected, to prove that the ancients must have been acquainted with harmony or symphonical music.

The opponents of this hypothesis have alleged, that from the sensations or ideas of simple chords no conception could be formed of the effects produced by their conjunction or succession. It is on all hands agreed, that several voices and instruments were used by the Greeks and Romans in performing the same piece of music; but the anti-harmonists, as we may term them, will not admit that the intervals of these voices or instruments were varied: nay, it is affirmed that they performed always in octave or unison one to the other: and from thence it is pretended, that all the passages which seem to import the acquaintance of the ancients with practical harmony may be rationally and consistently explained. This, however, notwithstanding the labours of French critics, will still remain extremely doubtful to any person who has either perused the dialogue ascribed to Plutarch, or other passages to the same purpose. Nor can it be reasonably thought, that, at a period so barbarous as the 12th century, harmony, though rude and simple, should have been the creature of naked invention, in places where every other branch of literature and degree of culture were unknown: Yet it is clear, from the monkish historians of that era, that harmony was even then in practice, where it could hardly be supposed to be immediately transmitted by a progress so rapid from other parts of the world, where the finer organization of the natives, the more propitious aspect of nature, and the more obvious vestiges of ancient improvement, might be thought favourable to the invention, culture, and propagation of the fine arts. Nor is it a weak presumption in favour of the knowledge of antiquity in harmony, that the adherence of a contrary opinion can neither ascertain the epoch nor the parent of symphonical music. Yet had it been, as they pretend, a modern invention, barbarous and ignorant as the general character of human nature was during that gloomy interval from the decline of the Roman empire to the revival

MUSIC.

val of letters, the author of an improvement so new and extraordinary could not have escaped the public notice. We cannot therefore cease to think with the author of *The principles and power of harmony*, p. 133, that the ancients were acquainted with this species of music, though perhaps it may be admitted, that its powers were neither so thoroughly known, nor so generally and successfully practised, as afterwards.

After the long and cruel devastation of the Goths and Vandals, music seems first to have been revived for the service of the church. It was this religious observation of determined and regular quantities in ancient poetry, which preserved and regulated the due proportion of sounds, and which, when abandoned, left the value of notes, with respect to their duration, impossible to be determined, till other characters and signs were superadded, which discovered the real estimate of every note, and shewed to what degree it should be protracted, or by what quantity of duration limited. This seems to have been the next advance in musical improvement, but it had one pernicious effect, which was, to render music independent of poetry. Yet these sister arts seem to be twin-born from heaven; and perhaps, in no case could the laws of nature have suffered a more cruel and impious violation, than in separating the one from the other. Modulated sound is a more genuine, powerful, and universal vehicle of sentiment, than any articulate or arbitrary signs can possibly be. But articulate signs may be so happily adjusted by convention, as to express the degrees, varieties, and modes of sentiment or emotion, which in modulated sounds are less definitely signified, if signified at all. Thus sounds give energy and sweetness to words, words variety and definiteness to sounds. Guy d'Arezzo, otherwise named *Guido Arctinus*, was the inventor of that disposition of the musical scale which is now in use. He could not, therefore, be the author of harmony, which we know to have been practised some centuries before his time, but only of a new set of characters by which it was expressed. This musician, by changing the tetrachords into hexachords, highly improved the scale, discovered more accurately the position of semitones, and rendered its intonation much more practicable. He likewise adapted the syllables *ut, re, mi, fa, sol, la*, to the various sounds which compose it, from the following Sapphic verses in a hymn to St. John.

<i>UT</i> quant laxis	<i>RE</i> sonare fibris
<i>M</i> lra gestorum	<i>F</i> amuli tuorum
<i>SOL</i> ve polluti	<i>L</i> ibii reatum. SANCTE JOANNES.

The rhythm in music, or the regular division and measures of sound, had formerly been determined by the quantities of the feet in poetry; and, independent of these, seems to have been entirely indefinite. The invention of a rhythm capable of subsisting by itself, is ascribed to one *Johannes des Muris*. Yet there is considerable reason to believe that it had been invented by one *Franco*, who lived a number of years before him. In these times there was a secular as well as sacred music. The Troubadours, or Provençal poets, composed songs of different kinds, which they sung to their harps or violins for public entertainment. Hence it happened, that harmony, melody, and rhythm, admitted of immensely greater varieties than they had hitherto done. We have formerly said, that in ancient music, the quantities or values of every note were determined by those of the syllables to which they answered. It is, however, by no means improbable, that at a very early period, in their private rehearsals, or practice for improvement, whether in taste or execution, the musicians frequently played the instrumental parts without being accompanied either by the voice or the words to which they had been set. The impressions of those poetical measures to which the parts corresponded, were abundantly sufficient to preserve in the memory of the performer the idea of the rhythm, and of course to determine the value of each particular note. But when airs were either set to pieces in prose, or composed without any regard to syllabical duration, the quantity of each note was absolutely indefinite. When therefore music began to be set in parts, it was indispensibly necessary that the points which mark the notes intended to correspond one with another, should be set in direct opposition. Hence the denomination of *counterpoint*. But when characters or different forms of characters, were invented, for expressing the different durations of sounds, or their relative proportions one to another, the same precision in opposing note to note became less necessary, and was on that account less scrupulously observed.

The airs into which secular music was originally distinguished seems to have been the madrigal, the song, the cantata, the canon. These were vocal, or at least common to voices and instruments; but the solo, the phantasia, the concerto, were progressive changes in instrumental music.

It is generally agreed, that the Greeks and Romans sung their tragedies and comedies from beginning to end; but no monument of these compositions remains to us: so that the music of the drama is as really a modern invention as if no such thing had subsisted among the ancients, since the mere knowledge of a fact could by no means throw any light upon the manner in which it was produced. All that has been transmitted to us concerning the ancient theatrical music, can only inform us, that it was pathetic and imitative to a high degree. But upon these hints few composers will think themselves sufficiently instructed to proceed. This arduous

enterprise, however, was nobly begun and successfully prosecuted by one *Jacopo Peri*. A poet, whose name was *Ottavio Rinuccini*, in the city of Florence, having composed a dramatic pastoral upon the story of Apollo and Daphne, engaged this excellent musician to set it. Both being warmed with the same ideas, and animated by the same design, so happily succeeded, that other poets and musicians were generally approved and admired in proportion as they pursued the vestiges of these great masters. A second performance of the same kind, called *Eurydice*, composed by the authors of the former pastoral, was represented in Florence, in the year 1600, upon occasion of the marriage of Mary de Medicis with Henry IV. of France. But a detail of the gradations by which theatrical music rose to its present perfection, would be a task too extensive for the limits by which we are circumscribed. Nor is it in our power, for the same reason, to enter more minutely and critically into the nature of those compositions called *operas*. Let it suffice to add, that in common with tragedy and comedy, they are representations of action. In consequence of this, they require the same unity of design, the same diversity of characters and passions, with the former. Hence it follows, that some parts of them will be simply narrative, some pathetic, and others more emphatically descriptive. Music suited to the first of these is called *recitative*. Its distinguishing characteristics are, to express the nature and degree of sentiment exhibited by the speaker, to be scrupulously adapted to the peculiar genius of that language which it is designed to accompany; and to be exactly modelled according to the accents of that nation, for which it was formed. Such parts of the music as are intended for more pathetic declamations may be called *airs*. In these the words, both with respect to their quantity and order, may be treated with greater freedom. The melody is less in the tone of conversation, and the harmony more complex. In this, however, there is no small hazard lest sentiment should be lost in sound; and it requires no small degree of judgment, delicacy, and taste in the composer, at once to fill the harmony and preserve the sentiment. The chorus is intended to express some emphatic event, to celebrate some distinguished hero, or to praise some beneficent god. It is properly the voice of triumph and exaltation. The harmony should therefore be as full and expressive as possible. But for the rules of such compositions, one must refer the reader to such theoretical and practical musicians as have been more successful in describing and cultivating dramatic music. What remains for us is to subjoin a list of those who have been most remarkable for their accuracy in the theory, or for their excellence in the practice, of music in general.

Of John de Muris we have already spoken, who lived in the year 1330, and to whom, by mistake, has been attributed the invention of those characters by which, in modern times, the value of notes and their relative proportions one to another, have been ascertained. But this expedient for making visible the different durations of notes, as constituent of one rhythmus or particular movement, we have found to be first introduced by one *Franco*, who lived prior to John de Muris. *Lafus* was the first who wrote on music; but his work is lost, as well as several other books of the Greeks and Romans upon the same subject. *Aristoxenus*, the disciple of *Aristotle*, and leader of a sect in music, is the most ancient author who remains to us upon this science. After him came *Euclid* of Alexandria. *Aristides Quintilianus* wrote after *Cicero*. *Alyphus* afterwards succeeded; then *Guadentius*, *Nicomachus*, and *Bacchius*. *Marchus Meibomius* has favoured us with a beautiful edition of these seven Greek authors, with a Latin translation and notes. *Plutarch* wrote a dialogue upon music. *Ptolomy*, a celebrated mathematician, wrote in Greek a treatise entitled *The Principles of Harmony*, about the time of the emperor *Antoninus*. This author endeavoured to preserve a medium between the *Pythagoreans* and the *Aristoxenians*. A long time afterwards, *Manuel Prynennius* wrote likewise upon the same subject. Among the Latins, *Boetius* wrote in the times of *Theodoric*: and not distant from the same period *Martianus*, *Cassiodorus*, and *St. Augustine*. The number of the moderns is almost indefinite. The most distinguished are, *Zarlino*, *Salinas*, *Valgulio*, *Galileo*, *Doni*, *Kircher*, *Mersenne*, *Parran*, *Perault*, *Wallis*, *Descartes*, *Holden*, *Mengoli*, *Malcolm*, *Baretti*, *Vallotti*, *Marcus Meibomius*, *Christopher Simpson*: *Tartini*, whose book is full of deep researches and of genius, but tedious from its prodigious length, and perplexed with obscurity; and *M. Rameau*, whose writings have had this singular good luck, to have produced a great fortune without being read almost by any one. Besides, the world may now be spared the pains of perusing them, since *M. d'Alembert* has taken the trouble of explaining to the public the system of the fundamental bass, the only useful and intelligible discovery which we find in *Rameau's* writings. To these we may add *Dr. Smith*, author of a learned and mathematical treatise, intitled, *Harmonies*; or, *The Philosopher of Musical Sounds*; *Mr. Stillingfleet*, author of the *Principles and the Power of Harmony*; or, *An Explanation of Tartini's System*; *Dr. Pepusch*, and his noble pupil *Lord Abercorn*; *Mr. Avison*, formerly organist at Newcastle, who wrote a treatise on *Musical Expression* with the politeness and elegance of a gentleman, the depth and precision of a scholar, the spirit and energy of a genius. The names of *Rousseau* and *d'Alembert* have been so often repeated during the course of these musical lucubrations, that it would be superfluous

MUSIC.

to resume their characters in this place. Among the authors already mentioned, it would be unpardonable to omit the names of Sir John Hawkins and Dr. Burney, each of whom has favoured the world with a history of music: The first protracted to five volumes, in quarto, replete with musical erudition, but seldom original; frequently careless, and sometimes too circumstantial and inelegant to be entertaining. The musical productions of the ingenious Dr. Burney, in two volumes, abound with descriptions, events, and disquisitions, highly worthy of attention; but, on account of the limits which the author has prescribed to himself, many things have been omitted which would have been equally acceptable to literary curiosity, and explicative of musical science. Dr. Young also, in a very learned work, entitled, *De Rina Sonorum*, throws considerable light on the theory of Music.

ELEMENTS OF MUSIC.

THEORETICAL AND PRACTICAL.

Preliminary Discourse.

Music may be considered, either as an art, which has for its object one of the greatest pleasures of which our senses are susceptible; or as a science, by which that art is reduced to principles. This is the double view in which we mean to treat of music in this System. There are two departments in music, melody and harmony. Melody is the combination of *successive*: Harmony the union of *co-existing* sounds. Melody has been known and felt through all ages: perhaps the same cannot be affirmed of harmony, we know not whether the ancients made use of it or not, nor at what period it began to be practised.

The first compositions upon the laws of harmony which we know, are of no higher antiquity than two ages prior to our own; and they were followed by many others. But none of these essays were capable of satisfying the mind concerning the principles of harmony; they confined themselves almost entirely to the single occupation of collecting rules, without endeavouring to account for them; neither had their analogies one with another, nor their common source been perceived; a blind and unenlightened experience was the only compass by which the artist could direct and regulate his course. M. Rameau was the first who began to transmute light and order through this chaos. In the different tones produced by the same sonorous body, he found the most probable origin of harmony, and the cause of that pleasure which we receive from it. His principle he unfolded, and showed how the different phenomena of music were produced by it: he reduced all the consonances to a small number of simple and fundamental chords, of which the others are only combinations or various arrangements. He has, in short, been able to discover, and render sensible to others, the mutual dependence between melody and harmony. Every sonorous body, besides its principal sound, likewise exhibits to the ear the 12th and 17th major of that sound. This multiplicity of different, yet concordant sounds, known for a considerable time, constitute the basis of the whole theory of M. Rameau, and the foundation upon which he builds the whole superstructure of a musical system.

Though these different topics may be contained in the writings of this celebrated artist, and in these writings may be understood by philosophers, who are likewise adepts in the art of music; still, however, such musicians as were not philosophers, and such philosophers as were not musicians, have long desired to see these objects brought more within the reach of their capacity; such is the intention of the system now presented to the public.

But though this system is intended to explain the theory of music, and to reduce it to a system more complete and more luminous than has hitherto been done, we ought to caution those who shall read this system, that they may be careful not to deceive themselves, either by misapprehending the nature of our object, or the end which our endeavours pursue.

We must not here look for that striking evidence which is peculiar to geometrical discoveries alone, and which can be so rarely obtained in these mixed disquisitions, where natural philosophy is likewise concerned: into the theory of musical phenomena there must always enter a particular kind of metaphysics, which these phenomena implicitly take for granted, and which brings along with it, its natural obscurity. In this subject, therefore, it would be absurd to expect what is called *demonstration*: it is an achievement of no small importance, to have reduced the principal facts to a system consistent with itself, and firmly connected in its parts; to have deduced them from one simple experiment; and to have established upon this foundation the most common and essential rules of the musical art. But in another view, if here it be improper to require that intimate and unalterable conviction, which can only be produced by the strongest evidence, we remain in the mean time doubtful whether it is possible to elucidate this subject more strongly.

Thus, though the greatest number of the phenomena in the art of music appear to be deducible in a simple and easy manner from the protracted tone of sonorous bodies, one ought not perhaps with too much temerity to affirm as yet, that this mixed and protracted tone is *demonstratively* the only original principle of harmony. But in the mean time it would not be less unjust to reject this principle, because certain phenomena appear to be deduced from it with less success than others. It is only necessary to conclude from this, either that by future scrutines means may be found for reducing these phenomena to this principle; or that harmony has perhaps some

other unknown principle, more general than that which results from the protracted and compounded tone of sonorous bodies, and of which this is only a branch; or lastly, that we ought not perhaps to attempt the reduction of the whole science of music to one and the same principle; which, however, is the natural effect of an impatience so frequent even among philosophers themselves, which induces them to take a part for the whole, and to judge of objects in their full extent by the greatest number of their appearances.

We would the more willingly persuade those who are skilled in theory, and eminent in practice, to extend and improve the views of him, who before them pursued and pointed out the career, because many amongst them have already made laudable attempts, and have even been in some measure successful in diffusing new light through the theory of this enchanting art. It was with this view that the celebrated Tartini has presented us, in 1754, with a treatise of harmony, founded on a principle different from that of M. Rameau. This principle is the result of a most beautiful experiment. If at once two different sounds are produced from two instruments of the same kind, these two sounds generate a third, different from both the others. They have inserted in the *Encyclopædie* under the article *Fundamental*, a detail of this experiment according to M. Tartini; and we owe to the public an information of which in composing this article we were ignorant. M. Rameau, a member of the Royal Society at Montpellier, had presented to that society, in the year 1753, before the work of M. Tartini had appeared, a memorial printed the same year, and where may be found the same experiment displayed at full length. In relating this fact, which it was necessary for us to do, it is by no means our intention to detract in any degree from the reputation of M. Tartini; we are persuaded that he owes this discovery to his own researches alone: but we think ourselves obliged in honour to give a public testimony in favour of him who was the first in exhibiting this discovery.

But whatever be the case, it is in this experiment that M. Tartini attempts to find the origin of harmony: his book, however, is written in a manner so obscure, that it is impossible for us to form any judgment of it; and we are told that others, distinguished for their knowledge of the science, are of the same opinion. It were to be wished that the author would engage some man of letters, equally practised in music, and skilled in the art of writing, to unfold these ideas which he has not discovered with sufficient perspicuity, and from whence the art might perhaps derive considerable advantage if they were placed in a proper light.

The famous discovery made by Sig. Tartini, is as follows: If two sounds be produced at the same time, properly tuned, and with due force, from their conjunction a third sound is generated, so much more distinctly to be perceived by delicate ears as the relation between the generating sounds is more simple; yet from this rule we must except the unison and octave. From the fifth is produced a sound unison with its lowest generator; from the fourth, one which is an octave lower than the highest of its generators; from the third major, one which is an octave lower than its lowest; and from the sixth minor (whose highest note forms an octave with the lowest in the third formerly mentioned) will be produced a sound, lower by a double octave than the highest of the lesser sixth; from the third minor, one which is double the distance of a greater third from its lowest; but from the sixth major (whose highest note makes an octave to the lowest in the third minor), will be produced a sound only lower by double the quantity of a greater third, than the highest; from the second major, a sound lower by a double octave than the lowest; from a second minor, a sound lower by triple the quantity of a third major than the highest; from the interval of a diatonic or greater semitone, a sound lower by a triple octave than the highest; from that of a minor or chromatic semitone, a sound lower by the quantity of a fifth four times multiplied than the lowest, &c. &c. But that these musical phenomena may be tried by experiments proper to ascertain them, two hautboys tuned with scrupulous exactness, must be procured, whilst the musicians are placed at the distance of some paces one from the other, and the hearers in the middle. The violin will likewise give the same chords, but they will be less distinctly perceived, and the experiment more fallacious, because the vibrations of other strings may be supposed to enter into it. If our readers should be curious to examine these experiments and the deductions made from them, in the theory of music, he will find them clearly explained and illustrated in a treatise, called *Principles and Power of Harmony*, printed at London, in the year 1771.

Philosophical musicians ought not to lose their time in searching for mechanical explanations for the phenomena in music, explanations will always be found vague and unsatisfactory; nor is it their province to exhaust their powers in vain attempts to rise above their sphere, into a region still more remote from the prospect of their faculties, and to lose themselves in a labyrinth of metaphysical speculations upon the causes of that pleasure which we feel from harmony. In vain would they accumulate hypothesis on hypothesis, to find a reason why some chords should please us more than others. Some ascribe the different degrees of pleasure which we feel from chords, to the more or less frequent coincidence of vibrations; others to the relations which these vibrations have among themselves as they are more or less simple. But why should this coincidence of vibrations, that is to say, their simultaneous im-

pulse

ar-
is
rm
for
e to
ally
heic
and
age

: If
 with
 d, so
 tion
 rule
 duced
 one
 from
 ; and
 h the
 ound,
 from
 third
 note
 duced
 , than
 ouble
 er by
 be in-
 triple
 semi-
 tplied
 a may
 utboys
 e mu-
 other,
 ive the
 e ex-
 strings
 urious
 n them,
 and il-
 armony,

arching
explica-
it their
ve their
of their
ical spe-
om har-
pothesis,
ore than
which we
of vibra-
e among
ould this
eous im-
pulse



Principles of Music: See the System Part 1. Section 1.

The Seven Characters or ways of Writing the Notes according to their value or length of Time with the Marks of their several Rests or Pauses.

Breve Semi-breve Minim Crotchete Quaver
 Semi-quaver Demi-semi-quaver
 Equal to a Breve Semi-breve Minim Crotchete Quaver Semi-quaver Demi-semi-quaver

The characters for denoting Rests or Pauses

When more Bars than one are to be rested it is commonly marked thus.

3 4 5 6 7 8 16

A Dot added to any Note increases its value one half

Equal to

There are three Cills. The lowest is called Bass or F. Cill. The next is the Tenor or C. Cill. and is placed upon the first. The last Cill is the Treble or G. Cill being five Notes higher than the first. When it is upon the fourth or third Line. When it is upon the second, third & fourth Line it is called Tenor upon the fourth Line. When the C. Cill is placed upon the second and first Line and upon the fourth Line it is called Bass, and upon the third Line tenor, and upon the second & third upon the first Line. Violin or Treble Cill upon the second Line & French Cill upon the first Line.

Violin or Treble Tenor or Soprano Third Treble or Mezzo Soprano Counter-tenor or Contralto Tenor Bass

Example of the unison or the same Note repeated in every Cill

Violin or Treble Tenor or Soprano Third Treble or Mezzo Soprano Counter-tenor or Contralto Tenor Bass

Chromatic Scale.

Chromatic Scale.

Enharmonic Scale

Enharmonic Scale

Violin Scale.

Whenever you go higher than the Notes marked in the following Scale you must change the position of your Hand which is called Shifting on all Instruments played with a Bow.

Thus 1st String 2nd String 3rd String 4th String

Tenor Viola or Alto Scale.

Thus 1st String 2nd String 3rd String 4th String

Viola da Gamba.

Thus 1st String 2nd String 3rd String 4th String

Violoncello.

Thus 1st String 2nd String 3rd String 4th String

Double Bass.

Thus 1st String 2nd String 3rd String 4th String

Guitar.

Thus 1st String 2nd String 3rd String 4th String

Harp.

There is a String for every Note and when half a note is wanted it must be made with the Pedal

Bass Treble

MUSIC.

pulse on the same organs of sensation, and the accident of beginning frequently at the same time, proves so great a source of pleasure. We may conceive without difficulty how the eye judges of relations; but how does the ear form similar judgments? Let us in sincerity confess our ignorance concerning the genuine causes of these effects. The metaphysical conjectures concerning the auditory organs, are probably in the same predicament with those which are formed concerning the organs of vision, if one may speak so, in which philosophers have, even till now, made such inconsiderable progress, and in all likelihood will not be surpassed by their successors.

The rules which we have attempted to establish, concerning the track which every one ought to pursue in the theory of the musical art, may suffice to shew our readers the end which we have endeavoured to attain in this System. We have nothing to do here (for it is proper that we repeat it) we have nothing to do with the mechanical principles of protracted and harmonic tones, produced by sonorous bodies; principles which, till now, have been explored in vain, and which perhaps may be long explored with the same success: we have still less to do with the metaphysical causes of those pleasing sensations which are impressed on the mind by harmony; causes which are still less discovered, and which, according to all appearances, will remain latent in perpetual obscurity. We are alone concerned to shew how the chief and most essential laws of harmony may be deduced from one single experiment; and for which, if we may speak so, preceding artists have been under a necessity of groping in the dark.

With an intention of rendering this system as generally useful as possible, we have endeavoured to adapt it to the capacity even of those who are absolutely uninstructed in music. To accomplish this design, it appeared necessary to pursue the following plan: To begin with such definitions as are necessary to explain the technical terms most frequently used in this art; such as, *chord, harmony, tone, third, fifth, octave, &c.*

Next, to enter into the theory of harmony, which is explained according to M. Rameau, with all possible perspicuity. This part, as well as that which includes definitions of technical terms, presupposes no other knowledge of music than that of the names and powers of the notes C, D, E, F, G, A, B, which all the world knows.

We shall not imitate those musicians, who, believing themselves geometers, or those geometers, who, believing themselves musicians, fill their writings with figures upon figures; imagining, perhaps, that this apparatus is necessary to the art. The propensity of adorning their works with a false air of science, can only impose upon credulity and ignorance, and serve no other purpose but to render their treatises more obscure, and less instructive.

This we may do with so much more reason, that in this subject the foundations of those calculations are in some measure hypothetical, and can never arise to a degree of certainty above hypothesis. The relation of the octave as 1 to 2, that of the fifth as 2 to 3, that of the third major as 4 to 5, &c. are not perhaps the genuine relation established in nature; but only relations which approach them, and such as experience can discover. For are the results of experience any thing more but mere approaches to truth?

But happily these approximated relations are sufficient, though they should not be exactly agreeable to truth, for giving a satisfactory account of those phenomena which depend on the relation of sounds; as in the difference between the notes in the gamut, of the alterations necessary in the fifth and third, of the different manner in which instruments are tuned, and other facts of the same kind. If the relations of the octave, of the fifth, and of the third are not exactly such as we have supposed them, at least no experiments can prove that they are not so; and, since these relations are signified by a simple expression, since they are, besides, sufficient for all the purposes of theory; it would not only be useless, but even contrary to sound philosophy, should any one incline to invent other relations, to form the basis of any system of music, less easy and simple than that which we have delineated in this System.

The third part of this System, contains the most essential rules of composition; or, in other words, the practice of harmony. These rules are founded on the principles laid down in the first part; yet those who wish to understand no more than is necessary for practice, without exploring the reasons why such practical rules are necessary, may limit the objects of their study to the *Introduction*, and the *Second Part*. This Second Part, strictly speaking, presupposes no more than the first, any habit of singing, nor even any knowledge of music; it only requires that one should know, not even the rules and manner of intonation, but merely the position of the notes in the cleff, *F* or *fa*, on the fourth line, and of that of *G* or *sol*, upon the second: and even this knowledge may be acquired from the system itself; for in the beginning of the second part we explain the position of the cleffs and of the notes. Nothing else is necessary but to render it a little familiar to our memory, and we shall have no more difficulty in it.

It would be wrong to expect here all the rules of composition, and especially those which direct the composition of music in several parts, and which, being less severe and indispensable, may be chiefly acquired by practice, by studying the most approved models, by the assistance of a proper master, but, above all, by the cultivation of the ear and of the taste. This System is intended for explaining to

beginners the fundamental principles, not the practical detail of composition. Those who wish to enter more deeply into this detail, will either find it in M. Rameau's Treatise of Harmony, or in the code of music which he published more lately (from our general recommendation of this code, we except the reflections on the principles of sound which are at the end, and which we should not advise any one to read) or, lastly, in the explication of the Theory and Practice of Music, by Mr. Bethini, printed at Paris, by Lambert, in the year 1754: this last book appears to us clear and methodical.

Is it necessary to add that, in order to compose music in a proper taste, it is by no means enough to have familiarized with much application the principles explained in this System. Here can only be learned the mechanism of the art; it is the province of nature alone to accomplish the rest. Without her assistance it is no more possible to compose agreeable music, by having read these elements, than to write verses in a proper manner by a poetical dictionary. In one word, it is the elements of music alone, and not the principles of genius, that the reader may expect to find in this System.

Such was the aim pursued in its composition, and such should be the ideas of the reader in its perusal. Once more let us add, that to the discovery of its fundamental principles we have not the remotest claim. The sole end which we proposed was to be useful; to reach that end we have omitted nothing which appeared necessary, and we should be sorry to find our endeavours unsuccessful.

PART I. DEFINITIONS OF SEVERAL TECHNICAL TERMS.

SECT. I. What is meant by Melody, by Chord, by Harmony, by Interval.

1. Melody is nothing else but a series of sounds which succeed one to another in a manner agreeable to the ear.

2. That is called a *chord* which arises from the mixture of several sounds heard at the same time; and harmony is properly a series of chords, which, in their succession one to another, delights the ear. A single chord is likewise sometimes called *harmony*, to signify the coalescence of sounds which that chord creates, and the sensation produced in the ear by that coalescence. We shall occasionally use the word *harmony* in this last sense, but in such a manner as never to leave our meaning ambiguous.

3. In melody and harmony, the distance between one sound and another is called an *interval*; and this is increased or diminished as the sounds between which it intervenes are higher or lower one than the other.

4. That we may learn to distinguish the intervals, and the manner of perceiving them, let us take the ordinary scale

ut, re, mi, fa, sol, la, si, UT,
C, D, E, F, G, A, B, C,

which every person, whose ear or voice is not extremely false, naturally modulates. These are the observations which will occur to us in singing this gamut. The sound D is higher or sharper than the sound C, the sound E higher than the sound D, the sound F higher than the sound E, &c. and so through the whole octave; so that the interval or the distance from the sound C to the sound D, is less than the interval or distance between the sound C and the sound E, the interval from C to E is less than that between C and F, &c. and in short that the interval from the first to the second C is the greatest of all.

5. In general, the interval between two sounds is proportionably greater, as one of these sounds is higher or lower with relation to the other: but it is necessary to observe, that two sounds may be equally high or low, though unequal in their force. The string of a violin, touched with a bow, produces always a sound equally high, whether faintly or strongly struck; the sound will only have a greater or lesser degree of strength. It is the same with vocal modulation; let any one form a sound, by gradually impelling or swelling the voice, the sound may be perceived to increase in its energy, whilst it continues always equally low or equally high.

6. We must likewise observe, concerning the scales, that the intervals between C and D, between D and E, between F and G, between G and A, between A and B are equal, or at least nearly equal; and that the intervals between E and F, and between B and C, are likewise equal among themselves, but consist almost only of half the former. This fact is known and recognised by every one: the reason for it shall be given in the sequel; in the mean time every one may ascertain its reality, by the assistance of an experiment.

This experiment may be easily tried. Let any one sing the scale of C, D, E, F, G, A, B, C, it will be immediately observed, without difficulty, that the last four notes of the octave G, A, B, C, are quite similar to the first C, D, E, F; inasmuch, that if, after having sung this scale, one would choose to repeat it, beginning with C in the same tone which was occupied by G in the former scale, the note D of the last scale would have the same sound with the note A in the first, the E with the B, and the F with the C.

From whence it follows that the interval between C and D is the same as between G and A; between D and E, as between A and B; and E and F, as between B and C. It will likewise be found, that from D to E, from F to G, there is the same interval as from C to D. To be convinced of this, we need only sing the

MUSIC.

scale once more; then sing it again, beginning with C, in this last scale, in the same tone which was given to D in the first; and it will be perceived, that the D in the second scale will have the same sound, at least as far as the ear can discover, with the E, in the former scale; from whence it follows, that the interval between D and E is, at least as far as the ear can perceive, equal to that between C and D. It will also be found, that the interval between F and G is, so far as our sense can determine, the same with that between C and D.

This experiment may perhaps be tried with some difficulty by those who are not inured to form the notes and change the key; but such may very easily perform it by the assistance of an harpsichord, by means of which the performer will be saved the trouble of retaining the sounds in one intonation whilst he performs another. In touching upon the harpsichord the keys G, A, B, C, and in performing with the voice at the same time C, D, E, F, in such a manner that the same sound may be given to C in the voice with that of the key G in the harpsichord, it will be found that D in the vocal intonation shall be the same with A upon the harpsichord, &c.

It will be found likewise by the same harpsichord, that if one should sing the scale beginning with C in the same tone with E on the instrument, the D which ought to have followed C, will be higher by an extremely perceptible degree than the F which follows E; thus it may be concluded, that the interval between E and F is less than that between C and D; and if one would rise from F to another sound, which is at the same distance from F as F from E, he would find in the same manner, that the interval from E to this new sound is almost the same as that between C and D. The interval then from E to F is nearly half of that between C and D.

Since then, in the scale thus divided, C, D, E, F, G, A, B, C, the first division is perfectly like the last; and since the intervals between C and D, between D and E, and between F and G, are equal, it follows, that the intervals between G and A, and between A and B are likewise equal to every one of the three intervals between C and D, between D and E, and between F and G; and that intervals between E and F and between B and C are also equal, but that they only constitute one half of the others.

7. It is for this reason that they have called the interval from E to F, and from B to C, a semitone; whereas those between C and D, D and E, F and G, G and A, A and B are tones. The tone is likewise called a *second major*, and the semitone a *second minor*.

8. To descend or rise diatonically, is to descend or rise from one sound to another by the interval of a tone or of a semitone, or in general by seconds, whether major or minor; as from D to C, or from C to D; from F to E, or from E to F.

SECT. II. *The Terms by which the different Intervals of the Gamut are denominated.*

9. An interval composed of a tone and a semitone, as from E to G, from A to C, or from D to F, is called a *third minor*. An interval composed of two full tones, as from C to E, from F to A, or from G to B is called a *third major*. An interval consisting of two tones and a semitone, as from C to F, or from G to C, is called a *fourth*. An interval, consisting of three full tones, as from F to B, is called *triton*, or *fourth redundant*. An interval consisting of three tones and a semitone, as from C to G, from F to C, from D to A, or from E to B, &c. is called a *fifth*. An interval composed of three tones and two semitones, as from E to C, is called a *sixth minor*. An interval composed of four tones a semitone, as from C to A, is called a *sixth major*. An interval consisting of four tones and two semitones, as from D to C is called a *seventh minor*. An interval composed of five tones and two semitones, as from C to B, is called a *seventh major*. And, in short, an interval consisting of five tones and two semitones, as from C to C, is called an *octave*. Many of the intervals which have now been mentioned, are still signified by other names, as may be seen in the beginning of the second part: but those which we have now given are the most common, and the only terms which our present purpose demands.

10. Two sounds equally high, or equally low, however unequal in their force, are said to be in *unison* one with the other.

11. If two sounds form between them any interval, whatever it be, we say, that the highest when ascending is in that interval with relation to the lowest; and when descending we pronounce the lowest in the same interval with relation to the highest. Thus, in the third minor E, G, where E is the lowest and G the highest sound, G is a third minor from E ascending, and E is third minor from G in descending.

12. In the same manner, if speaking of two sonorous bodies, we should say, that the one is a fifth above the other in ascending, this infers that the sound given by one is at the distance of a fifth ascending from the sound given by the other.

SECT. III. *Of Intervals greater than the Octave.*

13. If after having sung the scale C, D, E, F, G, A, B, C, one would carry this scale still farther in ascent, it would be discovered, without difficulty, that a new scale would be formed, C, D, E, F, &c. entirely similar to the former, and of which the sounds will be an octave ascending, each to its correspondent note in the former

scale; thus D, the second note of the scale, will be an octave in ascent to the D of the first scale; in the same manner E shall be the octave to E, &c. and so of the rest.

14. As there are nine notes from the C first to the second D, the intervals between these two sounds is called a *ninth*, and this ninth is composed of six full tones and two semitones. For the same reason the interval from C to F is called an *eleventh*, and the interval between C and G, a *twelfth*, &c. It is plain that the *ninth* is the octave of the *second*, the *eleventh* of the *fourth*, and the *twelfth* of the *fifth*, &c. The octave above the octave of any sound is called a *double octave*; the octave of the double octave is called a *triple octave*; and so of the rest. The double octave is likewise called a *fifteenth*; and for the same reason the double octave of the third is called a *seventeenth*, the double octave of the fifth a *nineteenth*, &c.

Let us suppose two vocal strings, formed of the same matter, of the same thickness, and equal in their tension, but unequal in their length, it will be found by experience; 1. That if the shortest is equal to half the longest, the sound which it will produce must be an octave above the sound produced by the longest. 2. That if the shortest constitutes a third part of the longest, the sound which it produces must be a twelfth above the sound produced by the longest. 3. That if it constitutes the fifth part, its sound will be a seventeenth above.

Besides, it is a truth demonstrated and generally admitted, that in proportion as one musical string is less than another, the vibration of the least will be more frequent (that is to say, its departures and returns through the same space) in the same time; for instance, in an hour, a minute, a second, &c. in such a manner that one string which constitutes a third part of another, forms three vibrations, whilst the largest has only accomplished one. In the same manner a string which is one half less than another, performs two vibrations whilst the other only completes one; and a string which is only the fifth part of another, will perform five vibrations in the same time which is occupied by the other in one. From thence it follows, that the sound of a string is proportionally higher or lower, as the number of its vibrations are greater or smaller in a given time; for instance, in a second. It is for that reason that if we represent any sound whatever by 1, one may represent the octave above by 2, that is to say, by the number of vibrations formed by the string which produces the octave, whilst the longest string only vibrates once; in the same manner we may represent the twelfth above the sound 1 by 3, the seventeenth major above by 5, &c. But it is very necessary to remark, that by these numerical expressions we do not pretend to compare sounds as such; for sounds in themselves are nothing but mere sensations, and it cannot be said of any sensation that it is double or triple to another: thus the expressions 1, 2, 3, &c. employed to denominate a sound, its octave above, its twelfth above, &c. signify only, that if a string performs a certain number of vibrations, for instance, in a second, the string which is in the octave above shall double the number in the same time, the string which is in the twelfth above shall triple it, &c. Thus to compare sounds among themselves is nothing else than to compare among themselves the numbers of vibrations which are formed in a given time by the strings that produce these sounds.

SECT. IV. *What is meant by Sharps and Flats.*

15. It is plain that one may imagine the five tones which enter into the scale, as divided each into two semitones; thus one may advance from C to D, forming in its progress an intermediate sound, which shall be higher by a semitone than C, and lower in the same degree than D. A sound in the scale is called *sharp*, when it is raised by a semitone; and it is marked with this character ♯; thus C♯ signifies C sharp; that is to say, C raised by a semitone above its pitch is the natural scale. A sound in the scale depressed by a semitone is called *flat*, and is marked thus, b: thus A♭ signifies A flat, or A depressed by a semitone.

SECT. V. *What is meant by Consonances and Dissonances.*

16. A chord composed of sounds, whose union or coalescence pleases the ear, is called a *consonance*; and the sounds which form this chord are said to be consonant one with relation to the other. The reason of this denomination is, that a chord is found more perfect, as the sounds which form it coalesce more closely among themselves.

17. The octave of a sound is the most perfect of consonances of which that sound is susceptible; then the fifth, afterwards the third, &c. This is a fact founded on experiment.

18. A number of sounds at the same time produced, whose union is displeasing to the ear, is called a *dissonance*, and the sounds which form it are said to be dissonant, one with relation to the other. The second, the triton, and the seventh of a sound, are dissonants with relation to it. Thus the sound CD, CB, or FB, &c. heard at the same time, form a dissonance. The reason which renders dissonances disagreeable is, that the sounds which compose it seem by no means coalescent to the ear, and are heard, each of them by itself, as distinct sounds, though produced at the same time.

PART II. THEORY OF HARMONY.

SECT. I. *Preliminary and Fundamental Experiments.*

EXPERIMENT I.

19. When a sonorous body is struck till it gives a sound, the ear, besides the principal sound and its octave, perceives two other sounds

MUSIC.

sounds very high, of which one is the twelfth above the principal sound, that is to say, the octave to the fifth of that sound; and the other is the seventeenth major above the same sound, that is to say, the double octave of its third major.

20. This experiment is peculiarly sensible upon the thick strings of the violoncello, of which the sound being extremely low, gives to an ear, though not very much practised, an opportunity of distinguishing with sufficient ease and clearness the twelfth and seventeenth now in question. Since the octave above the sound 1 is 2, the octave below that same sound shall be $\frac{1}{2}$; that is to say, that the string which produces this octave shall have performed half its vibration whilst the string which produces the sound 1 shall have completed one. To obtain therefore the octave above any sound, the operator must multiply the quantity which expresses the sound by 2; and to obtain the octave below, he must on the contrary divide the same quantity by 2.

It is for that reason that if any sound whatever, } for instance C, is denominated	1
Its octave above will be	2
Its double octave above	4
Its triple octave above	8
In the same manner its octave will be	$\frac{1}{2}$
Its double octave below	$\frac{1}{4}$
Its triple octave below	$\frac{1}{8}$
And so of the rest.	
Its twelfth above	$\frac{3}{2}$
Its twelfth below	$\frac{2}{3}$
Its seventeenth major above	$\frac{5}{4}$
Its seventeenth major below	$\frac{4}{5}$

The fifth then above the sound 1 being the octave beneath the twelfth, shall be, as we have immediately observed, $\frac{3}{2}$; which signifies that this string performs $\frac{3}{2}$ vibrations, that is to say, one vibration and a half, during a single vibration of the string which gives the sound 1. To obtain the fourth above the sound 1, we must take the twelfth below that sound, and the double octave above that twelfth. In effect, the twelfth below C, for instance, is F, of which the double octave F is the fourth above C. Since then the twelfth below 1 is $\frac{1}{2}$, it follows that the double octave above this twelfth, that is to say, the fourth from the sound 1 in ascending, will be $\frac{1}{2}$ multiplied by 4, or $\frac{2}{1}$. In short, the third major being nothing else but the double octave beneath the seventeenth, it follows, that the third major above the sound 1 will be 5 divided by 4, or in other words $\frac{5}{4}$. The third major of a sound, for instance the third major E, from the sound C, and its fifth G, form between them a third minor E, G; now E is $\frac{3}{2}$, and G $\frac{3}{2}$, by what has been immediately demonstrated: from whence it follows, that the third minor, or the interval between E and G, shall be expressed by the relation of the fraction $\frac{3}{2}$ to the fraction $\frac{3}{2}$.

To determine this relation, it is necessary to remark, that $\frac{3}{2}$ are the same thing with $\frac{12}{8}$, and that $\frac{3}{2}$ are the same thing with $\frac{10}{6}$: so that $\frac{3}{2}$ shall be to $\frac{3}{2}$ in the same relation as $\frac{12}{8}$ to $\frac{10}{6}$; that is to say, in the same relation as 10 to 12, or as 5 to 6. If, then, two sounds form between themselves a third minor, and that the first is represented by 5, the second shall be expressed by 6: or what is the same thing, if the first is represented by 1, the second shall be expressed by $\frac{6}{5}$. Thus the third minor, an harmonic sound which is even found in the protracted and coalescent tones of a sonorous body between the sound E and G, an harmonic of the principal sound, may be expressed by the fraction $\frac{6}{5}$.

One may see by this example, that in order to compare two sounds one with another, which are expressed by fractions, it is necessary first to multiply the numerator of the fraction which expresses the first by the denominator of the fraction which expresses the second, which will give a primary number: as here the numerator 5 of the fraction $\frac{5}{4}$, multiplied by 2 of the fraction $\frac{3}{2}$ has given 10. Afterwards may be multiplied the numerator or the second fraction by the denominator of the first which will give a secondary number, as here 12 is the product of 4 multiplied by 3; and the relation between these two numbers (which in the preceding example are 10 and 12) will express the relation between these two sounds, or, what is the same thing, the interval which there is between the one and the other, in such a manner, that the farther the relation between these sounds departs from unity, the greater the interval will be. Such is the manner in which we may compare two sounds one with another whose numerical value is known. We shall now shew the manner how the numerical expression of a sound may be obtained, when the relation which it ought to have with another sound is known whose numerical expression is given. Let us suppose, for example, that the third major of the fifth $\frac{3}{2}$ is sought. That third major ought to be, by what has been shewn above, the $\frac{5}{4}$ of the fifth; for the third major of any sound whatever is the $\frac{5}{4}$ of that sound. We must then look for a fraction which expresses the $\frac{5}{4}$ of $\frac{3}{2}$; which is done by multiplying the numerators and denominators of both fractions one by the other, from whence results the new fraction $\frac{15}{8}$. It will likewise be found that the fifth of the fifth is $\frac{3}{2}$, because the fifth of the fifth is the $\frac{3}{2}$ of $\frac{3}{2}$. Thus far we have only treated of fifths, fourths, third major and minor, in ascending; now it is extremely easy to find by the same rules the fifths, fourths, thirds major and minor in descending. For suppose C equal to 1, we have seen that its fifth,

its fourth, its third, its major and minor in ascending, are $\frac{3}{2}$, $\frac{4}{3}$, $\frac{5}{3}$, $\frac{6}{5}$. To find its fifth, its fourth, its third major and minor in descending, nothing more is necessary than to reverse these fractions, which will give $\frac{2}{3}$, $\frac{3}{4}$, $\frac{3}{5}$, $\frac{5}{6}$.

21. The principal sound is called the *generator*; and the two other sounds which it produces, and with which it is accompanied, are, inclusive of its octave, called its *harmonics*.

EXPERIMENT II.

22. There is no person insensible of the resemblance which subsists between any sound and its octave, whether above or below. These two sounds, when heard together, almost entirely coalesce in the organ of sensation. We may besides be convinced (by two facts which are extremely simple) of the facility with which one of these sounds may be taken for the other.

Let it be supposed that any person has an inclination to sing a tune, and having at first begun this air upon a pitch too high or too low for his voice, so that he is obliged, lest he should strain himself too much, to sing the tune in question on a key higher or lower than the first; without being initiated in the art of music, he will naturally take this new key in the octave below or the octave above the first; and in order to take this key in any other interval except the octave, he will find it necessary to exert a sensible degree of attention. This is a fact of which we may easily be persuaded by experience. Another instance, Let any person sing a tune in our presence, and let it be sung in a tone too high or too low for our voice; if we wish to join in singing this air, we naturally take the octave below or above, and frequently, in taking this octave, we imagine it to be the unison. It is not then imagined that we change the value of a sound in multiplying or dividing it by 2, by 4, or by 8, &c. the number which expresses these sounds, since by these operations we do nothing but take the simple, double, or triple octave, &c. of the sound in question, and that a sound coalesces with its octave.

SECT. II. The Origin of the Modes Major and Minor; of the most natural Modulation, and the most perfect Harmony.

23. To render our ideas still more precise and permanent, we shall call the tone produced by the sonorous body C: it is evident, by the first experiment, that this sound is always attended by its 12th and 17th major; that is to say, with the octave of G, and the double octave of E.

24. This octave of G then, and this double octave of E, produce the most perfect chord which can be joined with C, since that chord is the work and choice of nature.

25. For the same reason, the modulation formed by C with the octave of G and the double octave of E, sung one after the other, would likewise be the most simple and natural of all modulations which do not descend or ascend directly in the diatonic order, if our voices had sufficient compass to form intervals so great without difficulty; but the ease and freedom with which we can substitute its octave to any sound, when it is more convenient for the voice, afford us the means of representing this modulation.

26. It is on this account that, after having sung the tone C, we naturally modulate the third E, and the fifth G, instead of the double octave of E, and the octave of G; from whence we form, by joining the octave of the sound C, this modulation, C, E, G, C, which, in effect, is the simplest and easiest of them all; and which likewise has its origin even in the protracted and compounded tones produced by a sonorous body.

27. The modulation C, E, G, C, in which the chord C, E, is a third major, constitutes that kind of harmony or melody which we call the *mode major*; from whence it follows, that this new mode results from the immediate operation of nature.

28. In the modulation C, E, G, of which we have now been treating, the sounds E and G are so proportioned one to the other, that the principal sound C (art. 19.) causes both of them to resound; but the second tone E does not cause G to resound, which only forms the interval of a third minor.

29. Let us then imagine, that, instead of this sound E, one should substitute between the sounds C G, another note which (as well as the sound C) has the power of causing G to resound, and which is, however, different from the sound C: the sound which we explore ought to be such, by (art. 19.) that it may have for its 17th major G, or one of the octaves of G; of consequence the sound which we seek ought to be a 17th major below G, or what is the same thing, a third major below the same G. Now the sound E being a third minor beneath G, and the third major being (art. 9.) greater by a semitone than the third minor, it follows, that the sound of which we are in search shall be a semitone beneath the natural E, and consequently Eb.

30. This new arrangement, C, Eb, G, in which the sounds C, and Eb have both the power of causing G to resound, though C does not cause Eb to resound, is not indeed equally perfect with the first arrangement C, E, G; because in this the two sounds E and G are both the one and the other generated by the principal sound C; whereas in the other, the sound Eb is not generated by the sound C: but this arrangement C, Eb, G, is likewise dictated by nature (art. 19.) though less immediately than the former; and accordingly experience evinces that the ear accommodates itself almost as well to the latter as to the former.

31. In this modulation or chord C, Eb, G, C it is evident that the

MUSIC.

the third from Cb to E is minor; and such is the origin of that mode which we call *minor*.

32. The most perfect chords then are. 1. All chords related one to another, as C, E, G, C, consisting of any sound of its third major, of its fifth, and of its octave. 2. All chord related to one another, as C, Eb, G C, consisting of any sound, of its third minor, of its fifth, and of its octave. In effect these two kinds of chords are exhibited by nature; but the first more immediately than the second. The first are called *perfect chords major*, the second *perfect chords minor*.

SECT. III. Of the Series which the Fifth requires, and of the Laws which it observes.

33. Since the sound C, causes the sound G to be heard, and is itself heard in the same sound F, which sounds G and F are its two twelfths, we may imagine a modulation composed of that sound C and its two twelfths, or, which is the same thing (art. 22), of its two-fifths, F and G, the one below, the other above; which gives the modulation or series of fifths F, C, G, which we call the *fundamental bass* of C by fifths.

We shall find in the sequel, that there may be some fundamental basses by thirds, deduced from the two seventeenth, of which the one is an attendant of the principal sound, and of which the other includes that sound. But we must advance step by step, and satisfy ourselves at present to consider immediately the fundamental basses by fifths.

34. Thus, from the sound C, one may make a transition indifferently to the sound G, or to the sound F.

35. One may, for the same reason, continue this kind of fifths in ascending, and in descending, from C, in this manner:

 Eb, Bb, F, C, G, D, A, &c.

And from this series of fifths, one may pass to any sound which immediately precedes or follows it.

36. But it is not allowed in the same manner to pass from one sound to another which is not immediately contiguous to it; for instance, from C to D, or from D to C; for this very simple reason, that the sound D is not contained in the sound C, nor the sound C in that of D; and thus these sounds have not any alliance the one with the other, which may authorise the transition from one to the other.

37. And as these sounds C and D, by the first experiment, naturally bring along with them the perfect chords consisting of greater intervals C, E, G, C, D, F, A, D; hence may be deduced this rule, That two perfect chords, especially if they are major, cannot succeed one another diatonically in a fundamental bass; we mean that in a fundamental bass two sounds cannot be diatonically placed in succession, each of which, with its harmonies, forms a perfect chord, especially if this perfect chord be major in both.

SECT. IV. Of Modes in general.

38. A *mode*, in music, is nothing else but the order of sounds prescribed, as well in harmony as melody, by the series of fifths. Thus the three sounds F, C, G, and the harmonies of each of these three sounds, that is to say, their thirds major and their fifths, compose all the major modes which are proper to C.

39. The series of fifths then, or the fundamental bass F, C, G, of which C holds the middle space, may be regarded as representing the mode of C. One may likewise take the series of fifths, or fundamental bass, C, G, D, as representing the mode of G; in the same manner Bb, F, C, will represent the mode of F. By this we may see, that the mode of G, or rather the fundamental bass of that mode, has two sounds in common with the fundamental bass of the mode of C. It is the same with the fundamental bass of the mode F.

40. The mode of C, (F, C, G,) is called the *principal mode* with respect to the modes of these two fifths, which are called its two *adjuncts*.

41. It is then, in some measure, indifferent to the ear whether a transition be made to the one or to the other of these adjuncts, since each of them has equally two sounds in common with the principal mode. Yet the mode of G seems a little more eligible; for G is heard amongst the harmonies of C, and of consequence is implied and signified by C; whereas C does not cause F to be heard, though C is included in the same sound F. It is hence that the ear, affected by the mode of C, is a little more prepossessed for the mode of G, than for that of F. Nothing likewise is more frequent, nor more natural, than to pass from the mode of C to that of G.

42. It is for this reason, as well as to distinguish the two fifths one from the other, that we call G, the fifth above the generator the *dominant* sound, and the fifth F beneath the generator the *subdominant*.

43. It remains to add, as we have seen in the preceding section, that, in the series of fifths, we may indifferently pass from one sound to that which is contiguous: in the same manner, and for the same reason, one may pass from the mode of G, to the mode of D, after having made a transition from the mode of C to the mode of G, as from the mode of F to the mode of Bb. But it is necessary, however, to observe, that the ear which has been immediately affected with the principal mode feels always a strong propensity to return to it. Thus the further the mode to which we

make a transition is removed from the principal mode; the less time we ought to dwell upon it.

SECT. V. Of Temperament.

44. The alterations which we have observed in the intervals between particular sounds of the diatonic scale, naturally lead us to speak of temperament. To give a clear idea of this, and to render the necessity of it palpable, let us suppose that we have before us an instrument with keys, a harpsichord, for instance, consisting of several octaves or scales, of which each includes its twelve semitones.

Let us choose in that harpsichord one of the strings which will sound the note C, and let us tune the string G to a perfect fifth with C in ascending; let us afterwards tune to a perfect fifth with this, G and D which is above it: we shall evidently perceive that this D will be in the scale above that from which we set out; but it is also evident that this D must have in the scale a D which corresponds with it, and which must be tuned a true octave below D; and between this and G there should be the interval of a fifth; so that the D in the first scale will be a true fourth below the G of the same scale. We may afterwards tune the note A of the first scale to a just fifth with this last D; then the note E in the highest scale to a true fifth with this new A, and of consequence the E in the first scale to a true fourth beneath this same A: having finished this operation, it will be found that the last E, thus tuned, will by no means form a just third major from the sound C; it is impossible for E to constitute at the same time the third major of C, and the true fifth of A; or, what is the same thing, the true fourth of A in descending.

The A considered as the fifth of D is $\frac{3}{2}$, and the fourth beneath this A will constitute $\frac{2}{3}$ of $\frac{3}{2}$, that is to say, $\frac{2}{3} \times \frac{3}{2} = 1$; then shall be the value of E, considered as a true fourth from A in descending: now E, considered as the third major of the sound C, is $\frac{4}{3}$, or $\frac{8}{6}$; these two E's then are between themselves in the proportion of 81 to 80; thus it is impossible that E should be at the same time a perfect third major from C, and a true fourth beneath A.

45. What is still more, if after having successively and alternately tuned the strings C, G, D, A, E, in perfect fifths and fourths one from the other, we continue to tune successively by true fifths and fourths the strings E, B, F*, C*, G*, D*, A*, E*, B*; we shall find, that, though B*, being a semitone higher than the natural note, should be equivalent to C natural, it will by no means form a just octave to the first C in the scale, but be considerably higher; yet this B* upon the harpsichord ought not to be different from the octave above C; for every B* and every C is the same sound, since the octave or the scale only consists of twelve semitones.

46. From thence it necessarily follows, 1. That it is impossible that all the octaves and all the fifths should be just, at the same time, particularly in instruments which have keys, where no intervals less than a semitone are admitted. 2. That, of consequence, if the fifths are justly tuned, some alteration must be made in the octaves; now the sympathy of sound which subsists between any note and its octave, does not permit us to make such an alteration: this perfect coalescence of sound is the cause why the octave should serve as limits to the other intervals, and that all the notes which rise above or fall below the ordinary scale, are no more than repetitions, i. e. repetitions, of all that have gone before them. For this reason, if the octave were altered, there could be no longer any fixed point either in harmony or melody. It is then absolutely necessary to tune the C, or B* in a just octave with the first; from whence it follows, that in the progression of fifths, or, what is the same thing in the alternate series of fifths and fourths, C, G, D, A, E, B*, F, C*, G*, D*, A*, E*, B*, it is necessary that all the fifths should be altered, or at least some of them. Now, since there is no reason why one should rather be altered than another, it follows, that we ought to alter them all equally. By these means, as the alteration is made to influence all the fifths, it will be in each of them almost imperceptible; and thus the fifth, which, after the octave, is the most perfect of all consonances, and which we are under a necessity of altering, must only be altered in the least degree possible.

47. It is true, that the thirds will be a little harsh: but as the interval of sounds which constitutes the third, produces a less perfect coalescence than that of the fifth, it is necessary, says M. Rameau, to sacrifice the justice of that chord to the perfection of the fifth; for the more perfect a chord is in its own nature, the more displeasing to the ear is any alteration which can be made in it. In the octave the least alteration is insupportable.

48. This change in the intervals of instruments, which have, or even which have not, keys, is that which we call *temperament*.

49. It results then from all that we have now said, that the theory of temperament may be reduced to this question. The alternate succession of fifths and fourths having been given, G, D, A, E, B, F*, C*, G*, D*, A*, E*, B*, in which F*, or C is not the true octave of the first C, it is proposed to alter all the fifths equally, in such a manner that the two C's may be in a perfect octave the one to the other.

50. For a solution of this question, we must begin with tuning the two C's in a perfect octave the one to the other; in consequence of

MUSIC.

of which, we will render all the semitones which compose the octave as equal as possible. By this means the alteration made in each fifth will be very inconsiderable, but equal in all of them.

51. In this, then, the theory of temperament consists: but as it would be difficult in practice to tune a harpsichord or organ by thus rendering all the semitones equal, M. Rameau, in his *Generation Harmonique*, has furnished us with the following method to alter all the fifths as equally as possible.

52. Take any key of the harpsichord which you please, but let it be towards the middle of the instrument; for instance, C: then tune the note G a fifth above it, at first with as much accuracy as possible; this you may imperceptibly diminish: tune afterwards the fifth to this with equal accuracy, and diminish it in the same manner; and thus proceed from one fifth to another in ascent: and as the ear does not appreciate so exactly sounds that are extremely sharp, it is necessary, when by fifths you have risen to notes extremely high, that you should tune in the most perfect manner the octave below the last fifth which you had immediately formed: then you may continue always in the same manner; till in this process you arrive at the last fifth from E* to B*, which should of themselves be in tune; that is to say, they ought to be in such a state that B* the highest note of the two which compose the fifth, may be identical with the sound C, with which you began, or at least the octave of that sound perfectly just: it will be necessary then to try if this C, or its octave, forms a just fifth with the last sound E* or F which has been already tuned. If this be the case, we may be certain that the harpsichord is properly tuned. But if this last fifth be not true, in this case it will be too sharp, and it is an indication that the other fifths have been too much diminished, or at least some of them; or it will be too flat, and consequently discover that they have not been sufficiently diminished. We must then begin and proceed as formerly, till we find the last fifth in tune of itself, and without our immediate interpolation.

All that remains, is to acknowledge, with M. Rameau, that this temperament is far remote from that which is now in practice; you may here see in what this last temperament consists, as applied to the organ or harpsichord. They begin with C in the middle of the keys, and they flatten the four first fifths G, D, A, E, till they form a true third major from E to C: afterwards, setting out from this E, they tune the fifths B, F*, C*, G*, but flattening them still less than the former, so that G* may almost form a true third major with E. When they have arrived at G*, they stop; they resume the first C, and tune to it the fifth F in descending, then the fifth Bb, &c. and they heighten a little all the fifths till they have arrived at Ab, which ought to be the same with the G* already tuned. If in the temperament commonly practised, some thirds are found to be less altered than in that prescribed by M. Rameau, in return, the fifths in the first temperament are much more false, and many thirds are likewise so; inasmuch, that upon a harpsichord tuned according to the temperament in common use, there are five or six modes which the ear cannot endure, and in which it is impossible to execute any thing. On the contrary, in the temperament suggested by M. Rameau, all the modes are equally perfect: which is a new argument in its favour, since the temperament is peculiarly necessary in passing from one mode to another, without shocking the ear; for instance, from the mode of C to that of G, from the mode of G to that of D, &c. It is true, that this uniformity of modulation will, to the greatest number of musicians, appear a defect; for they imagine, that by tuning the semitones of the scale unequal, they give each of the modes a peculiar character; so that, according to them, the scale of C,

C, D, E, F, G, A, B, C,

is not perfectly similar to the gammut of the mode of E,

E, F*, G*, A*, B, C*, D*, E,

which in their judgment, renders the mode of C and E proper for different manners of expression. But after all that we have said in this system, on the formation of diatonic intervals, every one should be convinced, that, according to the intention of nature, the diatonic scale ought to be perfectly the same in all its modes: the contrary opinion, says M. Rameau, is a mere prejudice of musicians. The character of an air arises chiefly from the intermixture of the modes; from the greater or lesser degree of vivacity in the movement; from the tones, more or less grave, or more or less acute, which are assigned to the generator of the mode; and from the chords more or less beautiful, as they are more or less deep, more or less flat, more or less sharp, which are found in it. In short, the last advantage of this temperament is, that it will be found conformable, or at least very little different from that which they practise upon instruments without keys; as the bass-viol, the violin, in which true fifths and fourths are preferred to thirds and sixths tuned with equal accuracy; a temperament which appears incompatible with that commonly used in tuning the harpsichord.

By this method all the twelve sounds which compose one of the scales shall be tuned: nothing is necessary but to tune with the greatest possible exactness their octaves in the other scales, and the harpsichord shall be well tuned. We have given this rule for temperament, from M. Rameau; and it belongs only to disinherited artists to judge of it. However this question be determined, and whatever kind of temperament may be received, the alterations

which it produces in harmony will be but very small, or not perceptible to the ear, whose attention is entirely engrossed in attuning itself with the fundamental bass, and which suffers without uneasiness, these alterations, or rather takes no notice of them, because it supplies from itself what may be wanting to the truth and perfection of the intervals.

Simple and daily experiments confirm what we now advance. Listen to a voice which is accompanied in singing by different instruments; though the temperament of the voice, and the temperaments of each of the instruments, are all different one from another, yet you will not be in the least affected with the kind of cacophony which ought to result from these diversities, because the ear supposes these intervals true of which it does not appreciate the differences. We may give another experiment. Strike upon an organ the three keys E, G, B, you will hear nothing but the minor perfect chord; though E, by the construction of that instrument, must cause G*, likewise to be heard; though G should have the same effect upon D, and B upon F*; inasmuch, that the ear is at once affected with all these sounds, D, E, F*, G, G*, B; how many dissonances perceived at the same time, and what a jarring multitude of discordant sensations, would result from thence to the ear, if the perfect chord with which it is pre-occupied had not the power entirely to abstract its attention from such sounds as might offend!

SECT. VI. Of Repose or Cadences.

[That the reader may have a clear idea of the term before he enters upon the subject of this section, it may be necessary to caution him against a mistake into which he may be too easily led, by the ordinary signification of the word *repose*. In music, therefore, it is far from being synonymous with the word *rest*. It is, on the contrary, the termination of a musical phrase which ends in a cadence more or less emphatic, as the sentiment implied in the phrase is more or less complete. Thus a repose in music answers the same purpose as punctuation in language. See REPOS in Rousseau's Musical Dictionary.]

53. In a fundamental bass, whose procedure is by fifths, there always is, or always may be, a *repose*, or crisis, in which the mind acquiesces in its transition from one sound to another: but a repose may be more or less distinctly signified, and of consequence more or less perfect. If one should rise by fifths; if for instance, we pass from C to G; it is the generator which passes to one of these fifths, and this fifth was already pre-existent in its generator: but the generator exists no longer in this fifth: and the ear, as this generator is the principle of all harmony, and of all melody, feels a desire to return to it. Thus the transition from a sound to its fifth in ascent, is termed an *imperfect repose*, or *imperfect cadence*, but the transition from any sound to its fifth in descent is denominated a *perfect cadence*, or an *absolute repose*: it is the offspring, which returns to its generator, and as it were, recovers its existence once more in that generator itself, with which when sounding it resounds (sect. 1.)

54. Amongst absolute repeses, there are some, if we may be allowed the expression, more absolute, that is to say, more perfect than others. Thus, in the fundamental bass,

C, G, C, F, C, G, D, G, C,

which forms, as we have seen, the diatonic scale of the moderns, there is an absolute repose from D to G, as from G to C: yet this last absolute repose is more perfect than the preceding, because the ear, prepossessed with the mode of C by the multiplied impression of the sound C which it has already heard thrice before, feels a desire to return to the generator C; and it accordingly does so, by the absolute repose G C.

55. We may still add, that what is commonly called *cadence*, in melody, ought not to be confounded with what we name *cadence* in harmony. In the first case this word only signifies an agreeable and rapid alternation between two contiguous sounds, called likewise a *trill* or *shake*; in the second, it signifies a repose or clofe. It is however true, that this shake implies, or at least frequently enough prefaces, a repose, either present or impending, in the fundamental bass. M. Rousseau, in his letter on French music, has called this alternate undulation of different sounds, a *trill*, from the Italian word *trillo*, which signifies the same thing; and some French musicians already appear to have adopted this expression.

56. Since there is a repose in passing from one sound to another in the fundamental bass, there is also a repose in passing from one note to the other in the diatonic scale, which is formed from it, and which this bass represents: and as the absolute repose G C, is of all others the most perfect in the fundamental bass, the repose from B to C, which answers to it in the scale, and which is likewise terminated by the generator, is for that reason the most perfect of all others in the diatonic scale ascending.

57. It is then a law dictated by nature itself, that if you would ascend diatonically to the generator of a mode, you can only do this by means of the third major from the fifth of that very generator. This third major, which with the generator forms a semitone, has for that reason been called the *sensible note*, as introducing the generator, and preparing us for the most perfect repose. We have already proved, that the fundamental bass is the principle of melody. We shall besides make it appear in the sequel, that the effect of a repose in melody arises solely from the fundamental bass.

MUSIC.

SECT. VII. The Minor Mode and its Diatonic Series.

58. In the second section, we have explained (art. 29. 30. 31. and 32) by what means, and upon what principle the minor chord C, E $\flat$, D, C, may be formed; which is the characteristic chord of the minor mode. Now what we have there said, taking C for the principal and fundamental sound, we might likewise have said of any other note in the scale, assumed in the same manner as the principal and fundamental sound; but as in the minor chord C, E $\flat$, G, C, there occurs an E $\flat$ which is not found in the ordinary diatonic scale, we shall immediately substitute, for greater ease and convenience, another chord, which is likewise minor, and exactly similar to the former, of which all the notes are found in the scale.

59. The scale affords us three chords of this kind, viz. D, F, A, D, A, C, E, A, and E, G, B, E. Amongst these three we shall choose A, C, E, A; because this chord, without including any sharp or flat, has two sounds in common with the major chord, C, E, G, C. And besides, one of these two sounds is the very same C: so that this chord appears to have the most immediate, and at the same time the most simple, relation with the chord C, E, G, C. Concerning this we need only add, that the preference of the chord A, C, E, A, to every other minor chord, is by no means in itself necessary for what we have to say in this section, upon the diatonic scale of the minor mode. We might in the same manner have chosen any other minor chord; and it is only, as we have said, for greater ease and convenience, that we fix upon this.

60. Let us now remark, that in every mode, whether major or minor, the *principal* sound which implies the perfect chord, whether major or minor, may be called the *tonic note* or *key*; thus C is the key in its proper mode, A in the mode of A, &c. Having laid down this principle,

61. We have shewn how the three sounds, F, C, G, which constitute (art. 38) the mode of C, of which the first F and the last G are the two fifth of C; one descending the other rising, produce the scale B, C, D, E, F, G, A, of the major mode, by means of the fundamental bass G, C, G, C, F, C, F: let us in the same manner take the three sounds D, A, E, which constitute the mode of A, for the same reason that the sounds F, C, G, constitute the mode of C; and of them let us form this fundamental bass perfectly like the preceding, E, A, E, A, D, A, D: let us afterwards place below each of these sounds one of their harmonics, as we have done for the first scale of the major mode; with this difference, that we must suppose D and A as implying their thirds minor in the fundamental bass to characterise their minor mode; and we shall have the diatonic scale of that mode.

G $\sharp$, A, B, C, D, E, F.

62. The G $\sharp$ which corresponds with E in the fundamental bass, forms a third major with that E, though the mode be minor; for the same reason that a third from the fifth of the fundamental sound ought to be major (art. 57.) when that third rises to the fundamental sound A.

63. It is true, that, in causing E to imply its third major G, one might also rise to A by a diatonic progress. But that manner of rising to A would be less perfect than the preceding; for this reason (art. 56.) that the absolute repose, or perfect cadence E, A, which is found in the fundamental bass, ought to be represented in the most perfect manner in the two notes of the diatonic scale which answer to it, especially when one of these two notes is A, the key itself upon which the repose is made. From whence it follows, that the preceding note G ought rather to be sharp than natural; because G $\sharp$, being included in E (art. 19.) much more perfectly represents the note E in the bass, than the natural note G could do, which is not included in E.

64. We may remark this first difference between the scale G $\sharp$, A, B, C, D, E, F, and the scale which corresponds with it in the major mode B, C, D, E, F, G, A,

that from E to F, which are the two last notes of the former scale, there is only a semitone; whereas from G to A, which are the two last sounds of the latter series, there is the interval of a complete tone: but this is not the only discrimination which may be found between the scales of the two modes.

65. To investigate these differences, and to discover the reason for which they happen, we shall begin by forming a new diatonic scale of the minor mode, similar to the second scale of the major mode, C, D, E, F, G, A, B, C.

That last series, as we have seen, was formed by means of the fundamental bass F, C, G, D, disposed in this manner, C, C, F, C, G, D, G, C.

Let us take in the same manner the fundamental bass D, A, E, B, and arrange it in the following order,

A, E, A, D, A, E, B, E, A,

and it will produce the scale immediately subjoined,

A, B, C, D, E, E, F $\sharp$, G $\sharp$, A,

in which C forms a third minor with A, which in the fundamental bass corresponds with it, which denominates the minor mode: and on the contrary G $\sharp$ forms a third major with E in the fundamental bass, because G $\sharp$ rises towards A, (art. 62 and 63.)

66. We see besides an F $\sharp$ which does not occur in the former, G $\sharp$, A, B, C, D, E, F,

where F is natural. It is because, in the first scale, F is a third minor from D in the bass; and in the second, F $\sharp$ is the fifth from B in the bass.

67. Thus the two scales of the minor mode are still in this respect more different one from the other than the two scales of the major mode; for we do not remark this difference of a semitone between the two scales of the major mode. We have only observed some difference in the value of A as it stands in each of these scales, but this amounts to much less than a semitone.

68. From thence it may be seen why F and G are sharp, when ascending in the minor mode; nay, besides, the F is only natural in the first scale, G $\sharp$, A, C, D, E, F, because this F cannot rise to G $\sharp$.

69. It is not the same case in descending. For E, the fifth of the generator, ought not to imply the third major G $\sharp$, but in the case when that E descends to the generator A to form a perfect repose, (art. 57. and 63.); and in this case the third major G $\sharp$ rises to the generator A: but the fundamental bass A E may, in descending, give the scale A G natural, provided G does not rise towards A.

70. It is much more difficult to explain how the F, which ought to follow this G in descending, is natural and not sharp; for the fundamental bass

A, E, B, E, A, D, A, E, A,

produces in descending,

A, G, F $\sharp$, E, E, D, C, B, A.

And it is plain that the F cannot be otherwise than sharp, since F $\sharp$ is the fifth of the note B of the fundamental bass. In the mean time, experience evinces that the F is natural in descending in the diatonic scale of the major mode of A, especially when the preceding G is natural; and it must be acknowledged, that here the fundamental bass appears in some measure defective. M. Rameau has invented the following means for obtaining a solution of this difficulty. According to him, in the diatonic scale of the minor mode in descending, A, G, F, E, D, C, B, A, G, may be regarded simply as a note of passage; merely added to give sweetness to the modulation, and as a diatonic gradation by which we may descend to F natural. It is easily perceived, according to M. Rameau, by this fundamental bass,

A, D, A, D, A, E, A,

which produces

A, F, E, D, C, B, A;

which may be regarded, as he says, as the real scale of the minor mode in descending; to which is added G natural between A and F, to preserve the diatonic order. This answer appears the only one which can be given to the difficulty above proposed: but we know not whether it will fully satisfy the reader; whether he will not see with regret, that the fundamental bass does not produce, to speak properly, the diatonic scale of the minor mode in descent, when at the same time this same bass so happily produces the diatonic scale of that identical mode in ascending, and the diatonic scale of the major mode whether in rising or descending.

From what remains when G is said to be natural in descending the diatonic scale of the minor mode of A, this only signifies, that this G is not necessarily sharp in descending as it is in rising; for this G, besides, may be sharp in descending to the minor mode of A, as may be proved by numberless examples, of which all musical composers are full. It is true, that when the sound G is found sharp in descending to the minor mode of A, still we are not sure that the mode is minor till the F or C naturally is found; both of which impress a peculiar character on the minor mode, viz. C natural, in rising and in descending, and the F natural in descending.

SECT. VIII. Relative Modes.

71. Two modes, which are of such a nature that we can pass from the one to the other, are called *relative modes*. Thus we have already seen that the major mode of C is relative to the major mode of F and to that of G. It may likewise appear from what goes before, how many intimate connections there are between the *species*, or major mode of C, and the *species*, or minor mode of A. For, 1. The perfect chords, one major C E G C, the other minor A C E A, which characterise each of those two kinds of modulation or harmony, have two sounds in common, C or E. 2. The diatonic scale of the minor mode of A in descent, absolutely contains the same sounds with the gamut or diatonic scale of the major mode of C. It is for this reason that the transition is so natural and easy from the major mode of C to the minor mode of A, or from the minor mode of A to the major mode of C, as experience proves.

72. In the minor mode of E, the minor perfect chord E G B E, which characterises it, has likewise two sounds, E, G in common with the perfect chord major C E G C, which characterises the major mode of C. But the minor mode of E is not so closely related, nor allied to the major mode of C as to the minor mode of A; because the diatonic scale of the minor mode of E in descent has not, like the series of the minor mode of A, all these sounds in common with the scale of C. In reality, this scale is E D C B A G F $\sharp$ E, where there occurs an F sharp which is not in the scale of C. We may add, that though the minor mode of E is less relative to the major mode of C than that of A; yet the artist does not hesitate sometimes to pass immediately from the one to the other. We

MUSIC.

We may see besides, that when we pass from one mode to another by the interval of a third, whether in descending or rising, as from C to A, or from A to C, from C to E, or from E to C, the major mode becomes minor, or the minor mode becomes major.

73. There is still another minor mode, into which an immediate transition may be made in issuing from the major mode of C. It is the minor mode of C itself in which the perfect minor chord C E^b G C has two sounds, C and G, in common with the perfect major chord C E G C. Nor is there any thing more common than a transition from the major mode of C to the minor mode, or from the minor to the major.

SECT. IX. Of Dissonance.

74. We have already observed, that the mode of C (F, C, G,) has two sounds in common with the mode of G, (C, G, D); and two sounds in common with the mode of F (B^b, F, C); of consequence this procedure of the bass C G, may belong to the mode of C or to the mode of G, as the procedure of the bass F C, or C F, may belong to the mode of C or the mode of F. When any one therefore passes from C to F or to G in a fundamental bass, he is still ignorant even to that crisis what mode he is in. It would be however advantageous to know it, and to be able by some means to distinguish the generator from its fifths.

75. This advantage may be obtained by uniting at the same time the sounds G and F in the same harmony, that is to say, by joining to the harmony G B D of the fifth G, the other fifth F in this manner, G, B, D, F; this F which is added, forms a dissonance with G (art. 18.) It is for that reason that the chord G B D F, is called a dissonant chord, or a chord of the seventh. It serves to distinguish the fifth G from the generator C, which always implies without mixture or alteration, the perfect chord C, E, G, C, resulting from nature itself. (art. 32.) By this we may see, that when we pass from C to G, one passes at the same time from C to F, because F is found to be comprehended in the chord of G; and the mode of C by these means plainly appears to be determined, because there is none but that mode to which the sounds F and G at once belong.

76. Let us now see what may be added to the harmony F, A, C, of the fifth F below the generator, to distinguish this harmony from that of the generator. It seems probable at first, that we should add to it the other fifth G, so that the generator C, in passing to F, may at the same time pass to G, and that by this the mode should be determined; but this introduction of G, in the chord F, A, C, would produce two seconds in succession F, G, G, A, that is to say, two dissonances whose union would prove extremely harsh to the ear; an inconvenience which ought carefully to be avoided. For if, to distinguish the mode, we should alter the harmony of the fifth F in the fundamental bass, it must only be altered in the least degree possible.

77. For this reason, instead of G, we shall take its fifth D, which is the sound that approaches it the nearest; and we shall have, instead of the fifth F, the chord F, A, C, D, which is called a chord of the great sixth. We may here remark the analogy there is observed between the harmony of the fifth G, and that of the fifth F.

78. The fifth G, in rising above the generator gives a chord entirely consisting of thirds ascending from G, G, B, D, F; now the fifth F being below the generator C in descending, we shall find, as we go lower by thirds from C towards F, the same sounds C, A, F, D, which from the chord F, A, C, D, given to the fifth F.

79. It appears besides, that the alteration of the harmony in the two fifths consist only in the third minor D, F, which was reciprocally added to the harmony of these two fifths.

SECT. X. The Chromatic Species.

80. The series or fundamental bass by fifths produces the diatonic species in common use; now the third major being one of the harmonics of fundamental sound as well as the fifth, it follows, that we may form a fundamental basses by thirds major, as we have already formed fundamental basses by fifths.

81. If then we should form this bass C, E, G[♯], the two first sounds carrying each along with it their thirds major and fifths, it is evident that C will give G, and that E will give G[♯]; now the semitone which is between this G and this G[♯] is an interval much less than the semitone which is found in the diatonic scale between E and F, or between B and C. This may be ascertained by calculation; it is for this reason that the semitone from E to F, is called *major*, and the other *minor*.

82. If the fundamental bass should proceed by thirds minor in this manner, C, E^b, a succession which is allowed when we have investigated the origin of the minor mode (sect. 7), we shall find this modulation G, G^b, which would likewise give a minor semitone.

83. The minor semitone is hit by young practitioners in intonation with more difficulty than the semitone major. For which this reason may be assigned: the semitone major which is found in the diatonic scale, as from E to F, results from a fundamental bass by fifths C F, that is to say, by a succession which is most natural, and for this reason the easiest to the ear. On the contrary, the minor semitone arises from a succession by thirds, which is still less natural than the former. Hence, that scholars may truly hit the minor semitone, the following artifice is employed. Let

us suppose, for instance that they intend to rise from G to G[♯]; they rise at first from G to A, then descend from A to G[♯] by the interval of a semitone major; for this G sharp, which is a semitone major below A, proves a semitone minor above G.

84. Every procedure of the fundamental bass by thirds, whether major or minor, rising or descending, gives the minor semitone. This we have already seen from the succession of thirds in ascending. The series of thirds minor in descending C, A, gives C, C[♯]; and the series of thirds major in descending, C, A^b, gives C, C^b.

85. The minor semitone constitutes the species called *chromatic*; and with the species which moves by diatonic intervals, resulting from the succession of fifths, it comprehends the whole of melody.

SECT. XI. The Enharmonic Species.

86. The two extremes, or highest and lowest notes, C G[♯], of the fundamental bass by thirds major, C E G[♯], give this modulation C B[♯]; and these two sounds C, B[♯], differ between themselves by a small interval, which is called the *diefis*, or *enharmonic fourth of a tone*, which is the difference between a semitone major and a semitone minor. This quarter tone is inappreciable by the ear, and impracticable upon several of our instruments. Yet have means been found to put it in practice in the following manner, or rather to perform what will have the same effect upon the ear.

87. We have explained in what manner the chord G[♯] B D F, may be introduced into the minor mode, entirely consisting of thirds minor perfectly true, or at least supposed such. This chord supplying the place of the chord of the dominant (art. 88.) from thence we may pass to that of the tonic or generator A. But we must remark,

1. That this chord G[♯] B D F, entirely consisting of thirds minor, may be inverted or modified according to three following arrangements, B D F G[♯], D F G[♯] B, F G[♯] B D: and that in all these three different states, it will still remain composed of thirds minor; or at least there will only be wanting the enharmonic fourth of a tone to render the third minor between F and G[♯] entirely just; for a true third minor, as that from E to G in the diatonic scale, is composed of a semitone and a tone both major. Now from F to G there is a tone major, and from G to G[♯] there is only a minor semitone. There is then wanting (art. 86.) the enharmonic fourth of a tone to render the third F G[♯] exactly true. 2. But as this division of a tone cannot be found in the gradations of any scale practicable upon most of our instruments, nor be appreciated by the ear, the ear takes the different chords.

B	D	F	G [♯]
D	F	G [♯]	B
F	G [♯]	B	D

which are absolutely the same, for chords composed every one of thirds minor exactly just. Now the chord G[♯] B D F, belonging to the minor mode of A, where G[♯] is the sensible note; the chord B D F G[♯] or B D F A^b, will, for the same reason, belong to the minor mode of C, where B is the sensible note. In like manner the chord D F G[♯] B or B D F A^b C^b, will belong to the minor mode of E^b and the chord F G[♯] B D, or F A^b C^b E^b, to the minor mode of G^b. After having passed then by the mode of A to the chord G[♯] B D F one may, by means of this last chord, and by merely satisfying ourselves to invert it, afterwards pass all at once to the modes of C minor, of E^b minor, or of G^b minor; that is to say, into the modes which have nothing, or almost nothing, in common with the minor mode of A, and which are entirely foreign to it.

89. It must, however, be acknowledged, that a transition so abrupt, and so little expected, cannot deceive nor elude the ear; it is struck with a sensation so unlooked for, without being able to account for the passage to itself. And this account has its foundation in the harmonic fourth of a tone, which is overlooked as nothing, because it is inappreciable by the ear; but of which, though its value is not ascertained, the whole harshness is sensibly perceived. The instant of surprise, however, immediately vanishes; and that astonishment is turned into admiration, when one feels himself transported as it were all at once, and almost imperceptibly, from one mode to another, which is by no means relative to it, and to which he never could have immediately passed by the ordinary series of fundamental notes.

SECT. XII. The Diatonic Enharmonic Species.

90. If we form a fundamental bass, which rises alternately by fifths and thirds, as F, C, E, B, this bass will give the following modulation, F, E, E, D[♯]; in which the semitones from F to E, and from E to D[♯], are equal and major. This species of modulation or harmony, in which all the semitones are major, is called the *enharmonic diatonic species*. The major semitones peculiar to this species give it the name of *diatonic*, because major semitones belong to the diatonic species; and the tones which are greater than major by the excess of a fourth, resulting from a succession of major semitones give it the name of *enharmonic*.

SECT. XIII. The Chromatic Enharmonic Species.

91. If we pass alternately from a third minor in descending to a third major in rising, as C, C, A C[♯] C[♯], we shall form this modulation, E^b, E, E, E, E[♯], in which all the semitones are minor. This species is called the *chromatic enharmonic species*; the minor semitones peculiar to this kind give it the name of *chromatic*.

MUSIC.

matic, because minor semitones belong to the chromatic species; and the semitones which are lesser by the diminution of a fourth resulting from a succession of minor semitones, give it the name of *enharmonic*.

92. These new species confirm what we have all along said, that the whole effects of harmony and melody reside in the fundamental bass.

93. The diatonic species is the most agreeable, because the fundamental bass which produces it is formed from a succession of fifths alone, which is the most natural of all others.

94. The chromatic being formed from a succession of thirds, is the most natural after the preceding.

95. Finally, the enharmonic is the least agreeable of all, because the fundamental bass which gives it is not immediately indicated by nature. The fourth of a tone which constitutes this species, and which is itself inappreciable to the ear, neither produces nor can produce its effect, but in proportion as imagination suggests the fundamental bass from whence it results; a bass whose procedure is not agreeable to nature, since it is formed of two sounds which are not contiguous one to the other in the series of thirds (art. 86.)

SECT. XIV. *Shewing that Melody is the Offspring of Harmony.*

96. All that we have hitherto said, as it seems to us, is more than sufficient to convince us, that melody has its original principle in harmony, and that it is in harmony, expressed or understood, that we ought to look for the effects of melody.

97. If this should still appear doubtful, nothing more is necessary than to pay due attention to the first experiment (art. 19.) where it may be seen that the principal sound is always the lowest, and that the sharper sounds which it generates, are, with relation to it, what the treble of an air is to its bass.

98. Yet more, the diversification of basses produces effects totally different in a modulation which, in other respects, remains the same.

99. Can it be still necessary to adduce more convincing proofs? We have nothing to do but examine the different basses which may be given to this very simple modulation G C; of which it will be found susceptible of a great many, and each of these basses will give a different character to the modulation G C; though in itself it always remains the same, in such a manner that we may change the whole nature and effects of a modulation, without any other alteration except that of changing its fundamental bass.

M. Rameau has shewn, in his *System of Music*, printed at Paris, 1726, p. 44. that this modulation G C is susceptible of 20 different fundamental basses. Now the same fundamental bass, as may be seen in our Second Part, will afford several continued or thorough basses. How many means, of consequence, may be practised to vary the expression of the same modulation?

100. From these different observations it may be concluded, 1. That an agreeable melody, naturally implies a bass extremely sweet, and adapted for fingering; and that reciprocally, as musicians express it, a bass of this kind generally prognosticates an agreeable melody.

2. That the character of a just harmony is only to form in some measure one system with the modulation, so that from the whole taken together the ear may only receive, if we may speak so, one simple and indivisible impression.

3. That the character of the same modulation may be diversified, according to the character of the bass which is joined with it. But notwithstanding the dependency of melody upon harmony, and the sensible influence which the latter may exert upon the former; we must not conclude, with some celebrated musicians, that the effects of harmony are preferable to those of melody. Experience proves the contrary. [See, on this account, what is written on the licence of music, printed in tom. iv. of D'Alembert's *Mélanges de Littérature*, p. 448].

GENERAL REMARK.

The diatonic scale or gammut being composed of twelve semitones, it is clear that each of these semitones, taken by itself, may be the generator of a mode; and that thus there must be twenty-four modes in all, twelve major and twelve minor. We have assumed the major mode of C, to represent all the major modes in general, and the minor mode of A to represent the modes minor, to avoid the difficulties arising from sharps and flats, of which we must have encountered either a greater or lesser number in the other modes. But the rules we have given for each mode are general, whatever note of the gammut be taken for the generator of a mode.

PART III.

PRINCIPLES AND RULES OF COMPOSITION.

101. Composition, which is likewise called *counterpoint*, is not only the art of composing an agreeable air, but also that of composing a great many airs, in such a manner, that when heard at the same time, they may unite in producing an effect agreeable and delightful to the ear; this is what we call *composing music in several parts*. The highest of these parts is called the *treble*, the lowest is termed the *bass*; the other parts, when there are any, are termed *middle parts*; and each in particular is signified by a different name.

SECT. I. *Of the Different Names given to the same Interval.*

102. In the Introduction (art. 9.) which is at the front of this System, we have seen a detail of the most common names which are given to the different intervals. But there are particular inter-

vals which have obtained different names, according to particular circumstances; which it is proper to explain.

103. An interval composed of a tone and a semitone, which is commonly called a *third minor*, is likewise sometimes called a *second redundant*; such is the interval from C to D $\sharp$ in ascending, or that of A to G $\flat$ descending. This interval is so termed, because one of the sounds which form it, is always either sharp or flat, and that, if you deduct that sharp or that flat, the interval will be that of a second.

104. An interval composed of two tones and two semitones, as that from B to F, is called a *false fifth*. This interval is the same with the *triton* (art. 9.) since two tones and two semitones are equivalent to three tones. There are, however, some reasons for distinguishing them, as will appear below.

105. As the interval from C to D $\sharp$ in ascending has been called a *second redundant*, they likewise call the interval from C to D $\sharp$ in ascending a *fifth redundant*, or from B to E $\sharp$ in descending each of which intervals are composed of four tones. This interval is, in the main, the same with that of the sixth minor (art. 9.); but in the fifth redundant there is always a sharp or a flat; inasmuch, that if this sharp or flat were deducted, the interval would become a true fifth.

106. For the same reason, an interval composed of three tones and three semitones, as from G $\sharp$ to F in ascending, is called a *seventh diminished*; because, if you deduct the sharp from G, the interval from G to F will become that of an ordinary seventh. The interval of a seventh diminished is in other respects the same with that of the sixth major (art. 9.).

107. The major seventh is likewise sometimes called a *seventh redundant*.

SECT. II. *Comparison of the Different Intervals.*

108. If we sing C B in descending by a second, and afterwards C B in ascending by a seventh, these two B's shall be octaves one to the other; or, as we commonly express it they will be *replications* one of the other.

109. On account then of the resemblance between every sound and its octave (art. 22.) it follows, that *to rise by a seventh, or descend by a second*, amount to one and the same thing.

110. In like manner it is evident that the sixth is nothing but a replication of the third, nor the fourth but a replication of the fifth.

111. The following expressions either are, or ought to be, regarded as synonymous.

To rise	by a second.	To descend	by a seventh
To descend		To rise	
To rise	by a third	To descend	by a sixth
To descend		To rise	
To rise	by a fourth	To descend	by a fifth
To descend		To rise	

112. Thus, therefore, we shall employ them indifferently the one for the other; so that when we say, for instance, *to rise by a third*, it may be said with equal propriety *to descend by a sixth*, &c.

SECT. III. *Of the different Cleffs: of the Value or Quantity; of the Rhythm; and of Syncopation.*

113. There are three cleffs in music: for the representation of which, see the Plate on the Principles of the Science.

The cleff of F is placed on the fourth line, or on the third; and the line upon which this cleff is placed gives the names of F to all the notes which are upon that line. The cleff of C is placed upon the fourth, the third, the second, or the first line: and in these different positions all the notes upon that line where the cleff is placed take the name of C. Lastly the cleff of G is placed upon the second or first line; and all the notes upon that line where the cleff is placed take the name of G.

114. As the notes are placed on the lines, and in the spaces between the lines, any one, when he sees the cleff, may easily find the name of any note whatever. Thus he may see, that in the first cleff of F, the note which is placed on the lowest line ought to be G; that the note which occupies the space between the two first lines should be A; and that the note which is on the second line is a B, &c.

115. A note before which there is a sharp (marked thus $\sharp$) ought to be raised by a semitone: and if, on the contrary, there is a $\flat$ before it, it ought to be depressed by a semitone, (b being the mark of a flat.) The natural (marked thus $\natural$) restores to its natural value a note which had been raised or depressed by a semitone.

116. When you place at the cleff a sharp or a flat, all the notes upon the line on which this sharp or flat is marked are sharp or flat. Thus let us take, for instance, the cleff of C upon the first line, and let us place a sharp in the space between the second and third line, which is the place of F; all the notes which shall be marked in that space will be F $\sharp$; and if you would restore them to their original value of F natural, you must place a $\flat$ or a b before them. In the same manner, if a flat be marked at the cleff, and if you would restore the note to its natural state, you must place a $\sharp$ or a $\natural$ before it.

117. Every piece of music is divided into different equal times, which

MUSIC.

which they call *measures* or *bars*; and each bar is likewise divided into different times. There are properly two kinds of measures or modes, of time, the measure of two times, or of common time, which is marked by the figure 2 placed at the beginning of the tune; and the measure of three times, or of triple time, which is marked by the figure 3 placed in the same manner. The different bars are distinguished by perpendicular lines.

118. The longest of all notes is a semibreve. A minim is half its value; that is to say, in singing, we only employ the same duration in performing two minims which was occupied in one semibreve. A minim, in the same manner, is equivalent to two crotchets, the crotchet to two quavers, &c.

119. A note which is divided into two parts by a time, that is to say, which begins at the end of a time, and terminates in the time following, is called a *syncopated note* (where the notes C, B, and A, are each of them syncopated.)

120. A note followed by a point or dot is increased half its value.

SECT. IV. Containing a Definition of the principal Chords.

121. The chord composed of a third, a fifth, and an octave, as C E G C, is called a *perfect chord*. If the third be major, as in C E G C, the perfect chord is denominated *major*: if the third be minor, as in A C E A, the perfect chord is minor. The perfect chord major constitutes what we call the *major mode*; and the perfect chord minor, what we term the *minor mode* (Art. 31.)

122. A chord composed of a third, a fifth, and a seventh, as G B D F, or D F A C, &c. is called a *chord of the seventh*. It is obvious that such a chord is wholly composed of thirds in ascending. All chords of the seventh are practised in harmony, save that which might carry the third minor and the seventh major, as C E B G B; and that which might carry a false fifth and a seventh major, as B D F A ♯.

123. As thirds are either major or minor, and as they may be differently arranged, it is clear that there are different kinds of chords of the seventh; there is even one, B D F A, which is composed of a third, a false fifth, and a seventh.

124. A chord composed of a third, a fifth, and a sixth, as F A C D, D F A B, is called a *chord of the greater sixth*.

125. Every note which carries a perfect chord is called a *tonic*, and the perfect chord is marked by an 8, by a 3, or by a 5, which is written above the note; but frequently these numbers are suppressed. Thus in the example I. the two C's equally carry a perfect chord.

126. Every note which carries a chord of the seventh is called a *dominant*; and this chord is marked by a 7 written above the note. Thus, in the example II. D carries the chord D F A C, and G the chord G B D F. It is necessary to remark, that among the chords of the seventh, we do not reckon the chord of the seventh diminished, which is only improperly called a *chord of the seventh*: and of which we shall say more below.

127. Every note which carries the chord of the great sixth, is called a *sub-dominant* (Art. 77, and 42) and is marked with a 6. Thus, in the example III. F. carries the chord of F A C D. You ought to remark, that the sixth should always be major.

128. In every chord, whether perfect, or a chord of the seventh, or of the great sixth, the note which carries this chord, and which is the flattest or lowest, is called the *fundamental note*.

129. In every chord of the seventh, and of the great sixth, the note which forms the seventh or sixth above the fundamental, that is to say, the highest note of the chord, is called a *dissonance*. Thus in the chords of the seventh G B D F, D F A C, F and C are the dissonances, viz. F with relation to G in the first chord, and C with relation to D in the second. In the chord of the great sixth F A C D, D is the dissonance; but that D is only, properly speaking, a dissonance with relation to C from which it is a *second*, and not with respect to F, from which it is a *sixth major* (Art. 17 and 18.)

130. When a chord of the seventh is composed of a third major followed by two thirds minor, the fundamental note of this chord is called the *tonic dominant*. In every other chord of the seventh, the fundamental is called the *simple dominant*. Thus in the chord G B D F, the fundamental G is the *tonic dominant*; but in the other chords of the seventh, as C E G B, D F A C, &c. the fundamental C and D are *simple dominants*.

131. In every chord, whether perfect, or of the seventh, or of the sixth, if you have a mind that the third above the fundamental note should be major, though it is naturally minor, you must place a sharp above the fundamental note. For example, if I would mark the perfect major chord D F ♯ A D, as the third F above D is naturally minor, I place above D a sharp, as you may see in Example IV. In the same manner the chord of the seventh D F ♯ A C, and the chord of the great sixth D F ♯ A B, is marked with a ♯ above D, and above the ♯ a 7 or a 6. On the contrary, when the third is naturally major, and if you should incline to render it minor, you must place above the fundamental note a b.

SECT. V. Of the Fundamental Basi.

132. Invent a modulation at your pleasure; and under this modulation let there be set a bass composed of different notes, of which some may carry a perfect chord, others that of the seventh, and others that of the great sixth, in such a manner that each note of the modulation which answers to each of the bass, may be one of those which enters into the chord of that note in the bass; this bass

No. 113.

being composed according to the rules which shall be immediately given, will be the *fundamental bass* of the modulation proposed. See Part I. where the *nature and principles of the fundamental bass* are explained.

SECT. VI. Rules for the Fundamental Basi.

133. All the notes of the fundamental bass being only capable of carrying a perfect chord, or the chord of the seventh, or that of the great sixth, are either tonics, or dominants, or sub-dominants: and the dominants may be either simple or tonic. The fundamental bass ought always to begin with a tonic, as much as it is practicable. And now follow the rules for all the succeeding chords; rules which are evidently derived from the principles established in the *First Part* of this system.

RULE I.

134. In every chord of the tonic, or of the tonic dominant, it is necessary that at least one of the notes which form that chord should be found in the chord that precedes it.

RULE II.

135. In every chord of the simple dominant, it is necessary that the note which constitutes the seventh, or dissonance, should likewise be found in the preceding chord.

RULE III.

136. In every chord of the sub-dominant, at least one of its consonances must be found in the preceding chord. Thus, in the chord of the sub-dominant F A C D, it is necessary that F, A, or C, which are the consonances of the chord, should be found in the chord preceding. The dissonance D may either be found in it or not.

RULE IV.

137. Every simple or tonic dominant ought to descend by a fifth. In the first case, that is to say, when the dominant is simple, the note which follows can only be a dominant; in the second it may be any one you choose; or, in other words, it may either be a tonic, a tonic dominant, a simple dominant, or a sub-dominant. It is necessary, however, that the conditions prescribed in the second rule should be observed, if it be a simple dominant.

RULE V.

138. Every sub-dominant ought to rise by a fifth; and the note which follows it may, at your pleasure, be either a tonic, a tonic dominant, or a sub-dominant.

REMARK.

139. The transition from a tonic dominant to a tonic is called an *absolute repose*, or a *perfect cadence* (53), and the transition from a sub-dominant to a tonic is called an *imperfect* or *irregular cadence* (73).

SECT. VII. Of the Rules which ought to be observed in the Treble with relation to the Fundamental Basi.

141. The treble is nothing else but a modulation above the fundamental bass, and whose notes are found in the chords of that bass which corresponds with it.

142. We are just about to give the rules for the treble: but first we think it necessary to make the two following remarks.

1. It is obvious that many notes of the treble may answer to one and the same note in the fundamental bass, when these notes belong to the chord of the same note in the fundamental bass. For example, this modulation C E G E C, may have for its fundamental bass the note C alone, because the chord of that note comprehends the sounds C, E, G, which are found in the treble,

2. In like manner, a single note in the treble may, for the same reason, answer to several notes in the bass.

RULE I. For the TREBLE.

143. If the note which forms the seventh in a chord of the *simple dominant* is found in the treble, the note which precedes it must be the very same. This is what we call a *discord prepared*. For instance, let us suppose that the note of the fundamental bass shall be D, bearing the chord of the simple dominant D F A C; and that this C, which is the dissonance, should be found in the treble; it is necessary that the note which goes before it in the treble should likewise be a C.

And it is requisite to observe, that, according to the rules which we have given for the fundamental bass, C will always be found in the chord of that note in the fundamental bass which precedes the simple dominant D.

RULE II.

145. If a note of the fundamental bass be a tonic dominant, or a simple dominant, and if the dissonance be found in the treble, this dissonance in the same treble ought to descend diatonically. But if the note of the bass be a sub-dominant, it ought to rise diatonically. This dissonance which rises or descends diatonically, is what we have called a *dissonance saved* or *resolved*.

146. One may likewise observe here, that according to the rules for the fundamental bass which we have given, the note upon which the dissonance ought to descend or rise will always be found in the subsequent chord.

SECT. VIII. Of the Continued Bass, and its Rules.

147. A continued or thorough bass, is nothing else but a fundamental bass whose chords are *inverted*. We invert a chord when

MUSIC.

we change the order of the notes which compose it. For example, if, instead of the chord G B D F, I should say B D F G, or D F G B, &c. the chord is inverted. Let us see, then, in the first place, all the possible ways in which a chord may be inverted.

The Ways in which a PERFECT CHORD may be INVERTED.

148. The perfect chord C E G C may be inverted in two different ways. 1. E G C E, which we call a chord of the *sixth*, composed of a third, a sixth, and an octave, and in this case the note E is marked with a 6. 2. G C E G, which we call a chord of the *fourth and sixth*, composed of a fourth, a sixth, and an octave; and it is marked with a 4. The perfect minor chord is inverted in the same manner.

The Ways in which the CHORD of the SEVENTH may be INVERTED.

149. In the chord of the tonic dominant, as G B D F, the third major B above the fundamental note G is called a *sensible note* (57); and the inverted chord B D F G, composed of a third, a false fifth, and a sixth, is called the *chord of the false fifth*, and is marked with an 8 or a b 5.

The chord D F G B, composed of a third, a fourth, and a sixth, is called the *chord of the sensible sixth*, and marked with a 6 or a * 6. In this chord, thus figured, the third is minor, and the sixth major, as it is easy to be perceived.

The chord F G B D, composed of a second, a tritone, and a sixth, is called the *chord of the tritone*, and is marked thus 4 ♯, thus x 4, or thus * 4.

150. In the chord of the simple dominant D F A C, we find, 1. F A C D, a chord of the great sixth, which is composed of a third, a fifth, and a sixth, and which is figured with a 6.

2. A C D F, a chord of the lesser sixth, which is figured with a 6.

3. C D F A, a chord of the second, composed of a second, a fourth, and a sixth, and which is marked with a 2.

The Ways in which the CHORD of the sub-DOMINANT may be inverted.

151. The chord of the sub-dominant, as F A C D, may be inverted in three different manners; but the method of inverting it, which is most in practice, is the chord of the lesser sixth A C D F, which is marked with a 6, and the chord of the seventh D F A C.

RULES for the CONTINUED BASS.

152. The continued bass is a fundamental bass, whose chords are only inverted in order to render it more in the taste of singing, and suitable to the voice. The continued bass then is properly nothing else but a treble with respect to the fundamental bass. Its rules immediately follow; which are properly no other than those already given for the treble.

RULE I.

153. Every note which carries the chord of the false fifth, and which, of consequence, must be what we have called a *sensible note*, ought (57) to rise diatonically upon the note which follows it.

RULE II.

154. Every note carrying the chord of the tritone should descend diatonically upon the subsequent note.

RULE III.

155. The chord of the second is commonly put in practice upon notes which are syncopated in descending, because the notes are dissonances which ought to be prepared and resolved, 143, 145.

SECT. IX. *Of some Licences assumed in the Fundamental Bass.*

1. *Of BROKEN and INTERRUPTED CADENCES.*

156. The broken cadence is executed by means of a dominant which rises diatonically upon another, or upon a tonic by a licence.

157. The interrupted cadence is formed by a dominant which descends by a third upon another. These cadences ought not to be permitted but rarely, and with precaution.

2. *SUPPOSITION.*

158. When a dominant is preceded by a tonic in the fundamental bass, we add sometimes, in the continued bass, to the chord of that dominant, a new note, which is a third or fifth below; and the chord which results from it in this continued bass, is called a *chord by supposition*. For example, let us suppose that in the fundamental bass we have a dominant G carrying the chord of the seventh G B D F; let us add to this chord the note C, which is a fifth below this dominant, and we shall have the total chord C G B D F, or C D F G B, which is called a *chord by supposition*.

Of the different Kinds of Chords by Supposition.

159. It is easy to perceive that chords by supposition are of different kinds. For instance, the chord of the tonic G B D F gives,

1. By adding the fifth C, the chord C G B D F, called a *chord of the seventh redundant*, and composed of a fifth, seventh, ninth, and eleventh. It is figured with a * 7. This chord is not practised but upon the tonic. They sometimes leave out the sensible note; it is then reduced to C F G D, and marked with 3 or 1.

2. By adding the third E, we shall have the chord E G B D F, called a *chord of the ninth*, and composed of a third, fifth, seventh, and ninth. It is figured with a 9. This third may be added to every third of the dominant.

3. If to a chord of the simple dominant, as D F A C, we should add the fifth G, we would have the chord G D F A C, called a *chord of the eleventh*, and which is figured with a ♯ or ♮.

OBSERVE.

160. When the dominant is not a tonic dominant, they often

take away some notes from the chord. For example, let us suppose that there is, in the fundamental bass, this simple dominant E carrying the chord E G B D: if there should be added the third C beneath, we shall have this chord of the continued bass C E G B D. In this state the chord is simply composed of a third, fifth, and ninth, and is marked with a 9.

161. What is more, in the chord of the simple dominant, as D F A C, when the fifth G is added, they frequently obliterate the sounds F and A, that too great a number of dissonances may be avoided, which reduces the chord to G C D. This last is composed only of the fourth and the fifth. It is called a *chord of the fourth*, and it is figured with a 4.

162. Sometimes they only remove the note A, and then the chord ought to be figured with 7 or 5.

163. Finally, in the minor mode, for example, in that of A, where the chord of the tonic dominant (109) is E G * B D, if we add to this chord the third C below, we shall have C E G * B D, called the *chord of the fifth redundant*, and composed of a third, a fifth redundant, a seventh, and a ninth. It is figured with a * 5, or a + 5.

3. *Of the CHORD of the DIMINISHED SEVENTH.*

164. In the minor mode, for instance, in that of A, E a fifth from A is the tonic dominant, and carries the chord E G * B D, in which G is the sensible note. For this chord they sometimes substitute that other G * B D F, all composed of minor thirds; and which has for its fundamental sound the sensible note G. This chord is called a *chord of the flat or diminished seventh*, and is figured with 7 in the fundamental bass, but it is always considered as representing the chord of the tonic dominant.

165. This chord in the fundamental bass produces in the continued bass the following chords:

1. The chord B D F G *, composed of a third, false fifth, and sixth major. They call it the *chord of the sixth sensible and false fifth*, and it is figured thus, * ♯, or + ♯.

2. The chord D F G * B, composed of a third, a tritone, and a sixth, they call it the *chord of the tritone and third minor*; and they mark it thus, * b.

3. The chord F G * B D, composed of a second redundant, a tritone, and a sixth. They call it the *chord of the second redundant*, and they figure it thus, * 2, or + 2.

166. Besides, since the chord G * B D F, represents the chord E G * B D, it follows, that if we operate by supposition upon the first of these chords, it must be performed as one would perform it upon E G * B D; that is to say, that it will be necessary to add to the chord G * B D F, the notes C or A, which are the third or fifth below E, and which will produce,

1. By adding C, the chord C G * B D F, composed of a fifth redundant, a seventh, a ninth, and eleventh, which is the octave of the fourth. It is called a *chord of the fifth redundant and fourth*, and thus marked, ♯ or * ♯.

2. By adding A, we shall have the chord A G * B D F, composed of a seventh redundant, a ninth, and eleventh, and a thirteenth minor, which is the octave of the sixth minor. It is called the *chord of the seventh redundant and sixth minor*, and marked b ♯ or * b. It is of all chords the most harsh, and the most rarely practised.

In the *Treatise of Harmony*, by M. Rameau, and elsewhere, may be seen a much longer detail of the chords by supposition; but here we delineate the elements alone.

SECT. X. *Of some Licences used in the Treble and Continued Bass.*

167. Sometimes in a treble, the dissonance which ought to have been resolved by descending diatonically upon the succeeding note, instead of descending, on the contrary, rises diatonically: but in that case, the note upon which it ought to have descended must be found in some of the other parts. This licence ought to be rarely practised. In like manner, in a continued bass, the dissonance in a chord of the sub-dominant inverted, as A in the chord A C E G, inverted from C E G A, may sometimes descend diatonically instead of rising as it ought to do; but in that case the note ought to be repeated in another part, that the dissonance may be there resolved in ascending.

168. Sometimes, likewise, to render a continued bass more agreeable, by causing it to proceed diatonically, they place between two sounds of that bass a note which belongs to the chord of neither.

SECT. XI. *Containing the Method of finding the Fundamental Bass when the Continued Bass is figured.*

169. To exercise yourself with greater ease in finding the fundamental bass, and to render it more familiar to you, it is necessary to observe how eminent masters, and, above all, how M. Rameau has put the rules in practice. Now, as they never place anything but the continued bass in their works, it becomes then necessary to know how to find this fundamental bass when the continued bass is figured. This problem may be easily solved by the following rules:

170. 1. Every note which has no figure in the continued bass ought to be the same, and without a figure in the fundamental bass; it either is a tonic, or reckoned such.

2. Every note which, in the continued bass, carries a 6, ought

MUSIC.

in the fundamental bass to give its third below not figured, or its fifth below marked with a 7. We shall distinguish these two cases below.

1. Every note carrying a 2 gives, in the fundamental bass, its fifth below not figured.

2. Every note figured with a 7, or a ♯, is the same in both basses, and with the same figure.

Sometimes a note which carries a 7 in the continued bass, gives, in the fundamental bass, its third above, figured with a 6. For example, this continued bass A B C gives this fundamental bass C G C; but in this case it is necessary that the note figured with a 6 should rise by a fifth, as we see here C rise to G.

A note figured with a 2, gives likewise, sometimes, in the fundamental bass, its fourth above, figured with a 6; but it is necessary, in that case, that the note figured with a 6, may even here rise to a fifth.

3. Every note figured with a 2, gives, in the fundamental bass, the diatonic note above, figured with a 7.

4. Every note marked with a 4, gives, in the fundamental bass, the diatonic note above, figured with a 7.

5. Every note figured with an 8, gives its third below, figured with a 7.

6. Every note marked with 6, gives the fifth below, marked with a 7; and in the chord of the seventh, of which we treat in these three last articles, the third ought to be major, and the seventh minor, this chord of the seventh being the chord of the tonic dominant.

7. Every note marked with a 9, gives its third above, figured with a 7.

8. Every note marked with 2, gives the fifth above, figured with a 7.

9. Every note marked with a ♯ 5, or with a + 5, gives the third above, figured with a ♯.

10. Every note marked with a ♯ 7, gives a fifth above figured with a 7, or with a ♯. It is the same case with the notes marked ♯, or ♯: which shews a retrenchment, either in the complete chord of the eleventh, or in that of the seventh redundant.

11. Every note marked with a 4, gives a fifth above, figured with a 7, or a ♯.

12. Every note marked with ♯, gives the third minor below, figured with a ♯.

13. Every note marked with ♯ b, gives the tritone above, figured with a ♯.

14. Every note marked with a + 2, gives the second redundant above, figured with a ♯.

15. Every note marked with a ♯ 4, gives the fifth redundant above, figured with a ♯.

16. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

17. Every note marked with a ♯ 6, gives the seventh redundant above, figured with a ♯.

18. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

19. Every note marked with a ♯ 2, gives the second redundant above, figured with a ♯.

20. Every note marked with a ♯ 4, gives the fifth redundant above, figured with a ♯.

21. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

22. Every note marked with a ♯ 6, gives the seventh redundant above, figured with a ♯.

23. Every note marked with a ♯ 2, gives the second redundant above, figured with a ♯.

24. Every note marked with a ♯ 4, gives the fifth redundant above, figured with a ♯.

25. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

26. Every note marked with a ♯ 6, gives the seventh redundant above, figured with a ♯.

27. Every note marked with a ♯ 2, gives the second redundant above, figured with a ♯.

28. Every note marked with a ♯ 4, gives the fifth redundant above, figured with a ♯.

29. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

30. Every note marked with a ♯ 6, gives the seventh redundant above, figured with a ♯.

31. Every note marked with a ♯ 2, gives the second redundant above, figured with a ♯.

32. Every note marked with a ♯ 4, gives the fifth redundant above, figured with a ♯.

33. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

34. Every note marked with a ♯ 6, gives the seventh redundant above, figured with a ♯.

35. Every note marked with a ♯ 2, gives the second redundant above, figured with a ♯.

36. Every note marked with a ♯ 4, gives the fifth redundant above, figured with a ♯.

37. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

38. Every note marked with a ♯ 6, gives the seventh redundant above, figured with a ♯.

39. Every note marked with a ♯ 2, gives the second redundant above, figured with a ♯.

40. Every note marked with a ♯ 4, gives the fifth redundant above, figured with a ♯.

41. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

42. Every note marked with a ♯ 6, gives the seventh redundant above, figured with a ♯.

43. Every note marked with a ♯ 2, gives the second redundant above, figured with a ♯.

44. Every note marked with a ♯ 4, gives the fifth redundant above, figured with a ♯.

45. Every note marked with a ♯ 7, gives the seventh redundant above, figured with a ♯.

say, if it is C, in this case, and in this alone, he may place F in the fundamental bass. It is a consequence of this rule, that in the fundamental bass every sub-dominant ought to rise by a fifth (138).

SECT. XH. What is meant by being in a Mode or Tone.

174. In the scale C D E F G A B C may be found; the different sounds which form this scale compose what we call the *major mode* of C, because the third E above C is major. If, therefore, we would have a modulation in the major mode of C, no other sounds must enter into it than those which compose this scale; in such a manner that if, for instance, I should find F♯ in this modulation, this F♯ discovers to me that I am not in the mode of C, or at least that, if I have been in it, I am no longer so.

175. In the same manner, if I form this scale in ascending A B C D E F G A, which is exactly similar to the scale C D E F G A B C of the major mode of C, this scale, in which the third from A to C is major, shall be in the major mode of A; and if I incline to be in the minor mode of A, I have nothing to do but to substitute for C sharp C natural; so that the major third A C becomes minor A C; I shall have then

A B C D E F G A,

which is the scale of the minor mode of A in ascending; and the scale of the minor mode of A in descending shall be (65)

A G F E C D B A,

in which the G and F are no longer sharp. For it is a singularity peculiar to the minor mode, that its scale is not the same in rising as in descending.

176. This is the reason why, when we wish to begin a piece in the major mode of A, we place three sharps at the clef upon F, C, and G; and, on the contrary, in the minor mode of A, we place none, because the minor mode of A, in descending, has neither sharps nor flats.

177. As the scale contains twelve sounds, each distant from the other by the interval of a semitone, it is obvious that each of these sounds can produce both a major and a minor mode, which constitute 24 modes upon the whole. Of these we shall immediately give a table, which may be very useful to discover the mode in which we are.

A TABLE of the DIFFERENT MODES.

Major Modes.

Maj. Mode.	C D E F G A B C
of C	G A B C D E F G
of G	D E F G A B C D
of D	E F G A B C D E
of A	F G A B C D E F
of E	G A B C D E F G
of B	A B C D E F G A
of F	B C D E F G A B
of C	D E F G A B C D
of D	E F G A B C D E
of G	F G A B C D E F
of A	G A B C D E F G
of E	A B C D E F G A
of B	B C D E F G A B
of F	C D E F G A B C

Minor Modes.

Of A.	In descending. A G F E D C B A.
Of G.	In rising. A B C D E F G A.
Of E.	In descending. E D C B A G F E.
Of B.	In rising. E F G A B C D E.
Of C.	In descending. B A G F E D C B.
Of F.	In rising. B C D E F G A B.
Of D.	In descending. F E D C B A G F.
Of A.	In rising. F G A B C D E F.

not much practised. When a piece begins upon C, there ought only to place five flats, and to suppose the key D, which is almost here the mode of D, for that of C.

for that of G; for the scale of the major mode of C is

G, A, B, C, D, E, F, G.

at the clef: which is shocking and inconsistent. It is true that the clef, and by marking the note G with a natural through the would become troublesome, above all, if there should be occasion transposition. One might, likewise, in this series, instead of G

F, that is to say, F twice sharp; which, however, is not absolutely the same with G natural, especially upon instruments whose scales are fixed, or whose intervals are invariable.

But in that case two sharps may be placed at the clef upon F, which would produce another inconvenience. But by substituting

for G, the trouble is eluded.

REMARK.

171. We have omitted two basses, which may cause some uncertainty.

The first is that where the note of the continued bass is figured with a 6. We now present the reason of the difficulty.

Suppose we should have the dominant D in the fundamental bass, the note which answers to it in the continued bass may be A carrying the figure 6, that is to say, the chord A C D F; now if we should have the sub-dominant F in the fundamental bass, this sub-dominant might produce, in the continued bass, the same note A figured with a 6. When, therefore, one finds in the continued bass a note marked with a 6, it appears at first uncertain whether we should place in the fundamental bass the fifth below, marked with a 7, or third below, marked with a 6.

172. The second case is that in which the continued bass is figured with a ♯. For instance, if there should be found F in the continued bass, one may be ignorant whether he ought to insert in the fundamental bass F marked with a 6, or D figured with a 7.

173. You may easily extricate yourself from this little difficulty, in leaving for an instant this uncertain note in suspense, and in examining what is the succeeding note of the fundamental bass; for if that note be, in the present case, a fifth above F, that is to

say, C, of C, or D, and G, or A, are not much practised. When a piece begins upon C, there ought only to place five flats, and to suppose the key D, which is almost here the mode of D, for that of C.

for that of G; for the scale of the major mode of C is

G, A, B, C, D, E, F, G.

at the clef: which is shocking and inconsistent. It is true that the clef, and by marking the note G with a natural through the would become troublesome, above all, if there should be occasion transposition. One might, likewise, in this series, instead of G

F, that is to say, F twice sharp; which, however, is not absolutely the same with G natural, especially upon instruments whose scales are fixed, or whose intervals are invariable.

But in that case two sharps may be placed at the clef upon F, which would produce another inconvenience. But by substituting

for G, the trouble is eluded.

MUSIC.

	Of C*.
In descending.	C* B A G* F* E D* C*.
In rising.	C* D* E F* G* A* B* C*.
	Of G* or Ab.
In descending.	G* F* E C* B A* G*.
In rising.	A b B b C b D b E b F G A b.
	Of D* or Eb.
In descending.	E b A b C b B b A b G b F E b.
In rising.	E b F G b A b B b C D E b.
	Of A* or Bb.
In descending.	B b A b G b F E b D b C B b.
In rising.	B b C D b E b F G A B b.
	Of E* or Fb.
In descending.	F E b D b C B b A b G F.
In rising.	F G A b B b C D E F.
	Of C.
In descending.	C B b A b G F E b D C.
In rising.	C D E b F G A B C.
	Of G.
In descending.	G F E b D C B b A G.
In rising.	G A B b C D E F* G.
	Of D.
In descending.	D C B b A G F E D.
In rising.	D E F G A B C* D.

178. These then are all the modes, as well major as minor. Those which are crowded with sharps and flats are little practised, as being extremely difficult in execution.

179. From thence it follows,

1. That when there are neither sharps nor flats at the cleff, it is a token that the piece begins in the major mode of C, or in the minor mode of A.

2. That when there is one single sharp, it will always be placed upon F, and that the piece begins in the major mode of G, or the minor of E, in such a manner that it may be sung as if there were no sharp, by singing B instead of F*, and in singing the tune as if it had been in another cleff. For instance, let there be a sharp upon F in the cleff of G upon the first line; one may then sing the tune as if there were no sharp: and instead of the cleff of G upon the first line, let there be the cleff of C; for the F*, when changed into B, will require that the cleff of G should be changed to the cleff of C, as may be easily seen. This is what we call *transposition*.

Though this delicate operation in music will be found extremely just and compendious; and proceeds upon simple principles, and comprehends every possible contingency, yet as the manner of thinking upon which it depends may be less familiar to those readers who are not profoundly skilled in music, it has been thought proper to give a more familiar, though less comprehensive, explanation of the manner in which *transposition* may be executed.

It will occur to every musical reader, that if each of the intervals through the whole diatonic series were equal in a mathematical sense, it would be absolutely indifferent upon what note any air was begun, if within the compass of the gamut; because the same equal intervals must always have the same effects. But since, besides the natural semitones, there is another distinction of diatonic intervals, into greater or lesser tones; and since these vary their positions in the series of an octave, according as the note from whence you begin is placed, that note is consequently the best key for any tone whose natural series is most exactly correspondent with the intervals which that melody or harmony requires. But in instruments whose scales are fixed, notwithstanding the temperament, and other expedients of the same kind, such a series is far from being easily found, and is, indeed, in common practice, almost totally neglected. All that can frequently be done, is to take care that the ear may not be sensibly shocked. This, however, would be the case, if, in transposing any tune, the situation of the semi-tones, whether natural or artificial, were not exactly correspondent in the series to which your air must be transposed, with their positions in the scale from which you transpose it. Suppose, for instance, your air should begin upon C, requiring the natural diatonic series through the whole gamut, in which the distance between E and F, as also that between B and C, is only a semitone. Again, suppose it necessary for your voice, or the instrument on which you play, that the same air should be transposed to G, a fifth above its former keys; then, because in the first series, the intervals between the third and the fourth, seventh and eighth notes, are no more than semitones, the same intervals must take the same places in the octave to which you transpose. Now, from *sol* or G, the note with which you propose to begin the three tones immediately succeeding are full; but the fourth, *ut* or C, is only a semitone; it may therefore be kept in its place. But from *fa*, or F, the seventh note above, to *sol* or G the eighth, the interval is a full tone, which must consequently be redressed by raising your F a semitone higher. Thus the situations of the semitonic intervals, in both octaves, will be correspondent; and thus by conforming the positions of the semitones in the octave to which you transpose, with those in the octave in which the original key of the tune is contained, you will perform your operation with as much success as the nature of fixed scales can admit.

180. It is evident, that when F* is changed into B, G must be changed into C, and E into A. Thus, by transposition, the air

has the same melody as if it were in the major mode of C, or in the minor mode of A. The major mode then of G, and the minor of E are, by transposition, reduced to those of C major, and of A minor. It is the same case with all the other modes, as any one may easily be convinced.

Two sharps, F* and C*, indicate the major mode of D, or the minor of B; and then, by transposition, the C* is changed into B; and, of consequence, D into C, and B into A.

Three sharps, F* C* G*, indicate the major mode of A, or the minor of F*; and it is then G*, which must be changed into B, and, of consequence, A into C, and F* into A.

Four sharps, F* C* G* D*, indicate the major mode of E, or the minor of C*; then the D* is changed into B, and, of consequence, E into C, and C* into A.

Five sharps, F* C* G* D* A*, indicate the major mode of B, or the minor of G*; A then is changed into B, and, of consequence, B into C, and G* into A.

Six sharps, F* C* G* D* A* E*, indicate the major mode of F*; E* then is changed into B, and, of consequence, F*, into C.

Six flats, B b E b A b D b G b C b, indicate the minor mode of Eb; C is changed into B, and, of consequence, Eb into A.

Five flats, B b E b A b D b G b, indicate the major mode of Db, or the minor mode of Bb; then the Bb is changed into F, and, of consequence, Db into C, and the Bb into A.

Four flats, B b E b A b D b, indicate the major mode of Ab, or the minor mode of F; Db then is changed into F, and, of consequence, Ab into C, and F into A.

Three flats, B b E b A b, indicate the major mode of Eb, or the minor of C; the Ab then is changed into F, and, of consequence, Eb into C, and the G into A.

Two flats, B b E b, indicate the major mode of Bb, or the minor of G; Eb then is changed into F, and, of consequence Bb into C, and the F into A.

One flat, B b, indicates the major mode of F, or the minor mode of D, and Bb is changed into F; of consequence the F is changed into C, and the D into A.

All the major modes then may be reduced to that of C, and the minor modes to that of A minor.

It only remains to remark, that many musicians, and amongst others the ancient musicians of France, as Lulli, Campra, &c. place one flat less in the minor mode: so that in the minor mode of D, they place neither sharp nor flat at the cleff; in the minor mode of G, one flat only; in the minor mode of C, two flats, &c.

This practice in itself is sufficiently indifferent, and scarcely merits the trouble of a dispute. Yet the method which we have here described, according to M. Rameau, has the advantage of reducing all the modes to two; and besides it is founded upon this simple and very general rule: That in the major mode we must place as many sharps or flats at the cleff, as are contained in the diatonic scale of that mode in ascending: and in the minor mode, as many as are contained in that same scale in descending.

However this be, we here present a rule for transposition, which appears to us more simple than the rule in common use.

For the Sharps.

Suppose G, D, A, E, B, F, and change G into C, if there is one sharp at the cleff, D into C if there are two sharps, A into C if there are three, &c.

For the Flats.

Suppose F, B, E, A, D, G, and change F into C, if there is only one flat at the cleff, B into C if there are two flats, E into C if there are three, &c.

SECT. XIII. To find the fundamental Bais of a given Modulation.

181. As we have reduced to a very small number the rules of the fundamental bais, and those which in the treble ought to be observed with relation to this bais, it should no longer be difficult to find the fundamental bais of a given modulation, nay, frequently, to find several; for every fundamental bais will be legitimate when it is formed according to the rules which we have given (Sect. VI.) and that, besides this, the dissonances which the modulation may form with this bais will both be prepared, if it is necessary that they should be so, and always resolved.

We often say, that we are upon a particular key, instead of saying that we are in a particular mode. The following expressions therefore are synonymous; such a piece is in C major, or in the mode of C major, or in the key of C major.

We must recite a few technical phrases upon the same subject, and which, if we are not mistaken, will be found equally concise, at the same time that they are more natural and intelligible. When we mean to express the fundamental note of that series within the diatonic octave which any piece of music demands, we call that note the *key*. When we intend to signify its mode, whether major or minor, we denominate the harmony *sharp* or *flat*. When in a concert we mean to try how instruments are in tune, by that note upon which, according to the genius of each particular instrument, they may best agree in union, we desire the musicians who join us to sound A.

MUSIC.

182. It is of the greatest utility, in searching for the fundamental bass, to know what is the tone or mode of the melody to which that bass should correspond. But it is difficult in this manner to assign general rules, and such as are absolutely without exception, in which nothing may be left that appears indifferent or discretionary; because sometimes we seem to have the free choice of referring a particular melody either to one mode or another. For example, this melody G C may belong to all the modes, as well major as minor, in which G and C are found together; and each of these two sounds may even be considered as belonging to a different mode.

183. For what remains, one may sometimes, as it should seem, operate without the knowledge of the mode, for two reasons: 1. Because, since the same sounds belong to several different modes, the mode is sometimes considerably undetermined; above all, in the middle of a piece, and during the time of one or two bars. 2. Without giving ourselves much trouble about the mode, it is often sufficient to preserve us from deviating in composition, if we observe in the simplest manner the rules above described (Sect. VI.) for the procedure of the fundamental bass.

184. In the mean time, it is above all things necessary to know in what mode we operate at the beginning of the piece, because it is indispensable that the fundamental bass should begin in the same mode, and that the treble and bass should likewise end in it; nay, that they should even terminate in its fundamental note, which in the mode of C is C, and A in that of A, &c. Besides, in those passages of the modulation where there is a cadence, it is generally necessary that the mode of the fundamental bass should be the same with that of the part to which it corresponds.

185. To know upon what mode or in what key a piece commences, our enquiry may be entirely reduced to distinguish the major mode of C from the minor of A. For we have already seen (Art. 179, and 180) that all the modes may be reduced to these two, at least in the beginning of a piece. We shall now therefore give a detail of the different means by which these two modes may be distinguished.

1. From the principal and characteristical sounds of the mode, which are C E G in the one, and A C E in the other; so that if a piece should, for instance, begin thus, A C E A, it may be almost constantly concluded that the tone or mode is in A minor, although the notes A C E belong to the mode of C.

2. From the sensible note, which is B in the one, and G♯ in the other; so that if G♯ appears in the first bars of a piece, one may be certain that he is in the mode of A.

3. From the adjuncts of the mode, that is to say, the modes of its two fifths, which for C are F and G, and D and E for A. For example, if after having begun a melody by some of the notes, which are common to the modes of C, and of A (as E D E F E D C B C); I should afterwards find the mode of G, which I ascertain by the F♯, or that of F, which I ascertain by the B♭, or C♯, I may conclude that I have begun in the mode of C: but if I find the mode of D, or that of E, which I ascertain by B♭, C♯, or D♯, &c. I conclude from thence that I have begun in the mode of A.

4. A mode is not in ordinary deserted, especially in the beginning of a piece; but that we may pass into one or other of these modes which are most relative to it, which are the mode of its fifth above, and that of its third below, if the original mode be major, or of its third above if it be minor. Thus, for instance, the modes which are most intimately relative to the major mode of C, are the major mode of G, and that of A minor. From the mode of C we commonly pass either into the one or the other of these modes; so that we may sometimes judge of the principal mode in which we are, by the relative mode which follows it, or which goes before it, when these relative modes are decisively marked. For what remains, besides these two relative modes, there are likewise two others, into which the principal mode may pass, but less frequently, viz. the mode of its fifth below, and that of its third above, as, F and E for the mode of C.

It is certain that the minor mode of E has an extremely natural connection with the mode of C, as has been proved (Art. 72) both by arguments and by examples. It has likewise appeared in the note upon the Art. 73, that the minor mode of D may be joined to the major mode of C; and thus, in a particular sense, this mode may be considered as relative to the mode of C: but it is still less so than the major modes of G and F, or than those of A and E minor; because we cannot immediately, and without licence, pass in a fundamental bass from the perfect minor chord of C to the perfect chord of D; and if you pass immediately from the major mode of C, to the minor mode of D in a fundamental bass, it is by passing, for instance, from the tonic C, or from C G C, to the tonic dominant of D, carrying the chord A C♯ G, in which there are two sounds, E G, which are found in the preceding chord; or otherwise from C E G C to G B♭ D E, a chord of the sub-dominant in the minor mode of D; which chord likewise two sounds, G and E, in common with that which went immediately before it.

5. The modes may still be likewise distinguished by the cadences of the melody. These cadences ought to occur at the end of every two, or at most every four bars, as in the fundamental bass:

No. 113.

now the note of the fundamental bass which is most suitable to these closes is always easy to be found. For the sounds which occur in the treble, may be consulted M. Rameau, p. 64, of his *Nouveau Systeme de Musique Théorique et Pratique*.

All these different manners of distinguishing the modes ought, if we may speak so, to give mutual light and assistance one to the other. But it often happens, that one of these signs alone is not sufficient to determine the mode, and may even lead to error. For example, if a piece of music begins with these three notes, E C G, we must not with too much precipitation conclude from thence that we are in the major mode of C, although these three sounds, E C G, be the principal and characteristical sounds in the major mode of C; we may be in the minor mode of E, especially if the note E should be long.

When a person is once able to ascertain the mode, and can render himself sure of it by the different means which we have pointed out, the fundamental bass will cost little pains. For in each mode there are three fundamental sounds.

1. The tonic of the mode, or its principal sound, which carries always the perfect chord major or minor, according as the mode itself is major or minor.

Major mode of C. C E G C.
Minor mode of A. A C E A.

2. The tonic dominant, which is a fifth above the tonic, and which, whether in the major or minor mode, always carries a chord of the seventh, composed of a third major followed by two thirds minor.

Tonic dominant.
Major mode of C. G B D F.
Tonic dominant.
Minor mode of A. E G♯ B D.

3. The sub-dominant, which is a fifth below the tonic, and which carries a chord composed of a third, fifth, and sixth major, the third being either greater or lesser, according as the mode is major or minor.

Sub-dominant.
Major mode of C. F A C D.
Minor mode of A. D F A B.

These three sounds, the tonic, the tonic dominant, and the sub-dominant, contain in their chords all the notes which enter into the scale of the mode; so that when a melody is given, it may almost always be found which of these three sounds should be placed in the fundamental bass, under any particular note of the upper part. Yet it sometimes happens that not one of these notes can be used. For example, let it be supposed that we are in the mode of C, and that we find in the melody these two notes A B in succession; if we confine ourselves to place in the fundamental bass one of the three sounds, C G F, we shall find nothing for the

sounds A and B but this fundamental bass F G; now such a succession as F to G is prohibited by the fifth rule for the fundamental bass, according to which every sub-dominant, as F, should rise by a fifth; so that F can only be followed by C in the fundamental bass, and not by G.

To remedy this, the chord of the sub-dominant F A C D must be inverted into a fundamental chord of the seventh in this manner D F A C; which has been called the *double employment*, because it is a secondary manner of employing the chord of the sub-dominant. By these means we give to the modulation A B, this fundamental bass D G; which procedure is agreeable to rules.

Here then are four chords, C E G C, G B D F, F B C D, D F A C, which may be employed in the major mode of C. We shall find in like manner, for the minor mode of A, four chords, A C E A, F G♯ B D, D F A B, B D F A.

And in this mode we sometimes change the last of these chords into B D F♯ A, substituting the F♯ for F♮. For instance, if we have this melody in the minor mode of A, E F♯ G A, we would cause the first note E to carry the perfect chord A C E A, the second note F♯ to carry the chord of the seventh B D F♯ A, the third note G the chord of the tonic dominant E G♯ B D, and, in short, the last the perfect chord A C E A.

On the contrary, if this melody is given always in the minor mode A A G♯ A, the second A being syncopated, it might have the same bass as the modulation E F♯ G♯ A; with this difference alone, that F♯ might be substituted for F♮ in the chord B D F♯ A, the better to mark out the minor mode.

Beside these chords which we have just mentioned, and which may be regarded as the principal chords of the mode, there are still a great many others; for example, the series of dominants,

C A D G C F B E A C G C,
which is terminated equally in the tonic C, either entirely belong, or at least may be reckoned as belonging to the mode of C; because none of these dominants are tonic dominants except G, which is the tonic dominant of the mode of C; and besides, because the chord of each of these dominants forms no other sounds than such as belong to the scale of C.

They may be reckoned as belonging to this mode, for two reasons: 1. Because, properly speaking, there are only three chords which essentially and primitively belong to the mode of C, viz. C carrying the perfect chord, F carrying that of the sub-dominant, and G that of the tonic dominant, to which we may join the chord of the seventh, D F A C; but we here regard as extended, the series of dominants in question, as belonging to the mode of C, because it preserves in the ear the impression of that mode. 1. In a series of dominants, there are a great many of them which likewise belong to other modes; for instance, the simple dominant A belongs naturally to the mode of G, the simple dominant B to that of A, &c. Thus it is only improperly, and by way of extension, that we regard these dominants, as belonging to the mode of C.

But if we were to form this fundamental basis,

C ⁷ A ⁷ D ⁷ G ⁷ C ^b

considering the last C as a tonic dominant in this manner, C E G B^b; the mode would then be changed at the second C, and we should enter into the mode of F; because the chord C E G B^b indicates the tonic dominant of the mode of F; besides, it is evident that the mode is changed, because B^b does not belong to the scale of C.

In the same manner were we to form this fundamental basis

C ⁷ A ⁷ D ⁷ G ⁶ C

considering the last C as a tonic dominant, in this manner, C E G A; this last C would indicate the mode of G, of which C is the sub-dominant.

In like manner, still, if in the first series of dominants, we caused the first D to carry the third major, in this manner, D F* A C; this D, having become a tonic dominant, would signify the major mode of G; and the G which should follow it carrying the chord B D F would relapse into the mode of C, from whence we had departed.

Finally, in the same manner, if, in this series of dominants, one should cause B to carry F* in this manner, B D F* A; this F would shew that we had departed from the mode C, to enter into that of G.

From hence it is easy to form this rule for discovering the changes of mode in the fundamental basis.

1. When we find a tonic in the fundamental basis, we are in the mode of that tonic; and the mode is major or minor, according as the perfect chord is major or minor.

2. When we find a sub-dominant, we are in the mode of the fifth above that sub-dominant; and the mode is major or minor, according as the third in the chord of the sub-dominant is major or minor.

3. When we find a tonic dominant, we are in the mode of the fifth below that tonic dominant. As the tonic dominant carries always the third major, one cannot be secure by the assistance of this dominant alone, whether the mode be major or minor: but it is only necessary for the composer to cast his eye upon (art. 187) which must be the tonic of the mode in which he is; by the third of this tonic he will discover whether the mode be major or minor.

186. Every change of the mode supposes a cadence; and when the mode changes in the fundamental basis, it is almost always either after the tonic of the mode in which we have been, or after the tonic dominant of that mode, considered then as a tonic by favour of a close, which ought necessarily to be found in that place; whence it happens that cadences in a melody, for the most part, preface a change of mode which ought to follow them.

187. All these rules, joined with the table of modes which we have given (art. 177) will serve to discover in what mode we are in the middle of a piece, especially in the most essential passages, as cadences.

188. Two modes are so much more intimately relative as they contain a greater number of sounds common to both; for example, the minor mode of C and the major of G, or the major mode of C and the minor of A: on the contrary, two modes are less intimately relative, as the number of sounds which they contain as common to both is smaller; for instance, the major mode of C and the minor mode of B, &c.

189. When you find yourself led away by the current of the modulation, that is to say, by the manner in which the fundamental basis is constituted, into a mode remote from that in which the piece was begun, you must continue in it but for a short time, because the ear is always impatient to return to the former mode.

SECT. XIV. Of the Chromatic and Enharmonic.

190. We call that melody *chromatic* which is composed of several notes in succession, whether arising or descending by semi-notes.

191. When an air is chromatic in descending, the most natural and ordinary fundamental basis is a concatenated series of tonic dominants; all of which follow one another in descending by a fifth, or, which is the same thing, in rising by a fourth.

192. When the air is chromatic in ascending, one may form a fundamental basis by a series of tonics and of tonic dominants, which succeed one another alternately by the interval of a third in descending, and of a fourth in ascending. There are many other ways of forming a chromatic air, whether in rising or descending; but these details, in an elementary essay, are by no means necessary. With respect to the harmonic, it is very rarely put in practice.

SECT. XV. Design, Imitation, and Fugue.

193. In music, the name of *design*, or *subject*, is generally given to a particular air or melody, which the composer intends should prevail through the piece; whether it is intended to express the meaning of words to which it may be set, or merely inspired by the impulse of taste and fancy, in this last case, design is distinguished into *imitation* and *fugue*.

194. *Imitation* consists in causing to be repeated the melody of one, or of several, bars in one single part, or in the whole harmony, and in any of the various modes that may be chosen. When all the parts absolutely repeat the same air or melody, and beginning one after the other, this is called a *canon*. *Fugue* consists in alternately repeating that air in the treble, and in the bass, or even in all the parts, if there are more than two.

195. *Imitation* and *fugue* are sometimes conducted by rules merely deducible from taste, which may be seen in the 33d, and following pages, of M. Rameau's *Treatise on Harmony*; where will likewise be found a detail of the rules for composition in several parts. The chief rules for composition in several parts are, that the discords should be found, as much as possible, prepared and resolved in the same part; that a discord should not be heard at the same time in several parts, because its harshness would disgust the ear; and that, in no particular part there should be found two octaves, or two fifths in succession, with respect to the bass. Musicians, however, do not hesitate sometimes to violate this precept, when taste or occasion requires. In music, as in all the other fine arts, it is the business of the artist to assign and to observe rules; the province of men who are adorned with taste and genius is to find the exceptions.

SECT. XVI. Definitions of the different Airs.

166. We shall finish this system by giving, in a few words, the characteristic distinctions of the different airs to which names have been given, as *chacoon*, *minuet*, *rigadoon*, &c. The *chacoon* is a long piece of music, containing three times in each bar, of which the movement is regular, and the bars sensibly distinguished. It consists of several couplets, which are varied as much as possible. Formerly, the bass of the *chacoon* was a *constrained bass*, or regulated by a rhythmus, terminating in four bars, and proceeding again by the same number; at present, composers of this species no longer confine themselves to that practice. The *chacoon* begins, for the most part, not with the perfect time, which is struck by the hand or foot, but with the imperfect, which passes while the hand or foot is elevated. The *villanelle* is a *chacoon*, a little more lively, with its movement somewhat more brisk than the ordinary *chacoon*. The *passepied* only differs from a *chacoon* as it is more flow, more tender, and beginning in ordinary with a perfect time. The *minuet* is an air in triple time, whose movement is regular, and neither extremely brisk, nor flow, consisting of two parts of strains, which are each of them repeated; and for which reason they are called, by the French, *repries*: each strain of the minuet begins with a time which is struck, and ought to consist of 4, of 8, or of 12 bars; so that the cadences may be easily distinguished, and recur at the end of each 4 bars.

The *farabando* is properly a flow minuet; and the *courant* a very flow *farabando*: this last is no longer in use. The *passepied* is properly a very brisk minuet, which does not begin, like the common minuet, with a stroke of the foot or hand; but in which each strain begins in the last of the three times of which the bar consists.

The *loure* is an air whose movement is flow, whose time is marked with ♩, and where two of the times in which the bar consists are beaten; it generally begins with that in which the foot is raised. For ordinarily, the note in the middle of each time is shortened, and the first not of the same time pointed.

The *jig* is properly nothing else but a *loure* very brisk, and whose movement is extremely quick.

The *forlana* is a moderate movement, and in a mediocrity between the *loure* and *jig*.

The *rigadoon* has two times in a bar, is composed of strains, each to be repeated, and each consisting of 4, of 8, or of 12 bars: its movement is lively; each strain begins, not with a stroke of the foot, but at the last note of the second time.

The *bourée* is almost the same thing with the *rigadoon*.

The *gavotte* has two times in each bar, is composed of two strains, each to be repeated, and each consisting of 4, of 8, or of 12 bars: the movement is sometimes flow, sometimes brisk; but never extremely quick, nor very flow.

The *tambourin* has two strains, each to be repeated, and each consisting of 4, of 8, or of 12 bars, &c. Two of the times that make up each bar are beaten, and are very lively; and each strain generally begins in the second time.

The *musette* consists of two or three times in each bar; its movement is neither very quick, nor very flow; and for its bass it has often no more than a single note, which may be continued through the whole piece.

This System is principally an abridgment from the works of Messrs. Rameau, Rousseau, and d'Alembert, which are considered by the amateurs of the science, as the best treatises on the subject. We have introduced plates, to illustrate the relative value of the notes and rests; the different clefs and scales; and the scales of the several stringed instruments now in use; which addition, it is presumed, will facilitate the progress of the practitioner.

M U S

M U S

MUSK, formed the common Greek, *μοσχος*, musk, a kind of perfume of a very strong scent; only agreeable when moderated by the mixture of some other perfume. Musk is found in a kind of bag, or tumour, growing about the bigness of an hen's egg under the belly, towards the genital parts, of a wild beast of the same name; and appears to be nothing else but a kind of bilious blood there congealed, and almost corrupted.

The animal which produces it is pretty common in the kingdom of Bantam, Tonquin, and some others, as Cochinchina, &c. But the most esteemed are those in the kingdom of Thibet. See *Moscus*. They inhabit the woods and forests, where the natives hunt them down: when the beast is killed, they cut out the bladder under the belly, separate the coagulated blood, and dry it in the sun, where it is reduced into a light friable substance, almost of the nature of a powder, and of a dusky reddish colour and acquires a very strong and disagreeable smell. It is then tied up again in bladders, and exported to other countries; and this is the musk which we use. The musk itself is dry, with a kind of unctuousity; of a dark reddish brown, or rusty blackish colour; in small round grains, with a very few hard black clots perfectly free from any sandy or other visible foreign matter. Chewed, and rubbed on paper, it looks bright, yellowish, smooth, and free from grittiness.

When they want to adulterate it, they put a mash of the animal's blood and liver into the place of the blood and musk they had extracted. In two or three years this mixture produces certain small animals, which eat the good musk; so that, when opened, a great consumption is perceived. Others, after extracting a portion of the musk, put it in small pieces of lead to augment the weight. The merchants who transport the musk to foreign countries are less averse to this trick than the former; because in this case none of the animals above mentioned are produced. But the deceit is still worse to discover, when, of the skin taken from the belly of a young animal, they make little bags, which they sew so dexterously with threads of the same skin, that they resemble genuine bags. Those they fill with what they take out of the genuine bags, and some fraudulent mixture, which it is extremely difficult for the merchants to detect. When the bags are sewed immediately on their being cut, without allowing any part of the odour to dissipate in the air, after they have abstracted as much of the musk as they think proper, if a person applies one of these bags to his nose, blood will be drawn by the mere force of the odour, which must necessarily be weakened or diluted in order to render it agreeable without injuring the brain. M. Tavernier who brought one of the animals with him to Paris, says, the odour of which was so strong, that it was impossible for him to keep it in his chamber. It made every head in the house giddy; and he was obliged to put it in a barn, where the servants at last cut away the bag: the skin, notwithstanding, always retained a portion of the odour.

Musk affords the strongest of all known odours. A small bit of it perfumes a large quantity of matter. The odour of a small particle extends through a considerable space. It is likewise so fixed and permanent, that at the end of several years it seems to have lost no part of its activity.

From thirty grains of musk water extracts twelve grains, and spirit of wine ten grains. Spirit of nitre and oil of vitriol totally dissolve it: the former destroys the whole of its smell and the latter the greatest part of it. In the distillation of odoriferous waters and spirit a small portion of musk, included in a linen cloth, is generally hung in a still-head, the vapour of both liquors extracting its scent. Spirit, distilled with musk immersed with it, acquires little of its smell; but water by this method acquires both the smell and taste. A minute portion of musk greatly improves the fragrance of the distilled odoriferous waters, as those of lavender and rosemary, and heightens the smell of other odoriferous ingredients, without communicating any of its own peculiar smell. The quantity of liquor, which may be flavoured by macerating a certain known proportion of musk for a few days in rectified spirit of wine appears to be the best criterion of the genuineness and goodness of this commodity; a commodity which is not only said to vary according to the season of its being taken from the animal, but which is sometimes so artfully sophisticated, that the abuses cannot be discovered by any external characters, or by any other means than the degree of its specific smell and taste, which the above experiment affords the best method of estimating.

Musk is in considerable use among the perfumers and confectioners, though much less now than it was formerly. It is supposed to fortify the heart and brain, and is good against deafness, and is now received in general practice in different convulsive disorders; and its dose has been increased with advantage to a scruple and half a drachm, every four or six hours.

Musk and other perfumes of the same tribe, have been long celebrated as antispasmodics, but were formerly ordered in such small quantities as to have little effect. Practitioners thought four or five grains a large dose. But the Chinese have taught us to be more bold; the tenth part of an ounce is a usual dose among them. The remedy in the East, for the bite of the mad dog contains sixteen grains of musk, and this they repeat frequently. The effects of musk are, ease from pain, quiet sleep, and a copious diaphoresis. Hence it has been found of great use in spasmodic

disorders, petechial, malignant, putrid fevers, the gaol distemper, hiccoughs, *subultus tendinum*, &c. For the particular cases, we refer to the Philosophical Transactions, No. 474, Sect. 18, and xlv. p. 75, &c. Instances occur in which it has been of very great benefit in convulsive disorders, in the London Med. Obs. &c. vol. iii, art. 21, 31. It has also been found useful in spasmodic disorders given by way of clyster, as Dr. Wall observes, in that Transaction. The operation of musk, in some respects, resembles that of opium; but it is much preferable, that it does not leave behind it any stupor or languidness, which the latter often does. Musk therefore seems likely to answer in those low cases where sleep is much wanted and opiates are improper. It is said to be best given in a bolus, and that those who are most averse to perfumes may take it in that form without inconvenience. For, as Et Mullier and others have long ago observed, the smell of the perfume is often found to be of disservice, where the substance inwardly taken produces good effects. Dr. Wall confirms the observation by remarking, that two persons, labouring under a *subultus tendinum*, extreme anxiety, and want of sleep, from the bite of a mad dog, by taking two doses of musk, each of which was 16 grains, were perfectly relieved from their complaints. He likewise observes, that convulsive hiccups, attended with the worst symptoms, were removed by a dose or two, of 10 grains; and that in some cases, where this medicine could not, on account of strong convulsions, be administered to the patient by the mouth, it proved of service when injected as a clyster. He likewise adds, that under the quantity of six grains, he never found much effect from it; but that, taken to 10 grains and upwards, it never fails to produce a mild diaphoresis, without at all eating or giving any uneasiness, that, on the contrary, it eases pain, raises the spirits; and that, after the sweat breaks out, the patient usually falls into a refreshing sleep; that he never met with any hysterical person, how averse soever to perfumes, but could take it, in the form of a bolus, without inconvenience. To this paper is annexed an account of some farther extraordinary effects of musk, observed by another gentleman. Repeated experience has since confirmed its efficacy in these disorders. The dose has sometimes been increased, particularly in convulsive disorders, to the quantity of a scruple or half a drachm, every three or four hours, with two or three spoonfuls of the musk julep between. The julep is the only official preparation of it. It is combined with opium in tetanus, and with mercury in rabies canina.

In a paper read before the Royal Society, March 17, 1747-8, several cures performed by musk, on distempered cows, were mentioned.

When musk begins to decay, it is a practice used in the East Indies to put it into a bladder or bag, wherein many small holes are made with a needle, and hang it in the necessary-house, but not low enough to touch the filth. Others keep it wrapped up in linen, well moistened with rank urine. Mr. Boyle says, of his own knowledge, that musk has greatly contributed to the preservation of flesh. Works abr. vol. i. page 30.

MUSK RAT. The English name of a species of the genus *Castor*, in mammalia. For description of the genus and several species, see *CASTOR*. For representation of this species, see Plate 7. Genus 23. Species 2.

MUSSULMAN, or *Musulman*, written in the Arabic *moslem*, *mosleman*, or *mosolman*, a title by which the Mahometans distinguish themselves; signifying, in the Turkish language, true believer, or orthodox.

The appellation was first given to the Saracens; as is observed by Leunclavius. There are two kinds of mussulmans, very averse to each other; the one is called *Sunnites*, and the other *Shiites*. The *Sunnites* follow the interpretation of the Koran given by Omar; the *Shiites* are the followers of Ali. The subjects of the King of Persia are *Shiites*, and those of the Grand Signior, *Sunnites*. See *ALCORAN*.

Some authors will have it, that the word mussulman signifies saved, that is, predestinated; and that the Mahometans give themselves the appellation, as believing they are all predestinated to salvation. Martinus is more particular as to the origin of the name; which he derives from the Arabic word *musalam*, saved, snatched out of danger: the Mahometans, he observes, establishing their religion by fire and sword, massacred all those who would not embrace it, and granted life to all that did, calling them mussulmans; q. d. *eripiti e periculo*; whence the word, in course of time, became the distinguishing title of all those of that sect, who have affixed to it the signification of *true believer*.

MUST, **MUSTUM**, sweet wine newly pressed from the grape; or the new liquor pressed from the fruit before it has worked or fermented. See *WINE*.

MUST of Rhenish wine. This is a liquor that, though drank by some, is found extremely to affect the brain; for not having passed the natural effervescence which it would have been subject to, in the making of wine, its salts are locked up till the heat of the stomach setting them to work, they raise their effervescence there, and send up abundance of subtile vapours to the brain. The Rhenish must is of two kinds, being made either with or without boiling. That made without boiling is only put up so close in the vessel that it cannot work; this is called *stump wine*. They have

also another kind of Rhenish must, which is thus prepared: they boil the liquor to half the quantity, and put into it the medicinal ingredients they are most fond of; such as orange-peel, elecampane-root, and juniper-berries, or the like; being thus medicated, the whole works much more slowly than it otherwise would.

MUSTARD, *MUSTARD-Seed*, is one of the strongest of the pungent, stimulating, diuretic medicines, that operates without exciting much heat. It is sometimes taken unbruised, to the quantity of a spoonful at a time, in paralytic, cachectic, and serous disorders. It is applied also as an external stimulant, to benumbed and paralytic limbs; to parts affected with fixed rheumatic pains; and to the soles of the feet, in the last stage of acute diseases, for raising the pulse; in this intention, a mixture of equal parts of the powdered seeds and crumbs of bread, with the addition sometimes of a little bruised garlic, are made into a cataplasm with a sufficient quantity of vinegar. Mustard-feed yields, upon expression, a considerable quantity of oil, which is by some recommended externally against rheumatisms and palsies, though it has nothing of that quality by which the seeds themselves prove useful in those disorders; the oil being mild and insipid as that of olives, and the pungency of the feed remaining entire in the cake left after expression; nor is any considerable part of the pungent matter extracted by rectified spirit. The bruised seeds give out readily to water nearly the whole of their active matter: added to boiling milk they curdle it, and communicate their pungency to the whey. The powder of mustard-feed may be made into the consistence of a loch with warm water, into which a little sea-salt has been dissolved. Of this a common spoonful, sometimes two, diluted with tepid water, are given on an empty stomach; it operates as well as an emetic, and proves an excellent remedy in most nervous disorders, according to Dr. Monro, in *Med. Ess. Edin.* vol. ii. art. 19. p. 303, note.

MUSTELA, in mammalia, a genus belonging to the order *Fera*. There are six erect, sharp, distinct teeth, in the upper jaw, and an equal number in the under jaw, but blunter, and closer together, and two of them are situated a little further within the mouth; and the tongue is smooth. The most remarkable species are the following:

The lutris, or sea-otter, hath palmated feet, and the tail about one-fourth the length of the body; the hair thick, long, and excessive black and glossy: beneath that is a soft down; the colour sometimes varies to silvery. The largest of these animals weigh 70 or 80 pounds. They inhabit, in vast abundance, the coasts of Kamtschatka, and the parts of America opposite to it, discovered by the Russians; it is also met with in a most remote part of the continent of America, along the rivers of Brasil and Paraguay, and in the Oroonoko. It is a harmless animal; very affectionate to its young, inasmuch that it will pine to death at the loss of them, and die on the very spot where they have been taken from it. Before the young can swim, they carry them in their paws, lying in the water on their back: they run very swiftly; swim often on their back, their sides, and even in a perpendicular posture; are very sportive; embrace and kiss each other: they inhabit the shallows, or such places as abound with sea-weeds; feed on lobsters, and other shell-fish, as well as sepia, and common fishes: they breed but once a year, and have but one young at a time, fuckle it for a year, and bring it on shore. They are dull sighted, but quick scented; are hunted for their skins; which are of great value, being sold to the Chinese for 70 or 80 rubles apiece; each skin weighs 3½ lb. The young are reckoned very delicate meat, scarcely to be distinguished from a sucking lamb. For representation, see Plate V. Genus XV. Species I.

The lutra, or common otter, has palmated feet, the tail one-half the length of the body; the whole colour is a deep brown, except two small spots on each side of the nose, and another below the chin; the legs are short and thick, and loosely joined to the body: the length, from the nose to the tail, is 23 inches. The otter inhabits all parts of Europe, the north and the north-east of Asia, even as far as Kamtschatka; it abounds in North America, particularly in Canada, from whence the most valuable furs of this kind are brought. He is a voracious animal, but fonder of fish than of flesh: he doth not willingly quit the margins of rivers or lakes, and often depopulates fish-ponds; but if fish happen to fail, he makes excursions on land, and preys on lambs and poultry. It is observable that the otter always swims against the stream to meet its prey; and two of them, it is said, will hunt a salmon in concert. One stations itself above, and the other below the place where the fish lies, and continue chasing it incessantly, till the creature, quite wearied out, becomes their prey. Sometimes the otter preys in the sea, but not far from shore. It hath been observed however, in the Orkneys, to bring in cod, congers, &c. Properly speaking, he is not an amphibious animal; for, like other terrestrial creatures, he requires the aid of respiration. When in pursuit of a fish, if he chances to be entangled in a net, he drowns; and we perceive that he has not had time to cut a sufficient quantity of the meshes to effectuate his escape. For want of fishes, crabs, frogs, or other animal food, he gnaws the young twigs, and eats the bark of aquatic trees; he likewise eats the young herbage in the spring. The female frequently comes in season in winter, brings forth in March, and the litter consists of three or four. The young otters are less

handsome than the old. The otter is capable of being tamed; he will follow his master like a dog, and even fish for him, and return with his prey.

Though the otter doth not cast his hair, his skin is browner, and sells dearer in winter than in summer; and makes very fine fur.—His flesh has a disagreeable fishy taste. His retreat exhales a noxious odour, from the remains of putrid fishes; and his own body has a bad smell. The dogs chase the otter spontaneously, and easily apprehend him, when at a distance from water or from his hole; but, when seized, he defends himself; bites the dogs most cruelly, and sometimes with such force as to break their leg-bones, and never quits his hold but with life. The beaver, however, who is not a very strong animal, pursues the otters, and will not allow them to live on the same banks with themselves. For representation, see Plate V. Genus XV. Species II.

The otters, of which there are several more species described by authors, are distinguished from the following tribe, the weasels, by having their feet palmated or webbed; whereas the latter have their toes separate, or unconnected by any web or membrane.

The Galera, or Guinea-weasel: the toes are not connected with a membrane, he is of a black colour, with coarse hair, of the size of a martin: digs an habitation in the earth with his fore-feet, in which he has great strength, and which are much shorter than those behind. It inhabits Guinea, Brasil, and Guiana: when it rubs itself against trees, it leaves behind an unctuous matter that smells of musk. It is very fierce, and if driven to necessity, will fly at a man or beast; and it is very destructive to poultry.

The gulo, or glutton, is of a dusky red colour, and blackish on the middle of the back; it is a most voracious animal, but very slow of foot, so is obliged to take his prey by surprize. In America it is called the beaver-eater; because it watches those animals as they come out of their houses, and sometimes breaks into their habitations and devours them. It often lurks on trees, and falls on the quadrupeds that pass under: will fasten on an elk, or stag, and continue eating a hole into its body, till the animal falls down with pain, or else will tear out its eyes; no force can disengage it; yet sometimes the deer, in their agony, have been known to destroy the glutton, by running its head violently against a tree. This animal also devours the isatis, or white fox; searches for the traps laid for the fables, and other animals, and is often beforehand with the hunters, who sustain great loss by the glutton. He avoids water, and dreads horses, and men dressed in black. He walks by a kind of leap, and eats pretty voraciously. After taking a full meal, he covers himself in his cage with straw. When drinking, he laps like a dog. He utters no cry. After drinking, with his paws he throws the remainder of the water on his belly. He is almost perpetually in motion. If allowed, he would devour more than four pounds of flesh every day. He eats no bread; and devours his food so voraciously, and almost without chewing, that he is apt to choke himself.

The glutton is common in most of the northern regions of Europe, and even of Asia; but in Norway, according to Pontopidan, he is chiefly confined to the diocese of Drontheim. The same author remarks, that the skin of the glutton is very valuable. In its wild state, Mr. Pennant informs us, that the glutton is vastly fierce; a terror both to wolf and bear, which will not prey upon it when they find it dead; perhaps on account of its being so very fetid that it smells like a pole-cat: it makes a strong resistance when attacked; notwithstanding which it is capable of being tamed, and of learning several tricks. M. Buffon remarks that though the glutton employs considerable art and address in seizing other animals, he seems to possess no other talents but those which relate to appetite. "It would (says he) appear that the glutton even wants the common instinct of self-preservation. He allows himself to be approached by men, or comes up to them without betraying the smallest apprehensions." This indifference, which seems to be the effect of imbecility, proceeds, perhaps from a different cause.

It is certain the glutton is not stupid, since he finds means to satisfy his appetite, which is always vehement and pressing. Neither is he deficient in courage, since he attacks most enemies he meets with, and he shews no fear at the sight of men. Hence, if he wants attention to himself, it proceeds not from indifference to his own preservation, but from the habit of security. As he lives in a country which is almost desert, he seldom sees men, who are his only enemies. Every time he tries his strength with most animals, he finds himself their superior. He goes about with perfect confidence, and never discovers the smallest mark of fear, which always supposes some experience of weakness. Of this we have an example in the lion, who never turns away from man, unless he has experienced the force of his arms: and the glutton trailing along the snows of his desert climate, remains always in perfect safety, and reigns, like the lion, not so much by his own strength, as by the weakness of the animals around him.

The martes, or martin, is of a blackish yellow colour, with a pale throat, and the toes are not webbed. These animals are found in great numbers in all temperate countries, and even in warm regions, as in Madagascar and the Maldivia islands, and are never seen in high latitudes. The martin has a fine countenance, a lively eye, supple limbs, and a flexible body. His movements

are all exceedingly nimble: he rather bounds and leaps than walks. He climbs rough walls with ease and alacrity; enters the pigeon or hen-houses, eats the eggs, pigeons, fowls, &c. and the female often kills great numbers, and transports them to her young. He likewise seizes mice, rats, moles, and birds in their nests. M. Buffon kept one of these animals for a considerable time. He tamed to a certain degree, but never formed any attachment, and continued always so wild that it was necessary to chain him. He was then about a year and a half old, seemingly the age at which nature assumes her full ascendancy. He ate every thing presented to him, except salad and herbs; was fond of honey, and preferred hemp-seed to every other grain. It was remarked that he drank very often; that he sometimes slept two days successively, and at other times would not sleep for two or three days; that, before sleeping he folded himself in a round form, and covered his head with his tail; and that, while awake, his motions were violent and perpetual. The same author informs us, that he has had in his possession several martins of an advanced age, which had been taken in nets; but they continued to be totally savage, bit all who attempted to touch them, and would eat nothing but raw flesh.

Martins, it is said, go with young as long as cats. We meet therefore with young ones from spring to autumn; and therefore it is probable they bring forth more than once a-year. The younger females bring only three or four at a time; but the more aged produce six or seven. The martin has an agreeable musky colour, which proceeds from a matter contained in two vesicles, one on each side of the extremity of the rectum. The skin is a valuable fur, and much used for the linings to the gowns of magistrates. For representation see Plate V. Genus XV. Species VI.

The putorius, pole-cat, or fitchet, has unconnected toes, is of a dirty yellow-colour, with a white mouth and ears. He is a native of most parts of Europe; and has a great resemblance to the martin in temperament, manners, disposition, and figure. Like the former, he approaches our habitations, mounts on the roofs, takes up his abode in hay-lofts, barns, and unfrequented places, from which he issues during the night only in quest of prey. He burrows under ground, forming a shallow retreat, about two yards in length, generally terminating under the roots of some large tree. He makes greater havoc among the poultry than the martin, biting off the heads of all the fowls, and then carrying them off one by one to his magazine. If, as frequently happens, he cannot carry them off entire, on account of the smallness of the entry of his hole, he eats the brains, and takes only the heads along with him. He is likewise very fond of honey, attacks the hives in winter and forces the bees to abandon them. The females come in season in the spring, and bring forth three, four, or five at a time, but do not cast them off till the end of summer. The pole-cat is excessively foetid; yet the skin is dressed with the fur on, and used as the other furs for tippets, &c. and is also sent abroad to line clothes. For representation, see Plate V. Genus XV. Species VII.

The furo, or ferret, has red eyes, and unconnected toes; the colour of the whole body is of a very pale yellow; the length from nose to tail is about 14 inches, the tail five. In its wild state it inhabits Africa; from whence it was originally brought into Spain, in order to free that country from multitudes of rabbits with which it was over-run; and from thence the rest of Europe was supplied with it. This creature is incapable of bearing the cold, and cannot subsist even in France unless in a domestic state. The ferret is not in our climates endowed with the same capacity of finding his subsistence as other wild animals, but must be carefully nourished within doors, and cannot exist in the fields; for, those who are lost in the burrows of rabbits never multiply, but probably perish during winter. Like other domestic animals, he varies in colour. The female ferret is less than the male; and when in season, we are assured, she is so extremely ardent, that she dies if her desires are not gratified. Ferrets are brought up in walks or boxes, where they are furnished with beds of hemp or flax. They sleep almost continually. Whenever they awake, they search eagerly for food: and brawn, bread, milk, &c. are commonly given them. They produce twice every year; and the female goes six weeks with young. Some of them devour their young as soon as they are brought forth, instantly come again in season, and have three litters, which generally consist of five or six, and sometimes of seven, eight, or nine. This animal is by nature a mortal enemy to the rabbit. Whenever a dead rabbit is for the first time presented to a young ferret, he flies upon it, and bites it with fury; but if it be alive, he seizes it by the throat or the nose, and sucks its blood. When let into the burrows of rabbits he is muzzled, that he may not kill them in their holes, but only oblige them to come out, in order to be caught in the nets. If the ferret is let in without a muzzle, he is in danger of being lost: for, after sucking the blood of the rabbit, he falls asleep; and even smoking the hole is not a certain method of recalling him; because the holes have often several entries, which communicate with each other, and the ferret retires into one of those when incommoded with the smoke. Boys likewise use the ferret for catching birds, in the holes of walls, or old trees. The ferret, though easily tamed, and rendered docile, is extremely irascible: his odour

always disagreeable: but when he is irritated it becomes much more offensive. His eyes are lively, and his aspect is inflammatory: all his movements are nimble; and he is at the same time so vigorous that he can easily master a rabbit, though at least four times larger than himself. For representation, see Plate V. Genus XV. Species VIII.

The zibellina, or fable, has divided toes; the body is of a dusky yellow colour; with a white forehead, and an ash-coloured throat. It is found in Tartary, and the northern part of Asia. The fables inhabit the banks of rivers, and the thickest parts of the woods. They leap with great agility from tree to tree; and avoid the rays of the sun. They live in holes of the earth, or beneath the roots of trees: sometimes they will form nets in the trees, and skip with great agility from one to the other: they are very lively, and much in motion, during the night. Mr. Gmelin tells us, that after eating they generally sleep half an hour or an hour, when they may be pushed, shaken, or even pricked, without awaking. During the night they are extremely active and restless. A tame one, kept by Mr. Gmelin, was accustomed to rise upon its hind-legs, on sight of a cat, in order to prepare for the combat. During summer the fables prey on ermines, weasels, and squirrels, but especially on hares; in winter on birds; in autumn on huckleberries, cranberries, and the berries of the service-tree: but during that season the skins are at the work; that diet causing their skins to itch, and to rub off their fur against the trees: they bring forth at the end of March or beginning of April, and have from three to five at a time, which they suckle for four or five weeks. For representation, see Plate V. Genus XV. Species IX.

At present the hunters of fables form themselves into troops, from 5 to 40 each: the last subdivide into lesser parties, and each chooses a leader: but there is one that directs the whole: a small covered boat is provided for each party, loaded with provisions, a dog and net for every two men, and a vessel to bake their bread in. Each party also has an interpreter for the country they penetrate into; every party then sets out according to the course their chief points out: they go against the stream of the rivers, drawing their boats up till they arrive in the hunting country; there they stop, build huts, and wait till the waters are frozen, and the season commences; before they begin the chase, their leader assembles them, they unite in a prayer to the Almighty for success, and then separate; the first fable they take is called *God's fable*, and is dedicated to the church.

They then penetrate into the woods; mark the trees as they advance, that they may know their way back; and in their hunting-quarters form huts of trees, and bank up the snow round them; near these they lay their traps, then advance farther, and lay more traps, still building more huts in every quarter, and return successively to every old one to visit the traps and take out the game to skin it, which none but the chief of the party must do: during this time they are supplied with provisions by persons who are employed to bring it on sledges, from the places on the road where they are obliged to form magazines, by reason of the impracticability of bringing quantities through the rough countries they must pass. The traps are a sort of pit-fall, with a loose board over it, baited with fish or flesh. When fables grow scarce, the hunters trace them in the fallen snow to their holes; place their ferrets at the entrance; and sometimes wait, watching two or three days for the coming out of the animal. It has happened that these poor people have, by the failure of their provisions, been so pinched with hunger, that, to prevent the cravings of appetite, they have been reduced to take two thin boards, one of which they apply to the pit of the stomach, the other to the back, drawing them tight together by cords placed at the ends: such are the hardships our fellow creatures undergo to supply the wantonness of luxury!

The season of chase being finished, the hunters re-assemble, make a report to the leader of the number of fables each has taken, make complaints of offenders against their regulations, punish delinquents, share the booty, then continue at the head-quarters till the rivers are clear of ice, return home, and give to every church the dedicated furs.

The erminea, or white ermine, is ten inches long, from the nose to the origin of the tail, the tail itself is five inches and a half long. The colours bear a near resemblance to those of the weasel. In the most northern parts of Europe, these animals regularly change their colour in winter, and become totally white, except the end of the tail, which continues invariably black; and in that state are called ermines; we are informed that the same is observed in the Highlands of Scotland. The skins and tails are a very valuable article of commerce in Norway, Lapland, Russia, and other cold countries, where they are found in prodigious numbers. They are also very common in Kamtschatka and Siberia. In Siberia they burrow in the fields, and are taken with traps baited with fish. In Norway they are either shot with blunt arrows, or taken with traps, made of two flat stones, one being propped up with a stick, to which is fastened a baited string, which, when the animals nibble, the stone falls down and crushes them to death. The Laplanders take them in the same manner, only instead of stones, they use logs of wood. For representation, see Plate V. Genus XV. Species X. Variety I.

M U T

The vulgaris, fountart, or common ermine, is a variety of the erminea and the least of the weasel kind; the length of the head and body not exceeding six, or at most seven inches. The tail is only two inches and a half long, and ends in a point; the ears are large; and the lower parts of them are doubled in. The whole upper part of the body, the head, tail, legs, and feet, are of a very pale tawny brown. The whole under-side of the body; from the chin to the tail, is white; but beneath the corners of the mouth, on each jaw, is a spot of brown. It is a remarkably active animal, and will run up the sides of walls with such ease that scarce any place is secure from it; and the body is so small, that there is scarce any hole but what is pervious to it. This species is much more domestic than any of the rest, and frequents out-houses, barns, and granaries. It clears its haunts in a short time from mice and rats, being a much greater enemy to them than the cat itself. It may be perfectly tamed, and rendered caressing and frolicsome as a dog or squirrel. The method of taming is to stroke them often and gently over the back; and to threaten, and even to beat them when they bite. In the domestic state the odour is never offensive but when irritated. They are fed with milk, boiled flesh, and water. In most other respects this animal resembles the weasel kind in general. The natural history of this creature is much the same with that of the weasel; its food being birds, rabbits, mice, &c. its agility the same, and its scent equally fetid. For representation, see Plate V. Genus XV. Species X. Variety II.

The navalis, or stoat, according to Linnæus, is a distinct species of the genus Mustela; we have therefore, in conformity to our plan, adopted his mode of classification; though more modern naturalists differ from him, and consider him only as a variety of the erminea: nay, Linnæus himself describes it as entirely similar to the ermine, excepting in size, being smaller by the half. For representation, see Plate V. Genus XV. Species XI.

MUTE, in a general sense, signifies a person that cannot speak, or has not the use of speech. See the article DUMBNESS.

MUTILATION, the retrenching or cutting away any member of the body. This word is also extended to statues and buildings, where any part is wanting; or the projecture of any member, as a cornice or an impost, is broken off. It is sometimes also used in a more immediate manner for castration (See CASTRATION and EUNUCH.) The practice of this sort of mutilation is of various kinds: The Hottentots are said to cut away one testicle from their children, upon supposition that they are thereby made lighter and more active for running. In other countries, poor people completely mutilate their boys, to prevent the misery and want which could attend their offspring. Those who have nothing in view but the improvement of a vain talent, or the formation of a voice which disfigures nature, as was the case formerly in Italy, are contented with cutting away the testicles. But in some countries of Asia, especially among the Turks and in a part of Africa, those whom jealousy inspires with distrust would not think their wives safe in the custody of such eunuchs. They employ no slaves in their seraglios who have not been deprived of all the external parts of generation.

Amputation is not the only means of accomplishing this end. Formerly, the growth of the testicles was prevented, and their organization destroyed, by simple rubbing, while the child was put into a warm bath made of a decoction of plants. Some pretend that by this species of castration the life is in no danger. Amputation of the testicles is not attended with much danger; but complete amputation of the external parts of generation is often fatal. This operation can only be performed on children from seven to ten years of age. Eunuchs of this kind, owing to the danger attending the operation, cost in Turkey five or six times more than others. Chardin relates that this operation is so painful and dangerous after 15 years of age, that hardly a fourth part of those by whom it is undergone escape with life.

There are eunuchs at Constantinople, throughout all Turkey, and in Persia, of a grey complexion; they come for the most part from the kingdom of Golconda, the peninsula on this side the Ganges, the kingdoms of Assau, Aracan, Pegu, and Malabar. Those from the Gulf of Bengal are of an olive colour. There are some white eunuchs, who come from Georgia and Circassia, but their number is small. The black eunuchs come from Africa, and especially from Ethiopia. These, in proportion to their horrible appearance, are the more esteemed, and cost dearer. It appears that a very considerable trade is carried on in this species of men; for Tavernier informs us, that when he was in the kingdom of Golconda, in the year 1657, 22,000 eunuchs were made in it. In that country they are sold at the fairs.

Eunuchs who have been deprived only of their testicles, continue to feel a titillation in what remains, and to have the external sign even more frequently than other men. But the part which remains is very small, and continues almost in the same state in which it was when the operation was performed during childhood. If the different kinds of eunuchs are examined with attention, it will be found almost universally, that castration and its consequences have produced greater or less changes on their shape and appearance, independent of its physical effects.

Eunuchs, says Mr. Withof, are timid, irresolute, fearful, suspicious, and unsteady. And this seems to hold generally, though not

M Y C

universally, or without exceptions (see the article EUNUCH.) The reason is, that their blood has not received all the necessary preparation in passing through the spermatic vessels. Thus being deprived of the properties of males, they participate of the dispositions of females, and their very soul is of an intermediate sex. They are not, however, without advantages: They become larger and fatter than other men; but they sometimes grow to a disgusting size. Though oily substances are more abundant in eunuchs, they are likewise less subject to gout and madness than men who have a greater quantity of blood and splenic humours. The abundant circulation of oily liquor prevents roughness or inequalities in the trachea and palate. This, joined to the flexibility of the epiglottis and of the other organs of the voice, makes it so sonorous and extensive, and at the same time so sweet, that it is almost impossible for eunuchs to pronounce distinctly the letter R. Is this factitious advantage a sufficient consolation to these unhappy men for the barbarity of those who have dared to sacrifice nature at the shrine of avarice? It is impossible to reflect on all the motives for making eunuchs without a sigh of pity and regret; and yet it must not be supposed that this abominable cruelty is always infallibly attended with that advantage which is sometimes expected from it. Of 2000 victims to the luxury and extravagant caprices of the art, hardly three are found who unite good talents with good organs. The other languishing and inactive wretches, are outcasts from both sexes, paralytic members in the community, an useless burden upon the earth, by which they are supported and nourished. But let us pay the tribute which is due to that virtuous pontiff Pope Clement VIII. who, listening to the voice of modesty and humanity, proscribed and abolished this detestable and infamous practice. Mutilation, he declared, was the most abominable and disgraceful of crimes.

MYA, in conchology, a genus, &c. belonging to the second order Bivalves. For the generic and specific characters, see the System, Order II. Genus IV.

This shell is noted for producing quantities of pearl. There have been regular fisheries for the sake of this precious article in several of our rivers. Sixteen have been found within one shell. They are the disease of the fish, analogous to the stone in the human body. On being squeezed they will eject the pearl, and often cast it spontaneously in the sand of the stream. The Conway was noted for them in the days of Camden. A notion also prevails, that Sir Richard Wynne, of Gwydir, chamberlain to Catherine queen to Charles II. presented his majesty with a pearl (taken in this river) which is to this day honoured with a place in the regalia crown. They are called by the Welsh *cregin diluaw*, or "deluge shells," as if left there by the flood. The Irt, in Cumberland, was also productive of them. The famous circumnavigator, Sir John Hawkins, had a patent for fishing in that river. He had observed pearls plentifully in the Straits of Magellan, and flattered himself with being enriched by procuring them within his own island. In the last century, several of great size were got in the rivers of the counties of Tyrone and Donegal in Ireland. One that weighed 36 carats, was valued at 40*l.* but being foul, lost much of its worth. Other single pearls were sold at 4*l.* 10*s.* and even for 10*l.* The last was sold a second time to lady Glenelg, who put it into a necklace, and refused 80*l.* for it from the duchess of Ormond. Linnæus made a remarkable discovery relating to the generation of pearls in this fish.—It is a fish that will bear removal remarkable well; and it is said that in some places they form reservoirs for the purpose of keeping it, and taking out the pearl, which in a certain period of time, will be again renewed. From observations on the growth of their shells, and the number of their annular laminae or scales, it is supposed the fish will attain a very great age; 50 or 60 years are imagined to be a moderate computation. The discovery turned on a method, which Linnæus found, of putting these shell-fish into a state of producing pearls at his pleasure; though the final effect did not take place for several years: He says, that in five or six years after the operation, the pearl would have acquired the size of a vetch. We are unacquainted with the means by which he accomplished this extraordinary operation; but it was probably published at that time, and considered as important, since it is certain that the author was rewarded with a munificent premium from the states of the kingdom on this account. We regret that we cannot speak more fully of this head; but may observe, that it is probable, from a paper published many years afterwards in the Berlin acts, that the method consisted in injuring the shell externally, perhaps, by a perforation; as it has been observed that these concretions in shell-fish are found on the inside, exactly opposite to perforations and injuries made from without by serpulae and other animals.

MYCTERIA, the *Jabiru*, in ornithology; a genus of birds belonging to the order Grallæ. The bill is long, bending upwards, and acute; the nostrils are small and linear; there is a tongue; and the feet have four toes. The Americana, or American Jabiru, is about the size of a turkey. The bill is long, black, and of a black colour; the whole plumage is white, except the head, and about two-thirds of the neck, which are bare of feathers and of a blackish colour; the remainder is also bare, and of a red; on the hind-head are a few greyish feathers; the legs are strong, of a great length, and covered with black scales; with

and tail even at the end. This bird is found in all the savannas of Cayenne, Guiana, and other parts of South America. It is migratory and gregarious. They are very wild and ferocious, and their food is fish, which they devour in great quantities. The flesh of the young birds is said to be good eating, but that of the old is hard and oily. For representation, see Plate IV. Genus LXII.

MYOPS, *Myopia*, a person who is short-sighted; or, as we popularly call it, purblind. The word is Greek, *μυω*, compounded of *μυω*, mouse, and *ω*, eye; because, we suppose, the same conformation of the eye is observed in mice. *Myopes* are properly such as see remote objects confusedly, and near ones distinctly. Those who labour under the opposite defect are called *presbyta*. The defect of *myopes* is not in the optic nerve, the pupil, or the like; but in the form of the cornea or crystalline, or the distance of the retina from the same. The crystalline, or cornea being rounder or more convex than ordinary, the rays will be rendered more convergent than ordinary, in passing through the same. By this means they will be brought to meet or concur at a less distance from the crystalline; so that if the retina be at its usual distance, they will concur before they reach it. It is the too great nearness, then, of the retina to the crystalline, that constitutes the *myopes*.

MYRISTICA, the *Nutmeg-tree*, in botany: a genus of plants belonging to the class *Diacia*, and order *Syngenesia*.

Species. There are five species of this genus, according to some authors; but several of these being only varieties, may be reduced to three, viz.

1. *Myristica fatua*, or wild nutmeg: this grows in Tobago, and rises to the height of an apple-tree; has oblong, lanceolated, downy leaves, and a hairy fruit: the nutmeg of which is aromatic, but, when given inwardly, is narcotic, and occasions drunkenness, delirium, and madness, for a time. See a figure in *Gaernor de Sem.* and *Frucl. T.* 41. f. 3, 4.

2. The *myristica sebifera* (*Virola Sibiifera* Aublet, page 904, tab. 345). A tree frequent in Guiana, rising to 40, or even to 60, feet high; on wounding the trunk of which, a thick, acrid, red juice runs out. Aublet says nothing of the nutmegs being aromatic; he only observes, that a yellow fat is obtained from them, which serves many economical and medical purposes, and that the natives make candles of it.

3. The *myristica moschata*, or nutmeg, attains the height of 30 feet; producing numerous branches, which rise together in stories, and covered with bark, which, of the trunk, is a reddish-brown, but that of the young branches is of a bright green colour: the leaves are nearly elliptical, pointed, undulated, obliquely nerved; on the upper side of a bright green, on the under whitish, and stand alternately upon footstalks: the flowers are small, and hang upon slender peduncles, proceeding from the axillæ of the leaves: they are both male and female upon separate trees.

M. Schwartz, who has carefully examined this, as well as the two first species, preserved in spirits, places them amongst the monodelphia.

Nutmegs, when heated, yield to the press a considerable quantity of limpid yellow oil, which, on cooling, concretes into a sebaceous consistence. In the shops we meet with three sorts of unctuous substances, called *oil of mace*, though really expressed from the nutmeg. The best is brought from the East Indies, in stone jars; this is of a thick consistence, of the colour of mace, and has an agreeable fragrant smell; the second sort, which is paler coloured, and much inferior in quality, comes from Holland, in solid masses, generally flat, and of a square figure: the third, which is the worst of all, and usually called *common oil of mace*, is an artificial composition of *seum*, palm-oil, and the like, flavoured with a little genuine oil of nutmeg. A pound of them commonly gives three ounces of oil, which has the consistence of tallow, and has entirely the taste of nutmeg. Both the nut and mace, when distilled, afford an essential, transparent, and volatile oil, of an excellent flavour. These nuts are likewise pickled with brine, or with vinegar: and when they intend to eat them, they first steep them in fresh water, and afterwards boil them in syrup of sugar, &c.

Uses. Nutmegs preserved entire are presented as desserts, and the inhabitants of India sometimes eat them when they drink tea. Some of them use nothing but the pulp; others likewise chew the mace; but they generally throw away the kernel, which is really the nutmeg. Many, who perform sea-voyages to the north, chew this fruit every morning.

The medicinal qualities of nutmeg are supposed to be aromatic, anodyne, stomachic, and astringent; and, with a view to the last-mentioned effects, it has been much used in diarrhoeas and dysenteries. To many people the aromatic flavour of nutmeg is very agreeable; they, however, should be cautious not to use it in large quantities, as it is apt to affect the head, and even to manifest an hypnotic power, in such a degree as to prove extremely dangerous. Bonivius speaks of this as a frequent occurrence in India; and Dr. Cullen relates a remarkable instance of this soporific effect of the nutmeg, which fell under his own observation, and hence concludes, that, in apoplectic and paralytic cases, this spice may be very improper. He observes, that a person, by mistake, took two drachms, or little more, of powdered nutmeg: he felt it warm in his stomach, without any uneasiness; but in about an hour after he had taken it,

he was seized with a drowsiness, which gradually increased to a complete stupor and insensibility; and not long after he was found fallen from his chair, lying on the floor of his chamber in the state mentioned. Being laid in bed, he fell asleep; but waking a little from time to time, he was quite delirious; and he thus continued, alternately sleeping and delirious, for several hours. By degrees, however, both these symptoms diminished; so that, in about six hours from the time of taking the nutmeg, he was pretty well recovered from both. Although he still complained of head-ache, and some drowsiness, he slept naturally and quietly the following night, and next day was quite in his ordinary health.

The official preparations of nutmeg are a spirit and essential oil, and the nutmeg, in substance, roasted, to render it more astringent. Both the spice itself, and its essential oil, enter several compositions, as the *confectio aromatica*, *spiritus amonia com.* &c. Mace possesses qualities similar to those of the nutmeg, but is less astringent, and its oil is supposed to be more volatile and acrid.

Remarks on the Trade of Nutmegs. Nutmeg-trees grow in several islands in the Eastern ocean. The wood-pigeon of the Moluccas is unintentionally a greater planter of these trees, and disseminates them in places where a nation, powerful by its commerce, thinks it for its interest that they should be rooted out and destroyed. The Dutch, whose unwearied patience can surmount the greatest obstacles, have appropriated to themselves the crop of nutmeg, as well as that of cloves and cinnamon, growing in the islands of Ternate, Ceylon, &c. either by right of conquest, or by paying subsidies to the islanders, who find these much more profitable than the former produce of their trees. It is, nevertheless, true, that they have prevailed upon, or compelled, the inhabitants of the Moluccas to cut down and root out all the clove-trees, which they have preserved only in the islands of Amboyna and Ternate, which are in a great measure subject to them. We know, for certain, that the Dutch pay 18,000 rixdollars yearly to the king of Ternate, by way of tribute or gift, in order to recompense him for the loss of his clove-trees in the other Molucca islands; and that they are, moreover, bound, by treaty, to take, at 3½d. a pound, all the cloves brought by the natives of Amboyna to their magazines. They have likewise succeeded to destroy the cinnamon every where, except in the island of Ceylon, which is in their possession. The same is the case with white-pepper, &c. so that the trade of the whole of Europe, and of great part of Asia, in this species of commodity, passes through their hands.

The Dutch have immense and very rich magazines of these precious aromatics, both in India and Europe. They have actually by them the produce of 16 years, and never supply their neighbours with the last, but always with the oldest crop: in 1760, they sold what was laid up in 1744. It is commonly said, that when the Dutch have too great a quantity of cloves, nutmegs, &c. in their magazines, they throw them into the sea; but the fact is, that they get rid of their superfluous aromatics by burning them. On the 10th of June, 1760, M. Beaumare saw, at Amsterdam, near the Admiralty, a fire, the fuel of which was valued at 1,000,000 of livres; and as much was to be burned on the day following. The feet of the spectators were bathed in the essential oil of these substances; but no person was allowed to gather any of it, much less to take any of the spices which were in the fire. Some years before, upon a similar occasion, and at the same place, a poor man, who had taken up some nutmegs which had rolled out of the fire, was, as M. Beaumare was informed, seized and condemned to immediate execution. We will only add, that, notwithstanding the jealousy of the Dutch, and the pains they take to preserve the sale of cloves wholly to themselves, they have never been able to prevent their own officers, in several parts of India, from embezzling and selling considerable quantities of them. M. de Jacourt informs us, that, in order to defraud the company, they sell them to the vessels of other nations which they meet at sea, and moisten the remainder with water, that they may still have the number of quintals of which their cargo consisted. The quantity sold may amount to 10 quintals in 100, before it can be perceived by the clerks of the magazines at Batavia, where they are received.

We are informed, by M. Romé de Lisle, who came from India, that the English draw a great deal of cinnamon, pepper, and cloves, from the island of Sumatra. The staple for this commodity, which gives great offence to the Dutch, is at the factory of Bencoolen. We have likewise seen a specimen of pretty good cinnamon raised at Martinico.—The French, to prevent the exportation of specie for these aromatic and exotic productions, have attempted to introduce the culture of them into some of their colonies. A great many plants of the clove and nutmeg-tree have been procured, and planted in the Isle of France, the island of Bourbon, and also at Cayenne, where they have a very promising appearance.

MYRMECOPHAGO, or *Ant-Bear*, in mammalia, the 8th genus belonging to the order *Bruta*; the characters are these: there are two teeth in the mouth; the tongue is long and cylindrical; the head terminates in a long snout or muzzle; and the body is covered with pretty long hair. There are four species, viz.

1. The *didactyla*, or little ant-eater, hath a conic nose, bending a little down; ears small, and hid in the fur; two hooked claws on the

the fore feet; the exterior being much the largest; four on the hind feet; the head, body, limbs, and upper part and sides of the tail, covered with long soft silky hair, or rather wool, of a yellowish-brown colour: from the nose to the tail it measures seven inches and a half; the last four inches of which, on the under side, are naked. It is thick at the base, and tapers at the point. It inhabits Guinea, climbs trees in quest of a species of ants which build their nests among the branches: has a prehensile power with its tail.

2. The *jubata*, or great ant-eater, hath a long slender nose; small black eyes; short round ears; a slender tongue, two feet and a half long, which lies double in the mouth; the legs slender; four toes on the fore feet; five on the hind feet; the two middle claws on the fore feet very large, strong, and hooked; the hair on the upper part of the body is half a foot long, black, mixed with grey; the fore legs are whitish, marked above the feet with a black spot; the tail is clothed with a very coarse black hair, a foot long; the length, from the nose to the tail, about four feet; the tail two feet and a half. For a representation, see Plate II. Genus VIII. Species II.

These animals have many properties in common with each other, both in their structure and manners. They all feed upon ants, and plunge their tongues into honey, and other liquid or viscid substances. They readily pick up crumbs of bread, or small morsels of flesh. They are easily tamed, and can subsist for a long time without food. They never swallow all the liquor which they take for drink; for it falls back through their nostrils. They run so slowly that a man may easily overtake them in an open field. Their flesh, though its taste be very disagreeable, is eaten by the savages. At a distance, the great ant-eater has the appearance of a fox; and for this reason some travellers have given him the name of the American fox. He has strength sufficient to defend himself from a large dog, or even from the jaguar or Brazilian cat. When attacked, he at first fights on end, and, like the bear, annoys his enemy with the claws of his fore feet, which are very terrible weapons. He then lies down on his back, and uses all his four feet; in which situation he is almost invincible; and continues the combat to the last extremity. Even when he kills his enemy, he quits him not for a long time after. He is enabled to resist better than most other animals; because he is covered with long bushy hair; his skin is remarkably thick; his flesh has little sensation; and his principle of life is very tenacious.

MYRRH, a gummy, resinous, concrete juice, obtained from an Oriental tree, of which we have, as yet, no certain account. It comes over to us in globes or drops, of various colours and magnitudes. The best sort is somewhat transparent, friable, in some degree unctuous to the touch, of an uniform brownish or reddish yellow colour, often streaked internally with whitish semicircular or irregular veins; of a moderately strong, not disagreeable, smell; and a lightly pungent, very bitter taste, accompanied with aromatic flavour, but not sufficient to prevent its being nauseous to the palate.

We have, as already observed, no certain information concerning the tree from which this substance flows; we are only told that the myrrh-tree, or plant, is a native of Abexim, in Ethiopia, and is named *bedoins* by the Arabs. It is affirmed by some that the myrrh we have at present is not equal in quality to that of the ancients, and has not that exquisite smell which all authors ascribe to the latter. They aromatized their most delicious wines with it; and it was presented, as a very valuable perfume, to our Lord, while he lay in the manger. But to this it may be easily answered, that there is no disputing about perfumes any more than about tastes and colours. Men are equally changeable with regard to smells, of which we have striking examples in musk and civet.

The medical effects of this aromatic bitter are to warm and strengthen the viscera: it frequently occasions a mild diaphoresis, and promotes the fluid secretions in general. Hence it proves serviceable in languid cases, diseases arising from a simple inactivity, those female disorders which proceed from a cold, mucous, sluggish indispotion of the humours, suppressions of the uterine discharges, cachectic disorders, and where the lungs and thorax are oppressed by viscid phlegm. Myrrh is likewise supposed in a peculiar manner to resist putrefaction in all parts of the body; and, in this light, stands recommended in malignant, putrid, and pestilential fevers, and in the small-pox: in which last it is said to accelerate the eruption.

Rectified spirit extracts the fine aromatic flavour and bitterness of this drug, and does not elevate any thing of either in evaporation: the gummy substance left by this menstruum has a disagreeable taste, with scarcely any of the peculiar flavour of the myrrh; this part dissolves in water, except some impurities, which remain. In distillation with water, a considerable quantity of a ponderous essential oil arises, resembling, in flavour, the original drug. Myrrh is the basis of an official tincture. It enters the *pilula ex aloë et myrrha*, the *pilula e gummi*, and *pilula stomachica*, and some other formulæ. But, for obtaining its full effects, it must be given in doses of half a drachm or upwards; and it is thought to be advantageously united with a proportion of nitre, cream of tartar, or some other refrigerant salt.

Dr. Simmons, in his Treatise on Consumptions, has bestowed very high encomiums on it, even in cases of tuberculous phthisis; and although it can by no means be represented as a remedy much to be depended on, yet there is reason to believe that it has been serviceable in some cases.

Tinctures of myrrh, made by digesting three ounces of the concrete in a quart of rectified or proof spirit, are kept in the shops, and given sometimes internally, from fifteen drops to a teaspoonful; but oftener used among us, externally, for cleansing ulcers, and promoting the exfoliation of the carious bones. The extract, obtained by inspissating the tincture, is a fragrant, bitter, very tenacious resin, amounting to one-third or more of the weight of the myrrh.

This bitter, aromatic, gummy resin, enters a great number of medicinal compositions; it is a warm corroborant, deobstruent, and antiseptic: it is given from a few grains to a scruple and upwards, in uterine obstructions, cachexies, &c. and often employed, also, as an external antiseptic and vulnerary.

Its bitterness renders it good for the stomach, and against worms; and it is chewed to prevent infection from contagious diseases. Dr. Quincy says, it is excellent to cleanse and strengthen the womb, and against tickling rheums; a good detergent; and, as such, much used externally, in unguents, for the healing of wounds: it makes the principal ingredient in embalming.

It is an apophthegm of chymists, derived from Van Helmont, that whoever can make myrrh soluble by the human body, has the secret of prolonging his days. And Boerhaave owns there seems to be truth in this, from its resisting putrefaction. He himself, and other chymists before him, have given methods for making solutions of myrrh, but only by means of alcohol. It seems not a little surprising that such great chymists should never find out that myrrh is soluble in common water.

MYRTIFORMES, *Caruncula*, in anatomy. See the System, Part III. Sect. XV. Art. II. and Plate X.

MYRTUS, in botany, the *Myrtle*. A genus of the *Monogynia* order, belonging to the *icofandria* class of plants. The calyx is quinquefid, superior; there are five petals; the berry is dispersuous or trisperous. There are 14 species, of which the most remarkable are,

1. The *Communis*, or common myrtle-tree, rises with a shrubby, upright, firm stem, branching numerously all around, in a close, full head, rising eight or ten feet high; very closely garnished with oval lanceolate, entire, mostly opposite leaves, from half an inch, to an inch and a half long, and one broad, on short footstalks; and numerous small pale flowers, from the axillas, singly on each footstalk, having dyphillous involucrems; each flower succeeded by a small, oval, dark, purple berry. The most material varieties are, broad-leaved Roman myrtle, with oval, shining, green leaves, an inch and a half long, and one broad; and which is remarkably floriferous. Gold-striped, broad-leaved Roman myrtle: Broad-leaved Dutch myrtle, with spear-shaped, sharp-pointed, dark green leaves, an inch long, and about three-quarters of one broad. Double-flowered Dutch myrtle. Broad-leaved Jews' myrtle, having the leaves placed by threes at each joint; by which particular circumstance this species is in universal estimation among the Jews, in their religious ceremonies, particularly in decorating their tabernacles; and for which purpose many gardeners about London cultivate this variety with particular care, to sell to the above people, who are often obliged to purchase it at the rate of sixpence or a shilling for a small branch: for the true sort, having the leaves exactly by threes, is very scarce, and is a curiosity; but by care in its propagation, taking only the perfectly ternate-leaved shoots for cuttings, it may be increased fast enough; and is worth the attention of the curious, and particularly those who raise myrtles for the London markets.

2. The *pimenta*, pimento, Jamaica pepper, or allspice-tree, grows about 30 feet in height, and two in circumference; the branches near the top are much divided and thickly beset with leaves, which, by their continual verdure, always give the tree a beautiful appearance. This tree is a native of New Spain and the West India islands. In Jamaica it grows very plentifully; and in June, July, and August, puts forth its flowers, which, with every part of the tree, breathes an aromatic fragrance. The berries, when ripe, are of a dark purple colour, and full of a sweet pulp, which the birds devour greedily, and muting the seeds, afterwards propagate these trees in all parts of the woods. It is thought that the seeds, passing through them in this manner, undergo some fermentation, which fits them better for vegetating than those gathered immediately from the tree.

Properties, &c. The leaves and flowers of common upright myrtle have an astringent quality, and are used for cleansing the skin, fixing the teeth when loosened by the scurvy, and strengthening the fibres. From the flowers and young tops is drawn a distilled water that is deterfive, astringent, cosmetic, and used in gargles. A decoction of the flowers and leaves is applied in fomentations. The berries have a binding deterfive quality; and the chemical oil obtained from them is excellent for the hair, and used in pomatums, and most other external beautifiers of the face and skin. As an internal medicine, these berries have little or no merit.

In the *Dictionnaire portatif d'Histoire Naturelle*, a fact is related, which, if true, tends to show the strong alluring quality of myrtle. "Myrtle (says he) is likewise the base of a pomade called *pomade de la Comtesse*, and well known on account of an extraordinary historical fact. One of those gay youths who flatter about the toilets of the fair, happened one day to be left alone in the storehouse of the graces. With eager curiosity he examined the perfumes, the smelling bottles, the perfumed powder, the essences and the cosmetics. To give more of the vermilion and greater pliancy to his lips, and to remove some disagreeable eruptions, he lightly spreads with his indiscreet finger the fatal pomade, looks at himself in the glass, and contemplates his beauty with admiration. The lady enters: he wishes to speak, but his lips contracted, and he could only stammer. The lady looked at him with astonishment; at length casting her eyes on the toilet, she discovered by the open pot the cause of the mistake, and enjoyed a hearty laugh at the expense of her admirer, whose confusion announced his indiscretion."

Pimento berries are chiefly imported into Britain from Jamaica; whence the name *Jamaica pepper*. It is also called *allspice*, from its taste and flavour being supposed to resemble those of many different spices mixed together. It is one of the staple articles of Jamaica; where the pimento walks are upon a large scale, some of them covering several acres of ground. This spice, which was at first brought over for dietetic uses, has been long employed in the shops as a succedaneum to the more costly oriental aromatics: it is moderately warm, of an agreeable flavour, somewhat resembling that of a mixture of cloves, cinnamon, and nutmegs. Distilled with water it yields an elegant essential oil, so ponderous as to sink in the water, in taste moderately pungent, in smell and flavour approaching to oil of cloves, or rather a mixture of cloves and nutmegs. To rectified spirit it imparts, by maceration or digestion, the whole of its virtue: in distillation it gives over very little to this menstruum, nearly all its active matter remaining concentrated in the inspissated extract. Pimento can scarcely be considered as a medicine: it is, however, an agreeable aromatic, and on this account is not unfrequently employed with different drugs, requiring such a grateful adjunct. Both the pharmacopoeias direct an aqueous and spirituous distillation to be made from these berries, and the Edinburgh college order also the *oleum essentielle piperis Jamaicensis*.

MYSTERY. The English word *mystery* is derived from the Greek *μυστήριον*; and in its modern acceptation imports something above human intelligence, something obscure and enigmatical: any thing artfully made difficult: the secret of any business or profession. The word is often used by the founder of the Christian Religion, and more frequently by his apostles, especially St. Paul. In these cases, it generally signifies those doctrines of Christianity which the Jews, prior to the advent of the Messiah, either did not, or could not understand. The Trinity in Unity, and the Unity in Trinity; The incarnation of the Son of God; the union of two natures in one and the same person, &c. we generally call *mysteries*, because they are infinitely above human comprehension. Mysteries, according to the general acceptation of the word by the learned, from the most authentic accounts that can be obtained, imply those *αἰσθησις*, or *secret rites*, of the pagan superstition, which were carefully concealed from the knowledge of the vulgar, and which are universally known under the denomination of *mysteries*.

The word *μυστήριον* is evidently deduced from *μύω*; but the origin of this last term is not altogether so obvious. The etymologies of it exhibited are various; some of them absurd and inconsistent, others foolish and futile. Instead of fatiguing our readers with a detail of these, which would be equally unentertaining, and uninteresting, we shall only produce one, which to us appears to come nearest the truth. The mysteries under consideration at present were certainly imported into Greece from the East. In those regions, then, we ought of course to look for the etymology of the word. *Mistor*, or *misur*, in Hebrew, signifies "any place or thing hidden or concealed." As this word implies a kind of definition of the nature of the thing intended, and as it is one of the excellencies of original languages to apply vocables with this propriety, we find ourselves strongly inclined to assign the word *misur* as the root of the term *μυστήριον*, *myster*.

We have already observed, that the avarice and ambition of the pagan priesthood probably gave birth to the institution of the mysteries. To this observation we may now add, that the ministers of that superstition might possibly imagine, that some articles of their ritual were too profound to be comprehended by the vulgar; others too sacred to be communicated to a description of men whom the institutions of civil society had placed in a situation not only subordinate, but even contemptible. It was imagined, that things sacred and venerable would have contracted a taint and pollution by an intercourse with sordid and untutored souls. These appear to us the most probable motives for making that odious and pernicious distinction between the popular religion and that contained in the sacred and mysterious ritual.

The Hypothesis of Warburton ill founded.

The learned Bishop Warburton is positive, that the mysteries

of the pagan religion were the invention of legislators and other great personages, whom fortune, or their own merit, had placed at the head of those civil societies which were formed in the earliest ages in different parts of the world. It is with reluctance, and indeed with diffidence, that we presume to differ in our sentiments from such respectable authority. Whatever hypothesis this prelate had once adopted, so extensive was his reading, and so exuberant his intellectual resources, that he found little difficulty in defending it by an appearance of plausibility, if not of rational argumentation. The large quotations he has adduced from Plato and Cicero, do indeed prove that the sages and legislators of antiquity sometimes availed themselves of the influence derived from the doctrines of the mysteries, and from the authority they acquired by the opinion of their having been initiated in them; but that those men were the inventors and fabricators of them, is a position for which his quotations do not furnish the most slender presumption. At the same time, we think it not altogether certain, that the doctrine of a divine Providence, and a future state of rewards and punishments, were revealed in the mysteries with all the clearness and cogency which is pretended by his Lordship.

But granting that the fabric was raised by the hands of sages and legislators, we imagine it would be rather difficult to discover what emolument that description of men could propose to derive from the enterprise.—The institution was evidently, and indeed confessedly, devised to conceal from the million those very doctrines and maxims, which, had they known and embraced them, would have contributed most effectually to dispose them to submit to those wise regulations which their governors and legislators wished most ardently to establish. Experience has taught, that nothing has a more commanding influence on the minds of the vulgar, than those very dogmas, which, according to the Bishop, were communicated to the initiated. A conviction of the unity of the Deity, of his wisdom, power, goodness, omnipresence, &c. the steady belief of the immortality of the human soul, and of a future state of rewards and punishments, have, in all ages, and in all countries, proved the firmest supports of legal authority. The very same doctrines, in the dawn of christianity, contributed, of all other methods, the most effectually, to tame and civilize the savage inhabitants of the northern regions of Europe. Supposing those principles to have been inculcated by the mysteries, the most prudent plan legislators could have adopted, would have been to publish them to all mankind. They ought to have sent forth apostles to preach them to the savages whom they had undertaken to civilize. According to the learned prelate, they pursued the opposite course, and deprived themselves of those easy arms by which they might have encountered and overthrown all the armies of savagism.

The divine Author of the christian æconomy, viewed in the light of an human legislator, saw the propriety of this procedure. Nothing was concealed in his institutions; nothing was veiled with mystery, or buried in darkness. The success was answerable to the wisdom of the plan. The million flocked to the evangelical standard: the gospel was preached to the poor, to the illiterate, and the vulgar; and the meanest of mankind eagerly embraced its maxims. Wherever it prevailed, it produced civilization, morality, sobriety, loyalty, and every other private and social virtue.—Upon the supposition that the mysteries had contained and inculcated the principles and practices which the prelate supposed they did, the civilizers of mankind, legislators, magistrates, and princes, ought to have combined to make them public, for the sake of their own tranquillity, and the more effectual support of their authority and influence.

Mysteries the offspring of Egyptian priesthood; but adopted by Legislators, &c.

Upon the whole, we are inclined to believe that the mysteries were the offspring of Egyptian priesthood. They were instituted with a view to aggrandize that order of men, to extend their influence, and enlarge their revenues. To accomplish those selfish projects, they applied every engine towards besotting the minds of the multitude with superstition and enthusiasm: they taught them to believe that themselves were the distinguished favourites of heaven; and that celestial doctrines had been revealed to them, too holy to be communicated to the profane rabble, and too sublime to be comprehended by vulgar capacities. It is, we confess, exceedingly probable, that after the mysteries were instituted, and had acquired an exalted reputation in the world, legislators, magistrates, judges, and potentates, joined in the imposture, with the same views, and from the same principles. Princes and legislators, who found their advantage in overawing and humbling the multitude, readily adopted a plan which they found so artfully fabricated to answer these very purposes. They had interest enough with the sacerdotal myslagogues, to induce them to allow them to participate in those venerable rites which had already established the authority of that description of men, in whose hands they were deposited. The views of both parties were exactly congenial. The respect, the admiration, and dependence of the million, were the ultimate objects of their ambition respectively. Priests and princes were actuated by the very same spirit. The combination was advantageous, and of consequence harmonious.

For these reasons we have taken the liberty of differing from his Lordship of Gloucester with respect to the persons who first instituted the secret mysteries of the Pagan religion.

Hypothesis of Mosheim.

Another writer of considerable reputation in the republic of letters, is of opinion, that the mysteries were entirely commemorative; that they were instituted with a view to preserve the remembrance of heroes and great men, who had been deified in consideration of their martial exploits, useful inventions, public virtues, and especially in consequence of the benefits by them conferred on their contemporaries. According to him, the mysteries of Mithras were established for this very purpose. It would be no difficult matter to prove that the Persian deity of that name was the sun, and that his name and insignia jointly ascertain the truth of this assertion. The same writer extends this observation to the mysteries of the Egyptians, Phœnicians, Greeks, Hetruscans; and, in a word, to all the institutions of that species throughout the world. In opposition to this singular opinion, it may be argued, we think with some shew of reason, that the method of preserving the memory of great and illustrious men generally adopted, was the establishing festivals, celebrating games, offering sacrifices, singing hymns, dances, &c. We can recollect no secret mysteries instituted for that purpose, at least in their original intention. If any usage of the commemorative kind was admitted, it was superinduced at some period posterior to the primary institution. At the same time, upon the supposition that the orgia of Bacchus were the same with those of the Egyptian Osiris, and that the mysteries of Ceres, exhibited at Eleusis, were copied from those of the Egyptian Isis, and allowing that the former was the sun, and the latter the moon; it will be difficult to find out the human persons whose exploits, adventures, inventions, &c. were intended to be immortalized by those institutions. Upon the whole, the mysteries were performed in secret; they were intended to be communicated only to a few: of course, had they been instituted with a view to immortalize the memory of heroes and great men, the authors would have acted the most foolish and inconsistent part imaginable. Instead of transmitting the fame of their heroes with eclat to posterity, they would by this procedure have consigned it to eternal oblivion.

Our first position supported by the character of the priests of Egypt.

We must then recur to our first position. The mysteries were the offspring of bigotry and priestcraft; they originated in Egypt, the native land of idolatry. In that country the priesthood reigned predominant. The kings were ingrafted into their body before they could ascend the throne. They were possessed of a third part of all the land of Egypt. The sacerdotal function was confined to one tribe, and was transmitted unalienably from father to son. All the orientals, but more especially the Egyptians, delighted in mysterious and allegorical doctrines. Every maxim of morality, every tenet of theology, every dogma of philosophy, was wrapt in a veil of allegory and mysticism. This propensity, no doubt, conspired with avarice and ambition to dispose them to a dark and mysterious system of religion. Besides, the Egyptians were a gloomy race of men; they delighted in darkness and solitude. Their sacred rites were generally celebrated with melancholy airs, weeping and lamentation. This gloomy and unsocial bias of mind must have stimulated them to a congenial mode of worship. In Egypt then we are to search for the origin of the mysteries. Both the nature of the institution, and the genius of the people confirm this position; and historians, both ancient and modern, are agreed in admitting the certainty of the fact.

The Osiris and Isis of Egypt, the Bacchus and Ceres of Greece.

The Osiris of Egypt, was the original Bacchus; as the Isis of the same country was the Ceres of the Greeks. The rites of Osiris were performed with loud shrieks and lamentations when he was put into the coffin; and with the most extravagant mirth, when he was in a manner raised from the dead, or supposed to be found again. Their hymns were upon the whole always composed in melancholy affecting strains; and consisting of lamentations for the loss of Osiris, the mystic flight of Bacchus, the wandering of Isis, and the suffering of the gods. The Canaanites, who were a kindred tribe of the Mizraim or Egyptians, imitated them in their sacred rites. At Byblus, Berytus, Sidon, and afterwards at Tyre, they used particularly mournful dirges for the death of Adonis, or Tammuz, who was the same with the Egyptian Osiris, i. e. the sun.

The Egyptians, then, naturally inclined to gloom and secrecy, instituted a mode of worship congenial with their natural disposition of mind. The recess of the sun towards the southern hemisphere, was the death of Osiris: the wanderings of Isis in search of her husband and brother, allegorically imported the longings of the earth for the return of the fructifying influences of the solar heat.

When that luminary returned towards the summer solstice, and grain, trees, fruit, herbs, and flowers adorned the face of nature, another festival was celebrated, of a very different complexion from that of the former. In this season, all Egypt was dissolved in the most extravagant mirth and jollity. During the

celebration of those festivals, the priests formed allegorical representations of the sun and the earth. They personified the one and the other, and allegorized their motions, aspects, relations, sympathies, accesses, recesses, &c. into real adventures, perignations, sufferings, contests, battles, victories, defeats, and so forth. These, in process of time, were held up to the vulgar as real occurrences; and these in a few ages became the most essential articles of the popular creed. From this source were derived the conquests of Dionysus, or Bacchus, so beautifully exhibited by Nonnus, in his Dionysiacs; the wanderings of Io, wonderfully adorned by Æschylus; and the labours of Hercules, afterwards usurped by the Greeks.

The Egyptians deified departed Heroes.

Whether the Egyptians deified mortal men in the earliest ages has been much controverted. Jablonski has taken much pains to prove the negative. Diodorus assures us that they paid their monarchs a kind of divine adoration, even in their life-time.—Plutarch tells us plainly that some were of opinion that Isis, Osiris, Horus, Anubis, Typhon, were once mortal persons, who were exalted into dæmons after their death. The Sicilian, in his history of Isis and Osiris, Pan, Hermes, &c. plainly represents them as human personages; and informs us, that the Egyptians imagined, that after their decease they transmigrated into particular stars. From these authorities, we are inclined to believe that the Egyptians, as well as the other pagans, did actually deify persons who had distinguished themselves in their days of nature by prowess, wisdom, useful arts, and inventions. This was a constant practice among the Greeks, who probably learned it from the people in question.

The exploits of those heroes had been disguised by allegorical traditions and hieroglyphical representations. They had been magnified beyond all dimensions, in order to astonish and intimidate the vulgar. They had been interlarded with the most extravagant fables, in order to gratify their propensity towards the marvellous. All these secrets were developed in the mysteries. *Secrets respecting the Objects of Worship, revealed in the Mysteries.*

The catechumens, or pupils learning the elements of any science, were informed of every particular relating to the birth, the life, the exploits, the adventures, the misfortunes, and decease of those heroic personages, and when, and by what means, they had attained to the high rank of divinities. At the same time, we think it highly probable, that those demi-gods were represented in their state of exaltation and heavenly splendour. The magicians of Egypt were abundantly qualified for exhibiting *angels in machines*. The souls of virtuous men, who had not been eminent enough to merit the honour of deification, were shewn in all the perfection of Elysian felicity; and perhaps the souls of tyrants, and of the children of Typhon, were shown in Tartarus, suffering all the extremes of infernal punishment. From these exhibitions the mystagogues might naturally enough take occasion to read their pupils suitable lectures on the happy tendency of a virtuous conduct, and the dishonour and misery consequent upon a contrary course. They might set before them immortal renown, deification, and Elysium, on the one hand, and eternal infamy and misery on the other. This will probably be deemed the chief advantage accruing from this institution.

Besides the communications above-mentioned the catechumens were taught many secrets of physiology, or the nature of the phenomena of the world. This Pharnutus every where affirms, especially in his last book towards the end. Plutarch informs us, that many of the Greek philosophers were of opinion, that most of the Egyptian fables were allegorical details of physical operations. Eusebius acquaints us, that the physiology, not only of the Greeks, but likewise of the barbarians, was nothing else but a kind of science of nature, a concealed and dark theology, involved in fable and fiction, whose hidden mysteries were so veiled over with enigmas and allegories, that the ignorant million were as little capable of comprehending what was said as what was suppressed in silence. This, says he, is apparent from the poems of Orpheus, and the fables of the Phrygians and Egyptians. Dionysius of Halicarnassus likewise observes, that the fables of the Greeks detail the operations of nature by allegories. Proclus makes the same observation concerning the people in question. The Egyptians, says he, taught the latent operations of nature by fables.

Physiological secrets expounded in the Mysteries of Egypt.

These physiological secrets were no doubt expounded to the initiated; that the Egyptian priests were deeply skilled in physiological science, can scarce be questioned, if we believe that James and Jambres rivalled Moses in their enchantments. The preceding detail comprehends all that was revealed to the Epoptæ in the original Egyptian mysteries. What articles might have been introduced afterwards we cannot pretend to determine.

It is certain that the vulgar were excluded from all those choice secrets, which were carefully reserved for the nobility and sacerdotal tribes. To them it was given to know the mysteries of the kingdom of darkness; but to those who were without all was mystery and parable. While the laity fed on husks, the clergy and the quality fed on royal dainties. The priests who had deified

devoted these allegories understood their original import, and bequeathed it as an inestimable legacy to their children. Here then we have the primary object of the mysteries, namely, to develop to the initiated the original and rational import of those allegorical and mystical doctrines which were tendered to the uninitiated, wrapt up in impenetrable allegory and obscurity. To the former, these were communicated and explained: the latter were obliged to stand at an awful distance, and retire as the *Procul, O procul este profani*, thundered in their ears.

These allegorical traditions originated in Egypt, (see MYTHOLOGY.) It was the general bias of the oriental genius.—The Egyptians, however, according to the most authentic accounts, were the greatest proficient in that science. As early as the age of Joseph, the Egyptians were skilled in the interpretation of dreams, divinations, &c. and in the age of Moses they were become wise men, magicians, &c. The original subject of these institutions were the articles we have already specified; but in process of time, according to the natural course of things, numerous improvements were made, and many new rites, ceremonies, usages, and even doctrines, were superinduced, which were utterly unknown to the original hierophants. Simplicity is, for the most part, one of the distinguishing characters of a new institution; but succeeding architects generally imagine that something is still wanting to complete the beauty, the regularity, the uniformity, the magnificence, and perhaps the convenience of the structure. Hence, at length, it comes to be so overloaded with adventitious drapery, that its primary elegance and symmetry are altogether defaced. This was the case with the earliest Egyptian mysteries. Their subject was at first simple and easy to be comprehended; in time it became complex, intricate, and unintelligible.

In order to celebrate those mysteries with the greater secrecy, their temples were so constructed as to favour the artifice of the priests. The fanes, in which they used to execute their sacred functions, and to perform the rites and ceremonies of their religion, were subterranean apartments, constructed with such wonderful skill and dexterity, that every thing that appeared in them breathed an air of solemn secrecy. Their walls were covered with hieroglyphic paintings and sculpture, and the altar was situated in the centre of the apartment. Modern travellers have, of late years, discovered some vestiges of them, and bear witness to the above description of those dark abodes. In those subterranean mansions, which the priests of that ingenious nation had planned with the most consummate skill, the kings, princes, and great men of the state, encountered the dangers and hardships contrived to prove their prudence, fortitude, patience, abstinence, &c. These were appointed to try their merit; and by these the hierophants were enabled to decide whether or not they were duly qualified for receiving that benefit. Upon those occasions, we may believe, abundance of those magical tricks were exhibited, for which the magicians of Egypt were so much celebrated among the ancients. The strange and astonishing sights, the alternate succession of light and darkness, the hideous spectres exposed to view, the frightful howlings re-echoed by these infernal domes, the stones of Tartarus and Elysium, exhibited alternately and in quick succession, must have made a deep and lasting impression on the mind of the affrighted votary.

The Grecian infernal Regions copied from the Egyptian Mysteries.

From the scenes exhibited in celebrating the Egyptian mysteries, especially those of Isis and Osiris, the Greeks seem to have copied their ideas of the infernal regions, and the subterranean mansions of departed souls. Many colonies of Egyptians settled in Greece. From these the *æonoi*, or most early bards of Greece, learned them imperfectly. Of course, we find Homer's account of the infernal regions, and of the state of departed souls, lame and incoherent. Succeeding bards obtained more full and more distinct information. Euripides and Aristophanes seem to have paved the way for the prince of Roman poets. Plato and some of the other philosophers have shewn, by their descriptions or allusions, that the whole apparatus of Tartarus and Elysium had become a hackneyed topic some centuries before Virgil was born. This incomparable poet borrowed his ideas from Homer, Aristophanes, Euripides, Plato, &c. These, under his plastic hand, in the sixth *Æneid*, grew into a system beautiful, regular, uniform, and consistent. The materials he has employed were created to his hand; he had only to collect, polish, arrange, and connect them. The sentiments collected from the Platonic philosophy, and the inimitable episode copied from the annals of Rome, by the masterly skill which he has displayed in the application of them, form the chief excellencies of the piece. For the rest, he could well dispense with going to Eleusis: every old woman of Athens and of Rome could repeat them.

Mysteries brought from Egypt into Persia and Greece.

Hence it appears that Egypt was the native land of mysteries, as well as of idolatry. Every god and goddess respectively had their mysteries; but as those of Isis and Osiris were the most celebrated, they of course became principal objects of pursuit, as well as of imitation, to the neighbouring nations. These, as is generally believed, were carried into Persia by Zoroastres, or

Zordusht, by whom they were consecrated to Mithras. Orpheus imported them into Thrace; Cadmus brought them into Boeotia, where they were sacred to Bacchus. Inachus established them at Argos, in honour of Juno, the same with Isis: Cyniras in Cyprus, where they were dedicated to Venus. In Phrygia they were sacred to Cybele, the mother of the gods.

Our learned readers, who will probably reflect that the Egyptians were in ancient times inhospitable to strangers, will perhaps be surprised that this fastidious and jealous people were so ready to communicate the arcana of their religion to foreigners. But they will please to recollect, that a great part of Greece was planted with colonies from Egypt, Phœnicia, Palestine, &c. This we could easily prove, did the bounds prescribed us admit such a digression. Orpheus, if not an Egyptian, was at least of oriental extraction. Inachus, Cadmus, and Melampus, are universally allowed to have been Egyptians. Erechtheus, in whose reign the Eleusinian mysteries were established, was an Egyptian by birth, or at least sprung from Egyptian ancestors.—The Egyptians then, in those early ages, did not view the Greeks in the light of aliens, but as a people nearly related either to themselves or the Phœnicians, who were their brethren. Upon this connexion we imagine it was, that in later times most of the sages of Greece, especially of Athens, found so hospitable a reception among that people. They probably viewed them in the light of propagandi; apostles able and willing to disseminate their idolatrous rites. This observation, which might be supported by numberless authorities, did the nature of the present inquiry permit, will, we think, go a great way towards obviating the objection.

Mysteries of Mithras, Bacchus, and Ceres, the most august.

Although every particular deity had his own peculiar mysterious sacred rites, yet of all others those of Mithras, Bacchus, and Ceres, were deemed the most august, and were most universally and most religiously celebrated. To these, therefore, we shall confine ourselves upon this occasion. If our readers shall become intimately acquainted with these, they may readily dispense with the knowledge of the rest, which are, indeed, no more than streams and emanations from these sources. We shall then, in the first place, present to our readers a brief sketch of the mysteries of Mithras.

MITHRAS, or, according to the Persian, *Mihir*, was one of the great gods of the Asiatics. His worship was for many ages confined to Persia. Afterwards, however, it was propagated so far and wide, that some have imagined they had discovered vestiges of it even in Gaul. *Mihir*, according to Dr. Hyde, signifies love, and likewise the Sun. If we might presume to differ from so respectable an authority, we should conjecture that it is a cognate of the Hebrew word *Muthir*, "excellencia, prestantia." That there was an analogy between the Hebrew and old Persian, is generally admitted by the learned. Be that as it may, Mithras was the sun among the Persians; and in honour of that luminary this institution was established.

The grand festival of Mithras was celebrated six days, in the middle of the month *Mihir*. Upon these days, it was lawful for the kings of Persia to get drunk and dance. On this festival, we imagine, the candidates for initiation, having duly proved their vocation, were solemnly admitted to the participation of the mysteries.

Zoroastres worshipped Mithras, or the Sun, in a certain natural cave, which he formed into a temple, and filled up in a manner exactly mathematical. There Mithras was represented as presiding over the lower world with all the pomp of royal magnificence. In it too were seen the symbols of Mithras and of the world, philosophically and mathematically exhibited, to be contemplated and worshipped. This deity was sometimes represented as mounted on a bull, which he is breaking, and which he kills with a sword. On some bas reliefs still existing, he appears as a young man with his tiara turned upward, after the manner of the Persian kings. He is clothed with a short tunic and breeches, after the Persian fashion. Sometimes he wears a small cloak. By his sides are seen other human figures, with tiaras of the same fashion on their heads, but without cloaks. One of these figures commonly holds in his one hand a torch lifted up; in the other one turned downward. Sometimes over the cave is seen the chariots of the sun and moon, and divers constellations, such as cancer, scorpion, &c.

Probationary Exercises previous to Initiation.

In one of those caves the ceremonies of initiation were performed; but before the candidate could be admitted, he was forced to undergo a course of probationary exercises, so numerous and so rigorous, that very few had courage and fortitude enough to go through them. He was obliged to live a life of virtue and abstinence for a space of seven years previous to the period of his initiation.

Upon the eve of the initiation, the aspirant was obliged to brace on his armour, in order to encounter giants and savage monsters. In those spacious subterranean mansions a mock hunting was exhibited. The priests and all the subordinate officers of the temple, transformed into lions, tigers, leopards, boars, wolves, and other savage creatures, assailed him with loud howlings,

ings, roaring, and yelling, and every instance of ferine fury. In those mock combats, the hero was often in danger of being really worried, and always came off with bruises and wounds. Lamprius informs us, that when the emperor Commodus was initiated, he actually carried the joke too far, and butchered one of the priests who attacked him in the figure of a wild beast. The Persians worshipped Mithras or the Sun by a perpetual fire: hence the votary was obliged to undergo a fiery trial; that is, to pass seven times through the sacred fire, and each time to plunge himself into cold water. The candidate having undergone all these torturing trials with becoming patience and fortitude, was declared a proper subject for initiation. But before his admission, he was obliged to bind himself by the most solemn oath, with horrid imprecations annexed, never to divulge any single article of all that should be communicated to him in the course of initiation.

Revelations in the Mysteries of Mithras.

What *arogenta* or ineffable secrets were imparted to the initiated, it is impossible at this distance of time to discover with any tolerable degree of certainty. We may, however, rest assured that the most authentic tradition concerning the origin of the universe; the nature, attributes, perfections, and operations, of Oromasde; the baleful influences of Ariman; and the benign effects of the government of Mithras, were unfolded and inculcated. The secret phenomena of nature, as far as they had been discovered by the magi, were likewise exhibited; and the application of their effects, to astonish and delude the vulgar, were taught both in theory and practice. The exercise of public and private virtues was warmly recommended; and vice represented in the most odious and frightful colours. Both these injunctions were, we may suppose, enforced by a display of the pleasures of Elysium and the pains of Tartarus, as has been observed above in describing the mysteries of the Egyptians.

After that the Teletæ or rites which confer perfection were finished, the pupil was brought out of the cave or temple, and with great solemnity proclaimed a lion of Mithras; a title which imported strength and intrepid courage in the service of the deity. They were now consecrated to the god, and were supposed to be under his immediate protection; an idea which of course animated them to the most daring and dangerous enterprises.

The priests of Mithras were called the *lions of Mithras*, and his priestesses, *lionesses*: some say *hyænas*. The other inferior ministers were called *eagles, hawks, ravens, &c.* and on their festivals they wore masks corresponding to their titles, after the Egyptian manner, where the priests appeared at the ceremonies with masks resembling the heads of lions, apes, dogs, &c. a circumstance which furnishes a presumption that the mysteries of Mithras were of Egyptian original.

The worship of Mithras was introduced into the Roman empire towards the end of the republic, where it made very rapid progress. When Christianity began to make a figure in the empire, the champions for paganism thought of proposing to men the worship of this *power of benevolence*, in order to counterbalance or annihilate that worship which the Christians paid to Jesus Christ the true Sun of righteousness. But this mode was soon abolished, together with the other rights of paganism.

The votaries of Mithras pretended that he was sprung from a rock, and that therefore the place where the mysterious ceremonies were communicated to the initiated was always a cave. Many different reasons have been assigned for the origin of this rock-born deity, most of which appear to us unsatisfactory. If our readers will be obliging enough to accept of a simple and obvious conjecture, they may take the following: A rock is the symbol of strength and stability: the dominion of Mithras, in the opinion of his votaries, was firm as a rock, and stable as the everlasting hills. If our readers should not admit the probability of this conjecture, we would beg leave to remit them to the learned Mr. Bryant's *Analysis of Mythology*, where they will find this point discussed with deep research and wonderful ingenuity. Whatever may have been the origin of this opinion with relation to the birth of Mithras, it is certain that some reverence to rocks and caves was kept up a long time even after the establishment of Christianity. Hence the prohibition given to some of the prophets to that religion, that they should no more presume to offer up their prayers *ad petras* at the rocks.

We shall conclude our account of the mysteries of Mithras with a passage from Anquetil, to whom we are so much indebted for what knowledge we have of the Persian theology, and in which the functions of that deity are briefly and comprehensively delineated. "The peculiar functions of Mithras are to fight continually against Abriman and the impure army of evil geni, whose constant employment is to scatter terror and desolation over the universe: to protect the frame of nature from the demons and their productions. For this purpose he is furnished with a thousand ears and a thousand eyes, and traverses the space between heaven and earth, his hands armed with a club or mace. Mithras gives to the earth light and sun: he traces a course for the waters: he gives to men corn, pastures, and children: to the world virtuous kings and warriors; maintains har-

mony upon earth, watches over the law, &c." As the history of Mithras, and the nature of his mysteries, are not generally known, we imagined it would be agreeable to many of our readers to have the most important articles relating to that subject laid before them as it were in detail.

Mysteries of Bacchus.

We now proceed to the origin, or mysteries of Bacchus, which we shall introduce with a brief history of that deity. The original Dionysus of Bacchus was the Osiris of the Egyptians, which last was the Sun. Whether there was an Egyptian monarch of that name, as Diodorus Siculus asserts, has no manner of connection with the present disquisition. The Greek name of that deity is plainly oriental, being compounded of *di*, "bright," and *nafsa* or *nafa*, in the Æolic dialect *nafa*, "a prince." This name was imported from the east by Orpheus, Cadmus, or by whoever else communicated the worship of Osiris to the Greeks. That the Dionysus of the Greeks was the same with the Osiris of the Egyptians, is universally allowed. Herodotus tells us expressly, that *Osiris is Dionysus* in the Greek language: Marrianus Capellus, quoted above, expresses the very same idea. The original Osiris was then the sun: but the Dionysus or Bacchus of the Greeks was the same with the Osiris of the Egyptians; therefore the Bacchus or Dionysus of the Greeks was likewise the same luminary.

The name *Osiris* has much embarrassed critics and etymologists. The learned Jablonski, instead of delineating the character, attributes, operations, adventures, exploits, and peculiar department assigned this deity by his votaries, has spent much of his pains in trying to investigate the etymology of his name. If it is granted, which is highly probable, that the Hebrew and Egyptian tongues are cognate dialects, we should imagine that it is actually the *Chosher* or *Osir* of the former language, which imports, "to make rich, to become rich." Indeed the words *Osiris* and *Isis* were not the vulgar names of the sun and moon among the Egyptians, but only epithets importing their qualities. The name of the sun among that people was *Phri* or *Phry*, and that of the moon *Ioh*, whence the Greek *Io*. The term *Osiris* was applied both to the sun and to the river Nile; both which by their influence contributed respectively to enrich and fertilize the land of Egypt.

It was a general custom among the orientals to denominate their princes and great men from their gods, demigods, heroes, &c. When the former were advanced to divine honours, they were in process of time confounded with their archetypes. The original divinities were forgotten, and these upstart deities usurped their place and prerogatives. In the earliest periods of the Egyptian monarchy, there appeared two illustrious personages, Osiris and Isis. These were the children of Cronus; and being brother and sister they were joined in matrimony, according to the custom of the Egyptians. As the brother and husband had assumed the name of the *Sun*, so the sister and consort took that of *Isis*, that is, "the woman," a name which the Egyptians applied both to the moon and to the earth, in consequence of the similarity of their nature, their mutual sympathy, and congenial fecundity. Osiris having left his consort Isis regent of the kingdom, with Hermes as her prime minister, and Hercules as general of her armies, quitted Egypt with a numerous body of troops, attended by companies of fauns, satyrs, singing women, musicians, &c. traversed all Asia to the Eastern ocean. He then returned homeward through the Upper Asia, Thrace, Pontus, Asia Minor, Syria, and Palestine. Wherever he marched, he conferred numberless benefits on the savage inhabitants. He taught the art of cultivating the ground, preserving the fruits of the earth, and distinguishing the wholesome and nutritive from the unwholesome and poisonous. He instructed them in the culture of the vine; and where the vines could not be produced, he communicated to them the method of producing a fermented liquor from barley, very little inferior to wine itself. He built many cities in different parts of the globe, planted numerous colonies, and wherever he directed his course, instituted just and wholesome laws, and established the rights and ceremonies of religion, and left priests and catechists of his train to teach and inculcate the observations of them. In short, he left every where lasting monuments of his progress, and at the same time of his generosity and beneficence. Where he found the people docile and submissive, he treated them with kindness and humanity: if any shewed themselves obstinate, he compelled them to submit to his institutions by force of arms.

At the end of three years, he returned to Egypt, where his brother Typhon, a wicked unnatural monster, had been forming a conspiracy against his life. This traitorous design he soon after accomplished in the following manner: He invited Osiris with some other persons whom he had gained over, to an entertainment. When the repast was finished, he produced a beautiful coffer, highly finished, and adorned with studs of gold, promising to bestow it on the person whom it should fit best. Osiris was tempted to make the experiment. The conspirators nailed down the cover upon him, and threw the coffer into the river. This coffer, which was now become the coffin of Osiris, was, they tell us, wafted by the wind and waves to the neighbourhood

bourhood of Byblus, a city of Phœnicia, where it was cast on shore, and left by the waves at the foot of a tamarind tree.

Isis, in the mean time, disconsolate and forlorn, attended by Anubis, was ransacking every quarter in search of her beloved Osiris. At length being informed by her faithful attendant and guardian, that his body was lodged somewhere in the neighbourhood of Byblus, she repaired to that city. There, they say, she was introduced to the queen, and after a variety of adventures she recovered the corpse of her husband, which of course she carried back with her to Egypt: but the mischievous Typhon, ever on the watch, found her on the banks of the Nile; and having robbed her of her charge, cut the body into 14 parts, and scattered them up and down. Now, once more, according to the fable, Isis set out in quest of those parts, all of which, only one excepted, she found, and interred in the place where she found them: and hence the many tombs of Osiris in that country. These tombs were denominated *taposins* by the natives. Many other fabulous adventures were ascribed to those two personages, which it is not our province to enumerate at present. If our readers should wish to be more minutely informed on this subject, they may have recourse to the authors mentioned in the last-quoted author, or to the learned Mr. Bryant's Analysis of Ancient Mythology, and M. Cour de Gebelin, where they will find matter enough to gratify their curiosity.

The mysteries of Isis and Osiris instituted in Commemoration of these Adventures.

To commemorate those adventures, the mysteries of Isis and Osiris were instituted; and from them both those of Bacchus and Ceres, among the Greeks, were derived. Of the Egyptian solemnity, we have an exact epitome in one of the fathers of the church to the following purpose: "Here follows (says he) an epitome of the mysteries of Isis and Osiris. They deplore annually, with deep lamentations and shaved heads, the catastrophe of Osiris over the buried statue of that monarch. They beat their breasts, mangle their arms, tear open the scars of their former wounds; that by annual lamentations the catastrophe of his miserable and fatal death may be revived in their minds. When they have practised these things a certain number of days, then they pretend that they have found the remains of his mangled body; and having found them, their sorrows are lulled asleep, and they break out into immoderate joy." What maxims of morality, secrets of physiology, or phenomena of astronomy, were couched under this allegorical process, is not our business to investigate in this place. We shall only observe, that, in all probability, Osiris and Isis were sovereigns of Egypt at a very early period; that they had conferred many signal benefits on their subjects, who, influenced by a sense of gratitude, paid them divine honours after their decease; that in process of time they were confounded with the sun and moon; and that their adventures were at length magnified beyond all credibility, interlarded with fables, and allegories, and employed in the mysteries as channels to convey a variety of instructions to the initiated.

Be that as it may, it is certain that the very same mode of worship was established at Byblus, and in after ages transferred to Tyre. The Mizraim and Chanaanites were nearly connected by blood, and their religious ceremonies were derived from the very same source. By what medium the worship of Osiris at Abydus and Tyre was connected, we shall leave to others to explain; we shall only observe that among the Phœnicians this deity obtained the names *Adonis* and *Bacchus*. The former is rather an epithet than a name: the latter is evidently an allusion to the weeping and lamentations with which the rites were performed. We find another name of that divinity mentioned in Scripture: but that term is plainly of Egyptian original: we shall now proceed to the mysteries of Osiris as they were celebrated among the Greeks and Thracians, under the name of the *Orgia of Dionysus* or *Bacchus*.

Orpheus, the celebrated Thracian philosopher, had travelled into Egypt in quest of knowledge; and from that country, according to the most authentic accounts, he imported the Bacchanalian rites and institutions. Some have affirmed that this same Orpheus being immediately acquainted with the family of Cadmus, communicated these rites to them, and endeavoured to transfer them to the grandson of that hero, which grandson became afterwards the Grecian Bacchus.

The vain-glorious Greeks attributed all the actions of the Egyptian hero to their new Bacchus: and according to their laudable practice, engaged him in numberless adventures in which this prototype had no share. Most of those are futile and unentertaining. The Greeks commonly adopted some oriental personage as the hero of their mythological rhapsodies. Him they naturalized and adopted into some Grecian family, and so he became their own. To him they ascribed all the adventures and exploits of the oriental archetype from whom he was copied. Consequently, in the orgia, every thing was collected that had been imported from the east relating to Osiris; and to that farrago was joined all that the Grecian rhapsodists had thought fit to invent in order to amuse the credulous multitude. This, however,

No. 114

was not the whole of the misfortune. The adventures of Osiris were described by the Egyptian Hierophants, veiled with allegorical and hieroglyphical mysteries. These the persons who imported them into Greece did not thoroughly comprehend, or if they did, they were not inclined to communicate them found and unsophisticated. Besides, many oriental terms were retained, the import of which was in process of time lost or distorted. Hence the religious ceremonies of the Greeks became a medley of inconsistencies. The mysteries of Bacchus, in particular, were deeply tinged with this meretricious colouring; the adventures of the Theban pretender were grafted upon those of the Egyptian archetype, and out of this combination was formed a tiffue of adventures disgraceful to human nature, absurd and inconsistent. Indeed the younger or Theban Bacchus seems to have been a monster of debauchery; whereas the Egyptian is represented as a person of an opposite character. Of course the mysteries of the former were attended with the most shocking abominations.

These mysteries, as has been observed above, were first celebrated at Thebes, the capital of Bœotia, under the auspices of the family of Cadmus. From this country they gradually found their way into Greece, and all the neighbouring parts of Europe. They were celebrated once every three years, because at the end of three years Osiris returned from his Indian expedition. As the Greeks had impudently transferred the actions of the Egyptian hero to their upstart divinity, the same period of time was observed from the celebration of those rites in Greece that had been ordained for the same purpose in Egypt.

Process of their Celebration.

When the day appointed for the celebration of the orgia approached, the priest issued a proclamation, enjoining all the initiated to equip themselves according to the ritual, and attend the procession on the day appointed. The votaries were to dress themselves in coats of deer-skins, to loose the fillets of their hair, to cover their legs with the same stuff with their coats, and to arm themselves with thyrsi, which were a kind of spear wholly of wood entwined with leaves, and twigs of vine or ivy. It is said that the Bacchanalians, especially the Thracians, used often to quarrel and commit murder in their drunken revels; and that in order to prevent those unlucky accidents, a law was enacted, that the votaries, instead of real spears, should arm themselves with those sham weapons which were comparatively inoffensive. The statue of the deity, which was always covered with vine or ivy leaves, was now taken down from its pedestal, and elevated on the shoulders of the priests. The cavalcade then proceeded nearly in the following manner:

First of all, hymns were chanted in honour of Bacchus, who was called the *Power of dances, smiles, and jests*; while at the same time he was deemed equally qualified for the exploits of war and heroism. Horace, in some of his dithyrambic odes has concisely pointed out the subjects of those Bacchanalian songs. In the collection of hymns fabulously attributed to Orpheus, we find several addressed to this deity, each under a different title, derived from the different appellations of the god. All these names are of oriental original, and might easily be explained, did the bounds prescribed us admit of etymological disquisitions.

The hymn being finished, the first division of the votaries proceeded, carrying a pitcher of wine, with a bunch of the vine. Then followed the he-goat; an animal odious to Bacchus, because he ravages the vines. The chanting the hymns, the sacrificing the he-goat, and the revels, games, and diversions, with which the celebration of those rites was attended, gave birth to the dramatic poetry of the Greeks; as the persons habited in the dress of Fauns, Sylvas, and Satyrs, furnished the name of another species of poetry of a more coarse and forbidding aspect.

The mysterious Coffer, with its Contents.

Then appeared the mysterious coffer or basket, containing the secret symbols of the deity. These were the phallus, some grains of sesame, heads of poppies, pomegranates, dry stems, cakes baked of the meal of different kinds of corn, salt, carded wool, rolls of honey, and cheese; a child, a fan, and a serpent, which was in high veneration among the Egyptians. See Euseb. Præp. Evang. l. i. pag. 26. Steph. where we have a minute detail of the symbolical properties of that creature, according to Taautos the great legislator of that people. The fan was an emblem of that purifying influence of the mysteries by which the initiated were cleansed from all their former pollutions, and qualified for commencing a holy course of life.

Such was the furniture of the sacred coffer carried in the solemn Bacchanalian procession. The inventory given by some of the fathers of the church is somewhat different. They mention the dye, the ball, the top, the wheel, the apples, the looking-glass, and the fleece. The articles first mentioned seem to have been of Egyptian original; the last were certainly superinduced by the Greeks, in allusion to his being murdered and torn to pieces when he was a child by the machinations of Juno, who prevailed with the Titans to commit the horrid deed. These last seem to have been memorials of his

A

boyish

boyish play things; for, says Maternus, "the Cretans, in celebrating the rites of the child Bacchus, acted every thing that the dying boy either said, or did, or suffered. They likewise (says he) tore a live bull in pieces with their teeth, in order to commemorate the dismembering of the boy." For our part, we think, that if such a beastly rite was practised, it was done in commemoration of the savage manner of life which had prevailed among men prior to the more human diet invented and introduced by Isis and Osiris. Be that as it may, we learn from Porphyry, that in the island of Chios they used to sacrifice a man to Bacchus, and that they used to mangle and tear him limb from limb. This was no doubt practised in commemoration of the catastrophe mentioned above.

The orgia of this Pagan god Bacchus were originally simple enough; but this unsophisticated mode was of no long continuance, for riches soon introduced luxury, which quickly infected even the ceremonies of religion. On the day set apart for this solemnity, men and women crowned with ivy, their hair dishevelled and their bodies almost naked, ran about the streets, roaring aloud *Evohe, Bacche*. In this rout were to be seen people intoxicated at once with wine and enthusiasm, dressed like Satyrs, Fauns, and Silenuses, in such scandalous postures and attitudes, with so little regard to modesty and even common decency, that we are persuaded our readers will readily enough forgive our omitting to describe them. Next followed a company mounted upon asses, attended by Fauns, Bacchanals, Thyades, Mimallonides, Naiads, Tityri, &c. who made the adjacent places echo to their frantic shrieks and howlings. After this tumultuous herd were carried the statues of victory and altars in form of vinefets crowned with ivy, smoking with incense and other aromatics. Then appeared several chariots loaded with thyrsi, arms, garlands, casks, pitchers, and other vases, tripods and vans. The chariots were followed by young virgins of quality, who carried the baskets and little boxes, which in general contained the mysterious articles above enumerated.—

These, from their office, were called *cislophoræ*. The phallophori followed them, with a chorus of *Itophallophori* habited like Fauns, counterfeiting drunken persons, singing in honour of Bacchus songs and catches suited to the occasion. The procession was closed by a troop of Bacchanals, crowned with ivy, interwoven with branches of yew and with serpents. Upon some occasions, at those scandalous festivals, naked women whipped themselves, and tore their skin in a most barbarous manner. The procession terminated on mount Citheron, when it set out from Thebes; and in other places, in some distant unfrequented desert, where the votaries practised every species of debauchery with secrecy and impunity. Orpheus saw the degeneracy of those ceremonies; and in endeavouring to reform them he probably lost his life. Pentheus suffered in the like attempt, being torn in pieces by the Bacchanals on mount Citheron, among whom were his own mother and aunts. The Greeks, who were an airy jovial people, seem to have paid little regard to the plaintive part of the orgia; or rather, we believe, they acted with howling and frantic exclamations, often enhanced by a combination of drunkenness, exultation, and enthusiastic fury.

What secrets, religious, moral, political, or physical, were communicated to the votaries, it is impossible to determine with any degree of certainty.—One thing we may admit, namely, that the doctrines discovered and inculcated in the orgia, were originally the very same which the apostles of the sect had imbibed in Egypt and Phœnicia; and of which we have given a brief account near the beginning of this article. It is, however, probable, that the spurious or Theban Bacchus had superadded a great deal of his own invention, which, we may believe, was not altogether so sound and salubrious as the original doctrine. However that may be, the initiated were made to believe that they were to derive wonderful advantages from the participation of those rites, both in this life and that which is to come. This, however, we shall advert to in our account of the Eleusinian mysteries.

To detail the etymology of the names of this Pagan deity, the fables relating to his birth, his education, his transformations, his wars, peregrinations, adventures, the various and multifarious rites with which he was worshipped, would swell this article to a most immoderate size. If any of our readers should wish to be more minutely and more accurately acquainted with this subject, we must beg leave to remit them to Diod. Sic. Apollod. Bibl. Euripid. Bacchæ. Aristophane Ranæ. Nonn. Dionys. and among the moderns, to Ban. Mythol. Voss. de origi. Idol. Montf. Fourmont. Reflexions sur l'origine anciens peuples, Mr. Bryant's Analys. and especially to Mons. Cour de Gebelin, Calendriers ou Almanach. That prince of Etymologists, in his account of the festival of Bacchus, has given a most acute and ingenious explication of the names and epithets of that deity. For our part, we have endeavoured to collect and exhibit such as we judge most important, most entertaining, and most instructive to the less enlightened classes of our readers,

Eleusinian mysteries instituted in honour of Ceres.

We now proceed to the Eleusinian mysteries, which, among the ancient Greeks and Romans, were treated with a superior degree

of awe and veneration. These were instituted in honour of Ceres, the goddess of corn; who, according to the most authentic accounts, was the Isis of the Egyptians. The mysteries of Osiris and Isis have been hinted at in the preceding part of this article. These were originally instituted in honour of the sun and moon, and afterwards consecrated to an Egyptian prince and princess; who, in consequence of their merits, had been deified by that people. We know of no more exact and brilliant description of the ceremonies of that goddess, in the most polished ages of the Egyptian superstition, than what we meet with in the witty and florid Apuleius, to which we must take the liberty to refer our more curious readers. Our business at present shall be to try to investigate by what means, and upon what occasion, those mysteries were introduced into Attica, and established at Eleusis. A passage from Diodorus Siculus, which we shall here translate, will, we think, throw no inconsiderable light on that abstruse part of the subject.

"In like manner with him (Cecrops,) says that judicious historian, they tell us, that Erechtheus, a prince of Egyptian extraction, once reigned at Athens. Of this fact they produce the following evidence: A scorching drought, during the reign of this prince, prevailed over almost all the habitable world, except Egypt; which, in consequence of the humidity of its soil, was not affected by that calamity. The fruits of the earth were burnt up; and at the same time multitudes of people perished by famine. Erechtheus, upon this occasion, as he was connected with Egypt, imported a vast quantity of grain from that country to Athens. The people who had been relieved by his munificence, unanimously elected him king. Being invested with the government, he taught his subjects the mysteries of Ceres at Eleusis, and the mode of celebrating the sacred ceremonies, having transferred from Egypt the ritual for that purpose. In those times the goddess is said to have made her appearance at Athens three several times; because, according to tradition, the fruits of the earth which bear her name were then imported into Attica. On this account the seeds and fruits of the earth were said to be the invention of that deity. Now the Athenians themselves acknowledge, that, in the reign of Erechtheus, the fruits of the earth having perished for want of rain, the arrival of Ceres in their country did actually happen, and that along with her the blessing of corn was restored to the earth. They tell us at the same time, that the *teletæ* and the mysteries of that goddess were then received and instituted at Eleusis."

Here then we have the whole mystery of the arrival of Ceres in Attica, and the institution of her mysteries at Eleusis unveiled. The whole is evidently an oriental allegory. The fruits of the earth had been destroyed by a long course of drought: Egypt, by its peculiar situation, had been preserved from that dreadful calamity. Erechtheus, in consequence of his relation to the Egyptians, imported from their country a quantity of grain, not only sufficient for the consumption of his own subjects, but also a great overplus to export to other parts of Greece, Sicily, Italy, Spain, &c. Triptolemus, another Egyptian, was appointed by Erechtheus to export this superfluous store. That hero, according to Pherecydes, was the son of Oceanus and Tellus, that is, of the sea and the earth; because his parents were not known, and because he came to Eleusis by sea. The ship in which he sailed, when he distributed his corn to the western parts of the world, was decorated with the figure of a winged dragon: therefore, in the allegorical style of his country, he was said to be wafted through the air in a chariot drawn by dragons. Those creatures, every body knows, were held sacred by the Egyptians.

Wherever Triptolemus disposed of his corn, thither were extended the wanderings of Ceres. In order to elucidate this point, we must observe, that along with the grain imported from Egypt, Erechtheus, or Triptolemus, or both, transported into Attica a cargo of priests and priestesses from the temples of Buthotis, a city which lay in the centre of the Delta, where the goddess Isis had a number of chapels erected for her worship. The presidents of these ceremonies, like all other bigots, gladly laid hold on this opportunity of propagating their religious rites, and disseminating the worship of the deities of their country. That the Egyptian priests were zealous in propagating the dogmas of their superstition, is abundantly evident from the extensive spreading of their rites and ceremonies over almost all Asia and a considerable part of Europe. The Greek and Roman idolatry is known to have originated from them; and numberless monuments of their impious worship are still extant in Persia, India, Japan, Tartary, &c. Our inference then is, that the worship of Isis was introduced into every country where Triptolemus sold or disposed of his commodities.—Hence the wanderings of Ceres in search of her daughter Proserpine, who is generally called *Core*. The famine occasioned by the drought destroying the fruits of the ground, imports the loss of Proserpine. The restoration of the corn in various parts of the earth, by fresh supplies from Egypt from time to time, imports the wanderings of Ceres in quest of Proserpine. The whole process is an oriental allegory. The disappearing of the fruits of the earth, of which Proserpine, or Persephone, or Pesephone, is the emblem, is the allegorical rape of that goddess. She was seized and carried off by Pluto, sovereign

sovereign of the infernal regions. The seed committed to the earth in that dry season appeared no more, and was, consequently, said to dwell under ground with Pluto. It was then that Ceres, that is, corn imported from Egypt, set out in quest of her daughter. Again, when the earth recovered her pristine fertility, the Corn, or maid, was found by her mother Ceres, that is the earth; for Isis, among the Egyptians, frequently signified the earth. The wanderings of Isis in search of Osiris furnished the model for the peregrinations of Ceres.

Ceres, the Roman name of the goddess of corn, was unknown to the modern Greeks. They always denominated her *Damater*, which is rather an epithet than a proper name. The Greeks, who always affected to pass for originals, we think supposed the Egyptian name on purpose to conceal the country of that deity. As a proof of the probability of this conjecture it may be observed that they metamorphosed the wanderings of Isis in search of Osiris into the peregrinations of Ceres in quest of Proserpine. The Romans, who were less ambitious of the character of originality, retained one of her oriental names. Ceres, says Diodorus, appeared thrice in Attica during the reign of Erechtheus; which seems to import, that fleets loaded with corn had thrice arrived in that country from Egypt during that period.

Cecrops the first king of Attica had established the worship of the Saitic Athena or Minerva in that region, and consecrated his capital to that deity. Erechtheus, in his turn, introduced the worship of Isis or Damater, who in all appearance was the tutelary deity of Buthis his native city. The subjects of Cecrops were a colony of Saites, and readily embraced the worship of Minerva; but the aborigines of that district being accustomed to a maritime, perhaps to a piratical, course of life, were more inclined to consecrate their city to Neptune, the god of the sea, and to constitute him their guardian and protector. Cecrops by a stratagem secured the preference to Minerva his favourite divinity. Erechtheus, in order to give equal importance to his patroness, had the address to institute the Eleusinian mysteries; and to accomplish his design laid hold on the opportunity above mentioned.

This appears to us the most probable account of the origin and institution of the Eleusinian mysteries; for which the Sicilian historian has indeed furnished the clue. We shall now proceed to detail some other circumstances which attended the original institution of these far-famed ceremonies.

The archpriests who personated the newly imported deity was entertained by one Celeus, who was either viceroy of that petty district of which Eleusis was the capital, or some considerable personage in that city or its neighbourhood. Upon her immediate arrival, according to the fabulous relations of the Greeks, a farce was acted not altogether suitable to the character of a goddess whose mysteries were one day to be deemed so sacred and austere. These coarse receptions, and other indecencies attending the first appearance of the goddess, that is, the Egyptian dame who assumed her character, were copied from the like unhallowed modes of behaviour practised on occasion of the solemn processions of her native country. These scommata, or coarse jokes, had an allegorical signification in Egypt; and among the most ancient Greeks the very same spirit was universally diffused by the oriental colonists, who from time to time arrived and settled among them. In process of time they abandoned the figurative and allegorical style, in consequence of their acquaintance with philosophy and abstract reasoning. In the ceremonies of religion, however, the same allegorical and typical representations which had been imported from the east were retained; but the Grecian hierophants in a short time lost every idea of their latent import, and religious, moral, or physical interpretation. Accordingly, this shameful encounter between Ceres and Banbo, or Jambee, was retained in the mysteries, though we think it was copied from Egypt, as was said above, where even that obscene action was probably an allegorical representation of something very different from what appeared to the Greeks.

At the same time that Ceres arrived in Attica, Bacchus likewise made his appearance in that country. He was entertained by one Icarus; whom, as a reward for his hospitality, he instructed in the art of cultivating the vine, and the method of manufacturing wine. Thus it appears that both agriculture and the art of managing the vintage were introduced into Athens much about the same time. Ceres was no other than a priestess of Isis; Bacchus was no doubt a priest of Osiris. The arrival of those two personages from Egypt, with a number of inferior priests in their train, produced a memorable revolution in Athens, both with respect to life, manners, and religion. The sacred rites of Isis, afterwards so famous under the name of the Eleusinian mysteries, date their institution from this period.

When this company of propaganda arrived at Eleusis, they were entertained by some of the most respectable persons who then inhabited that district. Their names, according to Clem. Alexand. were Banbo, Dyfaulis, Triptolemus, Eumolpus, and Eubulus. From Eumolpus were descended a race of priests called Eumolpidae, who figured at Athens many ages after.—

Triptolemus was an ox-herd, Eumolpus a shepherd, and Eubulus a swine-herd. These were the first apostles of the Eleusinian mysteries. They were instructed by the Egyptian missionaries; and they, in their turn, instructed their successors. Erechtheus, or, as some say, Pandion, countenanced the seminary, and built a small temple for its accommodation in Eleusis, a city of Attica, a few miles west from Athens, and originally one of the twelve districts into which that territory was divided. Here then we have arrived at the scene of those renowned mysteries, which for the space of near 2000 years were the pride of Athens, and the wonder of the world.

The mysteries were divided into the greater and lesser. The latter were celebrated at Agræ, a small town on the river Illyssus; the former were celebrated in the month which the Athenians called Boedromion; the latter in the month Anthesterion. The lesser mysteries, according to the fabulous legends of the Greeks, were instituted in favour of the celebrated Hercules. That hero being commanded by Euristheus to bring up Cerberus from the infernal regions, was desirous of being initiated in the Eleusinian mysteries, before he engaged in that perilous undertaking. He addressed himself to Eumolpus, the hierophant for that purpose. There was a law among the Eleusinians prohibiting the initiation of foreigners. The priest not daring to refuse the benefit to Hercules, who was both a friend and benefactor to the Athenians, advised the hero to get himself adopted by a native of the place, and so to elude the force of the law. He was accordingly adopted by one Pyolius, and so was initiated in the lesser mysteries, which were instituted for the first time upon that occasion. This account has all the air of a fable. The lesser mysteries were instituted by way of preparation for the greater.

Most foreigners were debarred from these sacred rites. They tell us, however, that not only Hercules, but Bacchus, Castor and Pollux, Æsculapius and Hippocrates, were initiated in an extraordinary manner, from a regard to their high character and heroic exploits. All barbarians, too, were excluded; yet Anacharsis the Scythian was indulged that privilege, in consequence of his reputation for science and philosophy.

The celebration of the mysteries began on the 15th day of the month Boedromion; and, according to most ancient authors, lasted nine days.

On the evening of this day the initiation commenced. Our readers will observe, that all the most sacred and solemn rites of the pagan superstition were performed during the night: they were indeed generally works of darkness. On this day there was a solemn cavalcade of Athenian matrons from Athens to Eleusis, in carriages drawn by oxen. In this procession the ladies used to rally one another in pretty loose terms, in imitation, we suppose, of the Isiac procession described by Herodotus, which has been mentioned above. The most remarkable object in this procession was the Mundus Cereris, contained in a small coffer or basket. This was carried by a select company of Athenian matrons, who, from their office, were styled *Camphora*. In this coffer were lodged the comb of Ceres, her mirror, a serpentine figure, some wheat and barley, the pudenda of the two sexes, and perhaps some other articles which we have not been able to discover. The procession ended at the temple, where this sacred charge was deposited with the greatest solemnity.

The doctrines delivered in the greater mysteries, says Clem. Alex. relate to the nature of the universe. Here all instruction ends. Things are seen as they are; and nature, and the things of nature, are given to be comprehended. To the same purpose Cicero: "Which points being explained, and reduced to the standard of reason, the nature of things, rather than that of the gods, is discovered." The Father of the universe, or the supreme demiurgus, was represented as forming the chaotic mass into the four elements, and producing animals, vegetables, and all kinds of organized beings, out of those materials. They say that they were informed of the secrets of the anomalies of the moon; and the eclipses of the sun and moon; and, according to Virgil,

Unde hominum genus, et pecudes, unde imber et ignes.

What system of cosmogony those hierophants adopted, is evident from the passage above quoted from Eusebius; and, from the account immediately preceding, it was that of the most ancient Egyptians, and of the orientals in general. This cosmogony is beautifully and energetically exhibited in Plato's *Timæus*, and in the genuine spirit of poetry by Ovid in the beginning of his *Metamorphoses*.

The next scene exhibited upon the stage, on this solemn occasion, consisted of the exploits and adventures of the gods, demigods, and heroes, who had, from time to time, been advanced to divine honours. These were displayed as passing before the mystæ in pageants fabricated for that important purpose. This was the original mode among the Egyptians, and was, no doubt, followed by their Eleusinian pupils. Those adventures were most probably demonstrated to have been allegorical, symbolical, hieroglyphical, &c. at least they were exhibited in such a favourable point of view as to dispel those absurdities and inconsistencies with which they were sophisticated by the poets and the vulgar.

With

With respect to the origin of those fabulous deities, it was discovered that they had been originally men who had been exalted to the rank of divinity, in consequence of their heroic exploits, their useful inventions, their beneficent actions, &c.—This is so clear, from the two passages quoted from Cicero, by bishop Warburton, that the fact cannot be contradicted. But that prelate has not informed us so precisely, whether the mystagogues represented them as nothing more than dead men, in their present state, or as beings who were actually existing in a deified state, and executing the functions assigned them in the rubric of paganism. Another query naturally occurs, that is, to what purpose did the mystagogues apply this communication? That the hierophants did actually represent those deified mortals in the latter predicament, is obvious from another passage quoted from Cicero, by the same prelate, which we shall transcribe as translated by him: "What think you of those who assert that valiant, or famous, or powerful men, have obtained divine honours after death; and that these are the very gods now become the objects of our worship, our prayers, and adoration? Euhemerus tells us when these gods died, and where they lie buried. I forbear to speak of the sacred and august rites of Eleusis. I pass by Samothrace, and the mysteries of Lemnos, whose hidden rites are celebrated in darkness, and amidst the thick shades of groves and forests." If, then, those deified mortals were become the objects of worship and prayers, there can be no doubt of the belief of their deified existence. The allusion to the Eleusinian and other pagan mysteries, toward the close of the quotation, places the question beyond the reach of controversy. But though, according to this account, "there were gods many and lords many," yet it is evident, from the passage quoted from Eusebius, in the preceding part of this article, that the unity of the Supreme Being was maintained, exhibited, and inculcated. This was the original doctrine of the Hierophants of Egypt: It was maintained by Thales and all the retainers of the Ionian school. It was the doctrine of Pythagoras, who probably gleaned it up in the country just mentioned, in connexion with many other dogmas which he had the assurance to claim as his own.

But however the unity, and perhaps some of the most obvious attributes of the Supreme Author of nature, might be illustrated and inculcated, the tribute of homage and veneration due to the subordinate divinities was by no means neglected. The initiated were taught to look to the *dii majorum gentium* with a superior degree of awe and veneration, as beings endowed with an ineffable measure of power, wisdom, purity, goodness, &c.—These were, if we may use the expression, the prime favourites of the Monarch of the universe, who were admitted into his immediate presence, and who received his behests from his own mouth; and communicated them to his subordinate officers, prefects, lieutenants, &c. These they were exhorted to adore; to them they were to offer sacrifices, prayers, and every other act of devotion, both on account of the excellency of their nature, and the high rank they bore at the court of heaven. They were instructed to look up to hero-gods and demi-gods, as beings exalted to the high rank of governors of different parts of nature, as the immediate guardians and protectors of the human race; in short, as gods near at hand, as prompters to a virtuous course, and assistants in it; as ready upon all occasions to confer blessings upon the virtuous and deserving. Such were the doctrines taught in the teletæ with respect to the nature of the Pagan divinities, and the worship and devotion enjoined to be offered them by the mysteries.

Excellent Plan for accomplishing the Ends proposed in the Mysteries.

As the two principal ends proposed by these initiations were the exercise of heroic virtues in men, and the practice of sincere and uniform piety by the candidates for immortal happiness, the hierophants had adopted a plan of operations excellently accommodated to both these purposes. The virtuous conduct and heroic exploits of the great men and demi-gods of early antiquity, were magnified by the most pompous eulogiums, enforced with suitable exhortations to animate the votaries to imitate so noble and alluring an example. But this was not all: the heroes and demi-gods were themselves displayed in pageants, or vehicles of celestial light. Their honours, offices, habitations, attendants, and other appendages; in the capacity of demons, were exhibited with all the pomp and splendour that the sacerdotal college were able to devise. The sudden glare of mimic light, the melting music stealing upon the ear, the artificial thunders reverberated from the roof and walls of the temple, the appearance of fire and ætherial radiance, the vehicles of flame, the effigies of heroes and demons, adorned with crowns of laurel, emitting rays from every sprig, the fragrant odours and aromatic gales which breathed from every quarter, all dexterously counterfeited by sacerdotal mechanism, must have filled the imagination of the astonished votaries with pictures at once tremendous and transporting. Add to this, that every thing was transacted in the dead of night, amidst a dismal gloom; whence the most bright effulgence instantaneously burst upon the sight. By this arrangement, the aspirants to initiation were wonderfully animated to

the practice of virtue while they lived, and inspired with a hope of a blessed immortality when they died. At the same time, their awe and veneration for the gods of their country was wonderfully enhanced, by reflecting on the appearances above described. Accordingly, Strabo very judiciously observes, "that the mystical secrecy of the sacred rites preserves the majesty of the Deity, imitating its nature, which escapes our apprehension. For these reasons, in celebrating the teletæ, the demons were introduced in their deified or glorified state."

Private Virtues inculcated in the Mysteries, by the Doctrine of a future State.

But as all the candidates for initiation might not aspire to the rank of heroes and demigods, a more easy and a more attainable mode of conduct, in order to arrive at the palace of happiness, behoved to be opened. Private virtues were inculcated, and these too were to meet a condign reward. But, alas! this life is too often a chequered scene, where virtue is depressed and trodden under foot, and vice lifts up its head, and rides triumphant. It is a dictate of common sense, that virtue should sooner or later emerge, and vice sink into contempt and misery. Here then the conductors of the mysteries, properly and naturally adopted the doctrine of a future state of rewards and punishments. The dogma of the immortality of the human soul was elucidated, and carefully and pathetically inculcated. This doctrine was likewise imported from Egypt; for Herodotus informs us, "that the Egyptians were the first people who maintained the immortality of the human soul." The Egyptian immortality, however, according to him, was only the metempsychosis or transmigration of souls. This was not the system of the ancient Egyptians, nor indeed of the teletæ. In these, a metempsychosis was admitted: but that was carried forward to a very distant period; viz. to the grand Egyptian period of 36,000 years.

As the mystagogues well knew that the human mind is more powerfully affected by objects presented to the eyes, than by the most engaging instructions conveyed by the ear, they made the emblems of Elysium and Tartarus pass in review before the eyes of their novices. There the Elysian scenes, so nobly described by the Roman poet, appeared in mimic splendour; and, on the other hand, the gloom of Tartarus, Charon's boat, the dog of hell, the furies with tresses of snakes, the tribunal of Minos and Rhadamanthus, &c. were displayed in all their terrific state.—Tantalus, Ixion, Sisyphus, the daughters of Danaus, &c. were represented in pageants before their eyes. These exhibitions were accompanied with most horrible cries and howlings, thunders, lightnings, and other objects of terror, which we shall mention in their proper place.

No contrivance could be better accommodated to animate the pupils to the practice of virtue on the one hand, or to deter them from indulging vicious passions on the other. It resembled opening heaven and hell to a hardened sinner. The practices inculcated in celebrating the mysteries are too numerous to be detailed in this imperfect sketch. The worship of the gods was strictly enjoined as has been shewn above. The three laws generally ascribed to Triptolemus were inculcated, 1. To honour their parents; 2. To honour the gods with the first fruits of the earth; 3. Not to treat brute animals with cruelty. These laws were imported from Egypt, and were communicated to the Eleusinians by the original missionaries. Cicero makes the civilization of mankind one of the most beneficial effects of the Eleusinian institutions: "Nullum mihi cum multa eximia divinaque videntur Athenæ tuæ peperisse; tum nihil melius illis mysteriis, quibus ex agresti immanique vita, ex cultu ad humanitatem, et mihi quasi sumus; initiaque, ut appellantur, ita revera principia vitæ cognovimus; neque solum cum lætitia vivendi rationem accepimus, sed etiam cum spe meliore moriendi." Hence it is evident that the precepts of humanity and morality were warmly recommended in these institutions. The virtue of humanity was extended, one may say, even to the brute creation, as appears from the last of Triptolemus's laws above quoted.

The initiated then bound themselves by dreadful oaths to observe most conscientiously and to practise every precept tendered to them in the course of the teletæ; and at the same time never to divulge one article of all that had been heard or seen by them upon that occasion. In this they were so exceedingly jealous, that Æschylus the tragedian was in danger of capital punishment for having only alluded to one of the Eleusinian arcana in a tragedy of his; and one of the articles of indictment against Diagoras the Melian was, his having spoken disrespectfully of the mysteries, and dissuaded people from partaking of them. It must then be allowed, that the institution of the mysteries was of infinite advantage to the pagan world. They were indeed a kind of sacraments, by which the initiated bound themselves by a solemn vow to practise piety towards the gods, justice and humanity towards their fellow-men, and gentleness and tenderness towards the inoffensive part of the brute creation. The pagans themselves were so thoroughly convinced of this fact, that, in their disputes with the apologists for christianity, they often appealed to the teletæ, and contrasted their maxims with the most sublime doctrines of that heavenly institution.

In order to impress these maxims the more deeply upon the minds of the novices, and to fix their attention more steadfastly upon the lectures which were delivered them by the myllagogue or the sacred herald, a mechanical operation was played off at proper intervals during the course of the celebration.

Horrible spectres and pleasing scenes alternately exhibited.

"Towards the end of the celebration, says Stobæus, the whole scene is terrible; all is trembling, shuddering, and astonishment. Many horrible spectres are seen, and strange cries and howlings uttered. Light succeeds darkness; and again the blackest darkness the most glaring light. Now appear open plains, flowery meads, and waving groves; where are seen dances and choruses; and various holy phantasies enchant the sight. Melodious notes are heard from far, with all the sublime symphony of the sacred hymns. The pupil now is completely perfect, is initiated, becomes free, released, and walks about with a crown on his head, and is admitted to bear a part in the sacred rites." Aristides de Myst. Eleas. calls Eleusis "a kind of temple of the whole earth, and of all that man beholds done in the most dreadful and the most exhilarating manner. In what other place have the records of fable sung of things more marvellous? or in what region upon earth have the objects presented to the eye bore a more exact resemblance to the fables which strike the ear? What object of sight have the numberless generations of men and women beheld comparable to these exhibited in the ineffable mysteries?" To the same purpose, Pletho, in the oracles of Zoroastres, informs us, "that frightful and shocking apparitions, in a variety of forms, used to be displayed to the mystæ in the course of their initiation." And a little after, he adds, "that thunder and lightning and fire, and every thing terrible which might be held symbolical of the divine presence, was introduced." Claudian, in his poem *De Rapta Proserpina*, gives an elegant, though brief description of this phenomenon, which throws some light on the passage above quoted.

"Jam mihi cernitur trepidis delubra moveri

"Sedibus et olarum dis pergere culmina lucem,

"Adventum testata Dea; jam magnus ab imis

"Auditur fremitus terris, templumque remugit

"Cecropidum."

The sight of those appearances was called the *Antophsia*, or "the real presence;" hence those rites were sometimes called *Epoptica*. The *Epoptæ* were actually initiated, and were admitted into the *Sandum Sanctorum*, and bore a part in the ceremonial; whereas the *mystæ*, who had only been initiated in the lesser mysteries at Agræ, were obliged to take their station in the porch of the temple. The candidates for initiation bathed themselves in holy water, and put on new clothes, all of linen, which they continued to wear till they were quite torn, and then they were consecrated to Ceres and Proserpine. From the ceremony of bathing they were denominated *Hydrantæ*; and this again was a kind of baptismal ablution. Whether the phrases of *washing away sin, putting on the Lord Jesus Christ, putting off the old man with his deeds, putting on a robe of righteousness, being buried in baptism*, the words *mystery, perfect, perfection*, which occur so frequently in the New Testament, especially in the writings of the apostle St. Paul, are borrowed from the pagan mysteries, or from usages current among the Jews, we leave to our more learned readers to determine.

Numerous and important were the advantages supposed to redound to the initiated, from their being admitted to partake of the mysteries, both in this life and that which is to come. First, they were highly honoured, and even revered, by their contemporaries. Indeed, they were looked up to as a kind of sacred persons: they were, in reality, consecrated to Ceres and Proserpine. Secondly, they were obliged by their oath to practise every virtue, religious, moral, political, public, and private. Thirdly, they imagined, that sound advice and happy measures of conduct were suggested to the initiated by the Eleusinian goddesses. Accordingly, says Pericles the celebrated Athenian statesman, "I am convinced, that the deities of Eleusis inspired me with this sentiment, and that this stratagem was suggested by the principal of the mystic rites." There is a beautiful passage in Aristophanes's comedy of the *Ranæ* to the very same purpose, of which we shall subjoin the following periphrasis. "It is sung by the chorus of the initiated.

Let us to slowly meads repair,

With deathless roses blooming,

Whose balmy sweets impregnate the air,

Both hills and dales perfuming.

Since fate benign our choir has join'd,

We'll trip in mystic measure;

In sweetest harmony combin'd

We'll quaff full draughts of pleasure.

For as alone the pow'r of day

A milder light dispenses;

And sheds benign a mellow'd ray

To cheer our ravish'd senses:

For we beheld the mystic show,

And brav'd Eleusis' dangers,

We do and know the deeds we owe

To neighbours, friends, and strangers.

Euripides, in his *Bacchæ*, introduces the chorus extolling the happiness of those who had been acquainted with God, by participating in the holy mysteries, and whose minds had been enlightened by the mystical rites. They boast, "that they had led a holy and unblemished life, from the time they had been initiated in the sacred rites of Jupiter Idaeus, and from the time that they had relinquished celebrating the nocturnal rites of Bacchus, and the banquets of raw flesh torn off living animals." To this sanctity of life they had no doubt engaged themselves, when they were initiated in the mysteries of that god. The Eleusinian *Epoptæ* derived the same advantages from their sacramental engagements. Fourthly, The initiated were imagined to be the particular wards of the Eleusinian goddesses. These deities were supposed to watch over them, and often to avert impending danger, and to rescue them when beset with troubles.—Our readers will not imagine that the initiated reaped much benefit from the protection of his Eleusinian tutelary deities; but it was sufficient that they believed the fact, and actually depended upon their interposition. Fifthly, The happy influences of the teletæ, were supposed to administer consolation to the *Epoptæ* in the hour of dissolution; for, says Isocrates, "Ceres bestowed upon the Athenians two gifts of the greatest importance; the fruits of the earth, which were the cause of our no longer leading a savage course of life; and the teletæ, for they who partake of these, entertain more pleasant hopes both at the end of life, and eternity afterwards." Another author tells us, "that the initiated were not only often rescued from many hardships in their lifetime, but at death entertained hopes that they should be raised to a more happy condition." Sixthly, After death, in the Elysian fields, they were to enjoy superior degrees of felicity; and were to bask in eternal sunshine, to quaff nectar, and feast upon ambrosia, &c.

The priests were not altogether disinterested in this salutary process. They made their disciples believe, that the souls of the uninitiated, when they arrived in the infernal regions, should roll in mire and dirt, and with great difficulty arrive at their destined mansion. Hence Plato introduces Socrates, observing, "that the sages who instituted the teletæ had positively affirmed, that whatever soul should arrive in the infernal regions *unhoused and unanneal'd*, should lie there immersed in mire and filth." And as to a future state (says Aristides), "the initiated shall not roll in mire and grope in darkness; a fate which awaits the unholy and uninitiated." It is not hard to conceive with what a commanding influence such doctrines as these must have operated on the generality of mankind.

When the Athenians advised Diogenes to get himself initiated, and enforced their arguments with the above considerations, "It will be pretty enough replied the philosopher) to see Agelæus and Epaminondas wallowing in the mire, while the most contemptible rascals who have been initiated are strutting in the islands of bliss."

When Antisthenes was to be initiated in the Orphic mysteries, and the priest was boasting of the many astonishing benefits which the initiated should enjoy in a future state, "Why, forsooth," (says Antisthenes,) 'tis wonder your reverence don't e'en hang yourself in order to come at them the sooner."

When such benefits were expected to be derived from the mysteries, no wonder if all the world crowded to the Eleusinian standard. After the Macedonian conquests, the Hierophants abated much of their original strictness. By the age of Cicero, Eleusis was a temple whither all nations resorted to partake of the benefits of that institution. We find that almost all the great men of Rome were initiated. The Hierophants, however, would not admit Nero on account of the profligacy of his character. Few others were refused that honour; even the children of the Athenians were admitted. But this we think was rather a lustration or consecration, than an initiation. Perhaps it paved the way for the more august ceremony, as the Christian baptism does among us for the other sacrament.

That this institution gradually degenerated, can hardly be questioned; but how much, and in what points, we have not been able to investigate. The fathers of the church, from whom that charge is chiefly to be collected, are not always to be trusted, especially when they set themselves to arraign the institutions of Paganism. There were indeed several ancient authors, such as Melancthus, Menander, Sotades, &c. who wrote purposely on the subject in question; but their works are long since irrecoverably lost. For this reason, modern writers, who have professedly handled it, have not always been successful in their researches. The two who have laboured most indefatigably, and perhaps most successfully in this field, are Meursius and Warburton. The former, in his *Liber Singularis*, has collected every thing that can be gleaned from antiquity relating to the ceremonial of these institutions, without, however, pointing out their original, or elucidating the end and import of their establishment. The latter has drawn them into the vortex of the system which has in many instances led him to ascribe to them a higher degree of merit than we think they deserve. These instances we would willingly have noticed in our progress, had the limits prescribed us admitted such a discussion.

This institution continued in high reputation to the age of St. Jerome, as appears from the following passage: "Hierophantæ quoque Atheniensium legant usque hodie cicutæ forbitione castrari." The Emperor Valentinianus intended to have suppressed them; but Zozimus informs us, that he was diverted from his design by the proconsul of Greece. At length Theodosius the elder, by an imperial edict prohibited the celebration of these as well as of all the other sacra of Paganism. These mysteries, instituted in the reign of Erechtheus, maintained their ground to the period just mentioned, that is, near 2000 years; during which space the celebration had been interrupted but once. When Alexander the Great massacred the Thebans and razed their city, the Athenians were so much affected with this event, that they neglected the celebration of that festival.

There were almost numberless mysterious institutions among the ancient Pagans. The Samothracian mysteries, instituted in honour of the Cabiri, were likewise of considerable celebrity, and were supposed to confer much the same blessings with the Eleusinian, but were not of equal celebrity. The Cabiri were Phœnician and likewise Egyptian deities. The learned Bochart has explained their origin, number, names, and some part of their worship. The Orphic mysteries were likewise famous among the Thracians. Orpheus learned them in Egypt, and they were nearly the same with the sacra Bacchanalia of the Greeks. There were likewise the mysteries of Jupiter Idæus in great request among the Cretans, those of the Magna Mater or Cybele, celebrated in Phrygia. To enumerate and detail all these would require a complete volume. We hope our readers will be fully satisfied with the specimen above, for the purpose for which we have under this head extended the work. We are convinced many things have been omitted which might have been inserted, but we have collected the most curious and the most important.—Every one of the positions might have been authenticated by quotations from authors of the most undoubted credibility, but that process would have swelled the article beyond all proportion.

Religion, in its original form, was simple and intelligible. It was intended for the instruction and edification of all ranks of men; and of consequence its doctrines were on a level with vulgar capacities. The Jewish dispensation was openly practised: nothing was performed in secret; every article was plain, open, and accessible. The divine Author of the Christian œconomy commanded his disciples to preach his doctrine in the most public manner: "What ye have heard in secret (says he) preach openly; and what I have taught you in private teach ye publicly, and proclaim it on the house-tops." Such are the charms of truth, and such the character of that religion which came down from heaven, that they, as it were, "delight in the light, and lift up their voice in the streets, and cry in the chief places of concourse."

But such is the depravity of the nature of man, that the noblest institutions degenerate in his hands. Religion itself, originally pure, simple, and amiable, under his management has often been transformed into pollution, perplexity, and deformity. The ministers of religion, whose province it was to guard the sacred deposit, and to secure it from foreign and spurious intermixtures, have generally been the first innovators, and the first and most industrious agents in corrupting its integrity and tarnishing its beauty. Avarice and ambition prompted that class of men to deviate from the original plainness and simplicity of religious institutions, and to introduce articles, rites, and usages, which might furnish them with opportunities of gratifying these unhalloved and insatiable passions. Hence distinctions unknown to pure and undefiled religion were fabricated, and that heavenly institution, heretofore one, simple, indivisible, was divided into two partitions; the one popular and public; the other dark, secret, and mysterious.

MYSTICAL, *μυσικός*, MYSTIC, something *mysterious*, or allegorical. See MYSTERY, ALLEGORY, &c. The commentators on the scripture, besides a literal, find also a mystical, and a moral meaning. The Bible, they contend, is a book written both within-side, and without-side: within-side, in respect to the mystical, internal, sublime, and hidden sense; and without-side, in respect to the literal and grammatical sense immediately expressed by the words. The sense of scripture, say they, is either that immediately signified by the words and expressions in the common use of language; or it is mediate, sublime, typical, and mystical; wherein the things themselves signified are made to signify still other and farther things, according to the particular design and intention of God, and of the prophets and apostles inspired by him. The literal sense they again divide into proper literal, which is contained in the words taken simply and properly: and *metaphorical* literal, where the words are to be understood in a figurative and metaphorical sense; as, *where the right eye is commanded to be plucked out*. Writers allow of three kinds of mystical senses in the word of God: the first corresponding to faith, and called *allegorical*; the second to hope, called *anagogical*; and the third to charity, called the *tropological sense*. The four senses, and their applications are included in the Latin distich:

*Litera gesta docet, quid credas allegoria,
Moralis quid agas, quo tendas anagogia.*

Sometimes the same word in scripture is to be taken in all the four senses. Thus the word Jerusalem literary signifies the capital of Judea; allegorically, the church militant; tropologically and morally, a believer; and anagogically, heaven. So, that passage in Genesis, *Let there be light, and there was light*, signifies, according to the letter, corporeal light; by the allegory, the Messiah; in the tropological sense, grace; and anagogically, beatitude, or the light of glory.

MYSTICS, *μυσικοί*, a kind of religious sect, distinguished by their professing pure, sublime, and perfect devotion, with an entire disinterested love of God, free from all selfish considerations.

The mystics, to excuse their fanatic ecstasies and amorous extravagancies, alledge that passage of St. Paul, *The Spirit prays in us by sighs and groans that are unutterable*. Now if the Spirit, say they, pray in us, we must resign ourselves to its motions, and be swayed and guided by its impulse, by remaining in a state of mere inaction. Passive contemplation is that state of perfection to which the mystics all aspire. The authors of this mystic science, which sprung up towards the close of the third century, are not known; but the principles from which it was formed are manifest. Its first promoters proceeded from the known doctrine of the Platonic school, which was also adopted by Origen and his disciples, that the divine nature was diffused through all human souls, or that the faculty of reason, from which proceed the health and vigour of the mind, was an emanation from God into the human soul, and comprehended in it the principles and elements of all truth, human and divine. They denied that men could by labour or study excite this celestial flame in their breasts; and, therefore, they disapproved highly of the attempts of those, who, by definitions, abstract theorems, and profound speculations, endeavoured to form distinct notions of truth, and to discover its hidden nature. On the contrary, they maintained that silence, tranquillity, repose, and solitude, accompanied with such acts as might tend to extenuate and exhaust the body, were the means by which the hidden and internal word was excited to produce its latent virtues, and to instruct men in the knowledge of divine things. For thus they reasoned; those who behold with a noble contempt all human affairs, who turn away their eyes from terrestrial vanities, and shut all the avenues of the outward senses against the contagious influences of a material world, must necessarily turn to God, when the spirit is thus disengaged from the impediments that prevented that happy union. And in this blessed frame they not only enjoy inexpressible raptures from their communion with the Supreme Being, but also are invested with the inestimable privilege of contemplating truth undisguised and uncorrupted in its native purity, while others behold it in a viated and delusive form.

The number of the mystics increased in the fourth century, under the influence of the Grecian fanatic, who gave himself out for Dionysius the Areopagite, disciple of St. Paul, and probably lived about this period; and by pretending to higher degrees of perfection than other christians, and practising greater austerity, their cause gained ground, especially in the eastern provinces, in the fifth century. A copy of the pretended works of Dionysius was sent by Balbus to Lewis the Meek in the year 824, which kindled the holy flame of mysticism in the western provinces, and filled the Latins with the most enthusiastic admiration of this new religion.

In the twelfth century, these mystics took the lead in their method of expounding scripture; and by searching for mysteries and hidden meanings in the plainest expressions, forced the word of God into a conformity with their visionary doctrines, their enthusiastic feelings, and the system of discipline which they had drawn from the excursions of their irregular fancies. In the thirteenth century, they were the most formidable antagonists of the schoolmen; and towards the close of the fourteenth, many of them resided and propagated their tenets almost in every part of Europe. They had, in the fifteenth century, many persons of distinguished merit in their number: and in the sixteenth century, previous to the reformation, if any sparks of real piety subsisted under the despotic empire of superstition, they were only to be found among the mystics. The principles of this sect were adopted by those called *Quietists* in the seventeenth century, and under different modifications, by the Quakers and Methodists.

MYTHOLOGY is a term compounded of two Greek words, and in its original import it signifies any kind of fabulous doctrine: In its more appropriated sense, it means those fabulous details concerning the objects of worship which were invented and propagated by men who lived in the early ages of the world, and by them transmitted to succeeding generations, either by written records or by oral tradition. As the theology and mythology of the ancients are almost inseparably connected, it will be impossible for us to develop the latter, without often introducing some observations relating to the former. We must, therefore, intrude the indulgence of our readers, if upon many occasions we should hazard a few strictures on the names, characters, adventures, and functions of such pagan divinities as may have furnished materials for those fabulous narrations which the nature of the subject may lead us to discuss.

With respect to *fable*, it may be observed, in general, that it is a creature of the human imagination, and derives its birth from that love of the *marvellous* which is in a manner congenial to the soul of man.—The appearances of nature, which every day occur, objects, actions, and events, which succeed each other, by a kind of routine, are too familiar, too obvious, and uninteresting, either to gratify curiosity, or to excite admiration. On the other hand, when the most common phenomena in nature or life are new modelled by the plastic power of a warm imagination; when they are diversified, compounded, embellished, or even arranged and moulded into forms which seldom or perhaps never occur in the ordinary course of things;—novelty generates admiration, a passion always attended with delightful sensations. Here then we imagine we have discovered the very source of *fable* and *fiction*. They originated from that powerful propensity in our nature towards the *new* and *surprising*, animated by the delight with which the contemplation of them is generally attended. Many circumstances contributed to extend and establish the empire of *fable*. The legislator laid hold on this bias of human nature, and of course employed *fable* and *fiction* as the most effectual means to civilize a rude, unpolished world. The philosopher, the theologist, the poet, the musician, each in his turn, made use of this vehicle to convey his maxims and instructions to the savage tribes. They knew that truth, simple and unadorned, is not possessed of charms powerful enough to captivate the heart of man in his present corrupt and degenerate state. This consideration, which did, indeed, result from the character of their audience, naturally led them to employ *fiction* and *allegory*. From this was derived the allegorical taste of the ancients, and especially of the primary sages of the east.

Though almost every nation on the face of the globe, however remote from the centre of population, however savage and averse from cultivation, has fabricated and adopted its own system of mythology; the Orientals, however, have distinguished themselves in a peculiar manner, by the boldness, the inconsistency, and the extravagance of their mythology. The genial warmth of those happy climes, the fertility of the soil, which afforded every necessary, every convenience, and often every luxury of life, without depressing their spirits by laborious exertions; the face of nature perpetually blooming around them, the skies smiling with uninterrupted serenity; all contributed to inspire the Orientals with a glow of fancy and a vigour of imagination rarely to be met with in less happy regions. Hence every object was swelled beyond its natural dimensions. Nothing was great or little in moderation, but every sentiment was heightened with incredible hyperbole. The magnificent, the sublime, the vast, the enormous, the marvellous, first sprung up, and were brought to maturity, in those native regions of *fable* and *fairy land*. As nature, in the ordinary course of her operations, exhibited neither objects nor effects adequate to the extent of their romantic imaginations, they naturally deviated into the fields of *fiction* and *fable*. Of consequence, the custom of detailing fabulous adventures originated in the east, and was from thence transplanted into the western countries.

As the allegorical taste of the eastern nations had sprung from their propensity to *fable*, and as that propensity had in its turn originated from the love of the *marvellous*; so did *allegory* in process of time contribute its influence towards multiplying *fables* and *fiction* almost in *infinitum*. The latent import of the allegorical doctrines being in a few ages lost and obliterated, what was originally a moral or theological tenet, assumed the air and habit of a personal adventure.

The propensity towards personification, almost universal among the orientals, was another fruitful source of *fable* and *allegory*. That the people of the east were strongly inclined to personify inanimate objects and abstract ideas, we imagine will be readily granted, when it is considered, that in the formation of language they have generally annexed the affection of sex to those objects. Hence the distinction of grammatical genders, which is known to have originated in the eastern parts of the world. The practice of personifying virtues, vices, religious and moral affections, was necessary to support that allegorical style which universally prevailed in those countries. This mode of writing was in high reputation even in Europe some centuries ago; and to it we are indebted for some of the most noble poetical compositions now extant in our own language. Those productions, however, are but faint imitations of the original mode of writing still current among the eastern nations. The Europeans derived this species of composition from the Moorish inhabitants of Spain, who imported it from Arabia, their original country.

The general use of hieroglyphics in the east, must have contributed largely towards extending the empire of mythology. As the import of the figures employed in this method of delineating the signs of ideas was in a great measure arbitrary, mistakes must have been frequently committed in ascertaining the notions which they were at the first intended to represent. When the development of these arbitrary signs happened to be attended with uncommon difficulty, the expounders were obliged to have recourse to conjecture.

The wise men of the east delighted in obscure enigmatical sen-

tences. They seemed to have disdained every sentiment obvious to vulgar apprehension. The words of the wise, and their dark sayings, often occur in the most ancient records both sacred and profane. The sages of antiquity used to vie with each other for the prize of superior wisdom, by propounding riddles, and dark and mysterious questions, as subjects of investigation. The contest between Solomon and Hiram, and that between Amasis king of Egypt and Polycrates tyrant of Samos, are universally known. As the import of those enigmatical propositions was often absolutely lost, in ages when the art of writing was little known, and still less practised, nothing remained but fancy and conjecture, which always verged towards the regions of *fable*. This then seems to be a principal source of mythology.

The Pagan priests, especially in Egypt, were probably the first who reduced mythology to a kind of system. The sacerdotal tribe, among that people, were the grand depositories of learning as well as of religion. That order of men monopolized all the arts and sciences. They seem to have formed a conspiracy among themselves, to preclude the laity from all the avenues of intellectual improvement. This plan was adopted with a view to keep the laity in subjection, and to enhance their own importance. To accomplish this end, they contrived to perform all the ministrations of their religion in an unknown tongue, and to cover them with a thick veil of *fable* and *allegory*. The language of Æthiopia became their sacred dialect, and hieroglyphics their sacred character.—Egypt, of course, became a kind of fairyland, where all was jugglery, magic, and enchantment. The initiated alone were admitted to the knowledge of the occult mystical exhibitions, which, in their hands, constituted the essence of their religion. From these the vulgar and profane were prohibited by the most rigorous penalties (see MYSTERIES). The Egyptians, and, indeed, all the ancients without exception, deemed the mysteries of religion too sacred and solemn to be communicated to the herd of mankind, naked and unreserved; a mode by which they imagined those sacred and sublime oracles would have been defiled and degraded. “Procul, O procul este profani—Odi profanum vulgus et arceo.” Egypt was the land of graven images: *allegory* and *mythology* were the veil which concealed religion from the eyes of the vulgar; *fable* was the groundwork of that impenetrable covering.

In the earliest and most unpolished stage of society, we cannot suppose *fable* to have existed among men. *Fables* are always *tales of other times*, but at this period other times did not reach far enough backward to afford those fruits of the imagination sufficient time to arrive at maturity. *Fable* requires a considerable space of time to acquire credibility, and to rise into reputation. Accordingly, we find that both the Chinese and Egyptians, the two most ancient nations whose annals have reached our times, were altogether unacquainted with fabulous details in the most early and least improved periods of their respective monarchies. It has been shewn almost to a demonstration, by a variety of learned men, that both the one and the other people, during some centuries after the general deluge, retained and practised the primitive Noachic religion, in which *fable* and *fancy* could find no place: all was genuine unsophisticated truth.

As soon as the authentic tradition concerning the origin of the universe was either in a good measure lost, or at least adulterated by the inventions of men, *fable* and *fiction* began to prevail. The Egyptian *Thoth* or *Thyoth*, or Mercury Trismegistus, and Mochus the Phœnician, undertook to account for the formation and arrangement of the universe, upon principles purely mechanical. Here *fable* began to usurp the place of genuine historical truth. Accordingly, we find that all the historians of antiquity, who have undertaken to give a general detail of the affairs of the world, have ushered in their narration with a fabulous cosmogony. Here imagination ranged unconfined over the boundless extent of the primary chaos. To be convinced of the truth of this assertion, we need only look into Sanchoniathon's Cosmogony, Euseb. Præp. Evang. l. 1. sub init. and Diodorus Sic. l. 1. From this we suppose it will follow; that the first race of *fables* owed their birth to the erroneous opinions of the formation of the universe.

Mythology teaches the history of the gods, demi-gods, and fabulous heroes of antiquity; the theology of the pagans, the principles of their religion, their mysteries, metamorphoses, oracles, &c. By this definition it appears sufficiently what are the objects of which we are to treat in this article.

If we well consider the matter, we shall find, that there were, in pagan antiquity, three different religions. First, That of the philosophers, who treated metaphysically of the nature, the attributes, and of the works of the Supreme Being. They endeavoured to discover the true God, and the manner in which he ought to be worshipped. It is not wonderful, that these men of exalted genius should, in some degree, ridicule, in their works, the two other positive religions, and those gods on whom they were founded: at the same time that they outwardly professed the established religion, in order to preserve the peace of society, and to avoid the persecutions of the legislature, and the insults of the populace. For, in fact, was it possible for them to believe the pagan fables? Must they not foresee, that their religion would one day give place to another; while their own works would pass with their

their names to the latest posterity? And could they suffer the thought, that their reputation would be tarnished in the eyes of that posterity, by having it imagined they believed such idle tales as were broached by the priests of their times? Could Plato, Socrates, Seneca, and Cicero, be unconcerned for their fame among future generations, and future philosophers? And what should we at this day have said of those great men, had they been so political, or hypocritical, as to have entirely concealed their sentiments with regard to these matters?

The second religion was that of paganism, which was the established religion of all the ancient nations except the Jews. This was the doctrine that was taught by the priests, and protected by the sovereigns. Its dogmas were demonstratively false, but not always so absurd as may at first appear; especially if we annex to the divinities and to the religious ceremonies of the pagans, a sense that is frequently mystic, and always allegoric; if we remember that the first heathens deified those great men to whom the rest of mankind were indebted for any signal benefits, as Jupiter, Apollo, Ceres, Bacchus, Hercules, Æsculapius, &c. in order to induce others, as well of the present as of future ages, to reverence and to imitate them. Would not an ancient pagan, if he were to return upon the earth, have specious arguments, at least, to support his religion, when he saw weak mortals beatify or canonize, merely by their own authority, other weak mortals (frequently mere pedants), and place them in heaven, without the permission or approbation of the Supreme Being? Happy is it for mankind, when at different times sagacious pontiffs purge the calendar, and the brains of the people, from a herd of pretended saints, and prevent them, at least after their death, from doing injury to society, by interrupting the industry of the laborious inhabitants with keeping their festivals.

The third religion was idolatry, or the religion of the populace. For the common people, born to be deceived in every thing, confounding in their imaginations the statues of the gods, the idols of their divinities, the emblems of their virtues, and of religious worship, with the gods, divinities, virtues, and worship themselves, adored these images, and proceeded to extravagancies most ridiculous, and frequently most criminal, in their ceremonies, feasts, libations, sacrifices, &c. It is to be feared, that as long as there are upon the earth men of our limited capacities, this triple religion will constantly subsist under different forms; and we are much deceived if it may not be found under the empire of christianity itself, notwithstanding the purity of its doctrine. It will be easily conceived, that it is not of the religion of philosophers, nor that of the populace, of which we are to treat in this article of Mythology; but of that which subsisted under the authority of the magistracy and the priesthood, and consequently of paganism in general.

As far as we are able to judge by all the ancient authors we have read, the pagans adored the sovereign Lord of the universe under the name of *Fate* or *Destiny*, which we must not confound with Fortune, who was regarded as a subaltern divinity. Jupiter himself, all the gods, every animated being, the heavens, the earth, the whole frame of nature, was subservient to Destiny, and nothing could reverse its decrees. This divinity was so highly adorable, as to be above all rank; and was regarded as too supreme to be represented under any sensible image or statue, or to have any temple erected for its worship. We do not remember to have read, that ever any sacrifice was offered to this Destiny, or that any temple or city was ever dedicated to its name. We are almost inclined to think, that the pagans were sensible, that the temple and the worship of the God of gods ought to be in the heart of man. Mention is made, indeed, of a temple that was dedicated to the Unknown God; but we are ignorant whether or not Destiny were thereby meant. We must not confound this Destiny, moreover, with the goddess of chance, of which there are some antique statues that represent her in a recumbent posture, and playing with little bones; for this was nothing more than an invention of some statuary.

After this general and philosophical idea of the Supreme Being, comes the positive religion of the pagans. This was entirely founded on fable, which took its rise either from ancient traditions, or historical events, altered or augmented by the imaginations of the poets, by superstition, or by the credulity of the people; or else it consisted of allegoric or moral fictions. A crowd of writers, and among the rest *Noël le Comte*, (*Natalis Comes*) the abbots Bannier and Pluche, &c. have made many researches into the origin of fable; and they think they have discovered its source, 1. In the vanity of mankind; 2. In the want of letters and characters; 3. In the delusive eloquence of orators; 4. In the relations of travellers; 5. In fictions of poets, painters, statuary, and dramatic writers; 6. In the diversity and uniformity of names; 7. In the ignorance of true philosophy; 8. In the foundation of colonies, and the invention of arts; 9. In the desire of having gods for our ancestors; 10. In the imperfect or false interpretation of the holy scriptures; 11. In the ignorance of the ancient history; 12. In a like ignorance of chronology; 13. In that of foreign languages; 14. In the translation of the religion of the Egyptians and Phœnicians of Greece; 15. In the ignorance of geography; and 16. In the belief which the first people

had of the intercourse of gods with men. It is certain, that all these matters taken together are sufficient to produce many thousands of fables; are more than sufficient to enable us to deceive ourselves and others, and to give rise to infinite reveries. But we should take care how we draw from these sources demonstrations that might be used, by infidels, as arguments to overthrow the history of the Jews; a people the most stupid, most credulous, and ostentatious of all others. In the mean time, the pagan philosophers themselves asserted that it was a god who invented the fable; so much were they convinced of its ingenuity, and of its strong tendency to instruct mankind in their duty.

Mythology therefore, when properly treated, begins with making learned researches into the real origin of fable, of paganism, and that idolatry which was its consequence. It recurs for this purpose even to the beginning of the world: and after finding that Laban, the father-in-law of the patriarch Jacob, was a maker of idols, and that he had his little images, or household gods, which he formed of baked earth, and which shews that idolatry existed in the greatest antiquity; it then explains cosmogony, and theogony, or the belief that the first inhabitants of the earth entertained of the creation of the universe, and what the pagan theology taught of the genealogy of their false gods. It begins with the tradition of the Chaldeans, a people so ancient, that Nimrod was their first king; but at the same time so credulous and superstitious, that we may regard them as the authors of all those fables, and the propagators of all those visions, that have since blinded human reason. According to this tradition, a monster named *Oannes* or *Oes*, half fish and half man, sprang from the sea, before the chaos was completely dispersed, and gave laws to the Chaldeans. A woman called *Omorka*, reigned over all the earth. *Bel* cut her in two, and made of one moiety the heavens, and of the other the earth. They likewise invented the two primitive beings; of which the good one, who was named *Oramasdes*, had the direction of heaven; and the other, called *Arimanius*, that of hell.

The science of mythology then teaches the theogony of the Phœnicians; concerning whom it draws great lights from Sanchoniathon, a priest of Beryte, who lived before the Trojan wars, more than 400 years before Hesiod and Homer, and of whom Eusebius has preserved considerable fragments. From thence it passes to the theogony of the Egyptians; of whom *Thot* or *Thaut*, the founder of that nation, was likewise, they say, their first historian; that Sanchoniathon even copied from him; and of whom we find many relations in the Greek historians, especially in Herodotus, Diodorus Siculus, and in Eusebius of Cæsarea. It then examines the theogony of the Atlantides, who dwelt on the western part of Africa, and of whom Diodorus alone has preserved any account. From thence it proceeds to the theogony of the Greeks, which is far better known to us, as we find accounts of it more or less particular, in numberless Greek and Latin writers. This theogony had the same foundation as that of the Romans; the latter having only extended it, by adding to the Greek divinities certain gods or demi-gods, formed of their heroes, and certain symbolic and allegoric divinities, which mythology explains at the same time; and it is on this occasion that it enters into a particular explication of the cosmogony and theogony of Ovid; whose book of metamorphoses contains as copious descriptions as we could desire of the fables of the ancients: what was their belief concerning the habitations of the blessed after their death, or of the Elysian fields; as well as of their hell or Tartarus; of the dog Cerberus; of the ferryman Charon; of the Furies; of the four rivers, Cocytus, Lethe, Phlegethon, and Styx, which water the Tartarian regions, &c.

Mythologists then continue their researches into the time, the epoch, and place, of the real origin of paganism and idolatry; and they prove that the pagans began by adoring the heavenly bodies, the stars and planets. They next examine into the progress of idolatry: what were the temples of the pagans, their altars, their inclosures, their sacred groves, their asylums, the idols, and statues of their deities; in what manner they were represented; what were their sacrifices, the victims that were offered; what the days of penitence and supplication, the feasts of the gods of electricity, their invocations or incantations and exorcisms, the religious ceremonies observed at laying the foundations of cities, &c.

Divination, or the prediction of future events, a weakness that has at all times possessed the human mind, forms also an important article of pagan theology. It is, therefore, in this place that mythology considers the nature of oracles, and in what manner these oracles gave their answers; the ceremonies that were observed in consulting them; the frantic emotions of the priestess Pythia on her tripod, and those of other priests. See DIVINATION. It then endeavours to investigate the history of the Sibyls, and of their prophecies. It next passes to the examen of the nature of auguries, auspices, haruspices, prodigies, &c. of expiations and ablutions; of the magic and astrology of the ancients, &c. See ASTROLOGY, &c. It then proceeds to the examination of the nature of the pagan divinities themselves.

The celebrated treatise of Cicero *De natura Deorum*, will here furnish great lights: but modern authors, who have treated on these

these matters, have not been contented with this alone: they have, to say, extracted the essence of all antiquity, of which they have formed systems; but unluckily these scarce ever agree with each other. As philosophers, it is of very little importance for us to know what was the nature of these gods, seeing we know that they were merely fabulous; but as historians and antiquaries, it concerns us to know what was the nature that was attributed to them in general; and, in particular, what were the origin, genealogy, rank, functions, authority, and operations, that were attributed to each divinity; and it is on those matters that we have still some remarks to make.

The gods of the ancient Greeks and Romans were all either *Dii majorum gentium*, or *Dii minorum gentium*; that is, of the first or second order. The former were also called *conferentes*, *magni consultores*, &c. According to Ennius, they were 12 in number, and are included in these verses:

Juno, Vesta, Minerva, Ceres, Diana, Venus, Mars,
Mercurius, Jovis, Neptunus, Vulcanus, Apollo.

To these were added eight others, under the title of *Selecti*, which were Sol, Luna, Tellus, Genius, Janus, Saturnus, Liber, and Pluto. The second order, or *minorum gentium*, were called *Ascripti*, *Medioximi*, *Minuscularii*, *Putatitii*, *Indigetes*, *Semones*, &c. the principal of which were Æsculapius, Bacchus, Castor, Fauna, Hercules, the Lares or Penates, Pollux, Quirinus. We might add more, but these shall suffice.

According to the second division, all their divinities were classed into, 1. Celestial gods; 2. Terrestrial gods; 3. Sea gods; and, 4. The infernal deities, or *inferi*. The celestial gods were Jupiter, Juno, Apollo, Aurora, Cupid, Cybele, the Graces, Hebe, Iris, Luna, Mars, Mercury, Minerva, Nemesis, Saturn, Themis, Venus, &c. The terrestrial gods were Æolus, Atræa, Ceres, Diana, the Fauni, Feronia, Flora, Janus, Momus, the Muses, Pales, Pan, Pomona, Priapus, the Satyrs, Silenus, the god Terminus, Vesta or Rhea, Vulcan, &c. The sea-gods were Neptune, Amphitrite, Thetis, Canopus, Glaucus, Ino, the Nereids, Nereus, Oceanus, Palæmon, Triton, &c. The infernal gods were Pluto, Proserpine, Charon, Minos, Æacus, Rhadamanthus, the Furies, Death, Night, the Fates, Pluto, &c.

The third division ranged the divinities according as they presided, 1. Over the pregnancy of women, (*Pregnantium*); 2. At parturitions, (*Parturientium*); 3. At births, (*Nascentium*); 4. At adulteries; 5. At marriages; to which they added, 6. *Dii morales*, or moral gods; and 7. Funeral gods. The gods of pregnancy were Pilumnus, Intercidonia, and Deverra. The gods of parturition, Juno, Lucina, Diana, Egerio, Prosa, Postverta, Menagenatta, Latona, the gods that were called *Nixi*, or of *labour*, &c. The gods of birth were Janus, Opis, Nascion, Cunnia, Carmenta, Vaginianus, Levana, Rumia, Potina, Educa, Ostiatio, Carnea, Nundina, Stalilinus, Fabulinus, Paventia, &c. The gods of adultery were Juvenius, Agenoria, Strenua, Simula, Horta, Quies, Murcia, Adeona, Abeona, Voluptas, Orbona, Pellonia, Numeria, Camoena, Sentia, Angerona, Heres, Manea, Laverna, the god Averruncus, Confus, Catus, Voluminus and Volumna, Honorius, Aius Locutius, &c. &c. The nuptial gods were Diana, Domitica, Domitius, Hymenæus, or Hymen, Jucatinus, Jupiter perfectus, Juno perfecta, Juno cinxia, Juno unxia, Lucina, Manturna, Mutinus, Dea Mater prima, Suada, Thalassius, Venus, &c. The moral gods were called *Virtus*, *Honor*, *Fides*, *Spes*, *Justitia*, *Pietas*, *Misericordia*, *Clementia*, *Pudicitia*, *Veritas*, *Mens*, *Concordia*, *Pax*, *Salus*, *Felicitas*, *Libertas*, *Pecunia*, *Risus*, *Invidia*, *Contumelia*, *Impudentia*, *Calumnia*, *Fraus*, *Discordia*, *Furor*, *Fama*, *Fortuna*, with all their epithets good or bad, *Febris*, *Pavor*, and *Palor*, *Paupertas*, *Necessitas*, *Tempestas*, *Silentium*, &c. The funeral gods were Pluto, Libitina, Nenia, Death, the Fates, &c.

Hesiod, indeed, pretends, that all these gods derived their origin from chaos; but we have already pointed out more just sources. It is almost incredible to what a prodigious number the superstition and weakness of the Greeks and Romans multiplied these divinities: there have been 30,000 of them enumerated. It will not be expected that we should here attempt to describe them, nor will it be remarkable if we have forgotten to mention even some of the first rank: although, vast as this company of gods is, mythology does not omit to trace the history of the greatest part of them, as is taught by paganism; and they, who are desirous of particular information in these matters may consult with advantage the theology of Hesiod, the catalogue of Apollodorus, the metamorphosis of Ovid, the fables of Hygine, Lylii Gregorii Gyraldi, Synagoga de diis Gentilium, the mythology of Natalis Comes, the books of Gerard Vossius de idolatria Gentilium, Johannis Boccacii Genealogia deorum, the Pantheon of Pompey, the history of heaven by Abbé Pluche, the historic explanation of fables by Abbé Banier, and Bryant's Mythology.

There were still many other distinctions, of which the pagans made use to mark the rank, the functions, and nature of their several divinities. For example, the goddess Vesta, or the mother of all the gods, was adored by all people in general. Mars, Bellona, Victoria, Fortunata, &c. assisted all parties. The principal gods, on the contrary, were ordained in particular countries only; as Astarte in Syria, Derceto and Semiramis among

the Assyrians, Isis and Osiris by the Egyptians, Quirinus at Rome, &c. The title *Semones*, which was given to a certain class of divinities, was doubtless derived from *Semi-homines*, that is, *demi-men*; and signified the same as *femi-dii*, or *demi-gods*. These were monarchs and illustrious heroes, or those great men who were the founders of cities and nations, that were deified by way of apotheosis. Pythagoras had taught the Chaldeans the doctrine of transmigration; and that, after their death, those who were virtuous would be elevated to the rank of divinities. This doctrine was adopted by all the Pagan world. The apotheosis, after they had erected temples and altars to the new gods, was celebrated with much solemnity. In the last ceremony, an eagle was fixed on the catafalk, or funeral pile, on which was placed the image of the hero: and when the pile began to burn, the eagle was let loose, who mounting into the air with the flames, seemed to carry the soul of the departed hero up to heaven.

Mythology informs us also, who those persons were that antiquity regarded as the children of the gods, such as Theseus, Hippolytus, Paris, &c. what the pagans believed with regard to the nature of their genii and demons, of their dryades, hamadryades, nymphs, tritons, sirens, fauns, sylfens, centaurs, and other subaltern divinities; and in this manner it explains all the systems of the positive religion of the Greeks and Romans. They who are desirous of extending their knowledge of paganism still further, of knowing the dogmas of each particular people, what were their gods, and the various manners in which they were worshipped, such as Apis, Isis, Osiris, &c. the adoration of crocodiles and onions, &c. among the Egyptians, must study the different theogonies of these people; and notwithstanding all the informations which ancient and modern authors afford, this study is yet boundless, and attended with many difficulties and uncertainties: though it appears demonstrative, that the origin of paganism, and of idolatry in general, was derived from the Chaldeans, from whom the Egyptians drew that doctrine which they afterwards transmitted to all other nations; and consequently that the primordial divinities were the same, under different denominations, among all the idolatrous nations of the earth.

The nature of this work will not permit us to descend to further particulars. But to give our readers an idea of the manner in which mythology treats its subjects, and of the method that should be observed in studying fable, or the history of the gods of antiquity, we shall here give, by way of example, a cursory description of Parnassus and its inhabitants.

Parnassus was a mountain of Phocis, that had two summits, one of which was called *Tithoreus*, and the other *Hyampeus*. Others say, that one of these hills was named *Helicon*, and the other *Cytheron*; and that it is an error to imagine, that Helicon was a mountain of Bœotia. However that be, this double hill was consecrated to Apollo and the muses, who there held their usual residence. According to fable, there had been a very remarkable combat on this hill, between Helicon and Cytheron. Whoever slept on Parnassus, when he waked, became a poet. Apollo had there a temple. There also was the fountain Calistia, into which Apollo had metamorphosed a nymph that he loved, and had given to its waters the power of making all who drank of them poets. At the foot of Parnassus flowed the river Hippocrene, that had the same virtue; and the source of which was opened by a stroke of the foot of the horse Pegasus. This river nourished a great number of swans, that were regarded as sacred. Pegasus was a winged horse, that belonged to Apollo, and grazed on the summit of Parnassus. He sprang from the blood of Medusa, when Perseus cut off her head, which was placed among the stars. Such was the delicious abode of Apollo, the son of Jupiter and Latona, who was born, with his twin sister Diana, in the island of Delos. He killed the Cyclops, who forged the thunderbolts with which Jupiter had overthrown his son Æsculapius; but for that presumption he was forced to leave heaven, and became an inhabitant of the earth. He guarded the oxen of Admetus; he aided Neptune to build the walls of Troy, and Alceus in forming the Labyrinth. He killed the dragon or serpent Pythor. He invented music and physic; and was honoured as the god of poets and physicians. He was represented as a young man without a beard, his head surrounded with rays, and bearing in his hand a bow, or a lyre. As the ancients denoted the sun by the name of *Apollo*, they sometimes represented him also as seated in a chariot, drawn by two white horses, preceded by Aurora and the star Venus: Phaeton his son, being desirous of conducting these horses, was thrown into the sea. Apollo was also called *Phabus*, *Titan* and *Sol*. He is known to have had amours with Arsinoe, Corycia, Melæne, Cyrene, Mantho, Sinope, Calliope, and others; by whom he had Delphe, Naxe, Niletus, Arabe, Garamas, Sirius, Linus, Orpheus, and other children. He had peculiar honours paid him in the Pythian games at Delphos, and in the secular games at Rome.

The muses were the companions of Apollo in his rural abode. They were likewise called the *learned sisters*; as also the *Camænon*, *Heliconian*, *Parnassian*, *Anian*, *Pierian*, *Pegasian*, *Aganippian*, *Thepsian*, *Libethrian*, and *Castalian sisters*. They

were the daughters of Jupiter and Mnemosyne, and were regarded as the goddesses of sciences and arts in general. There were nine of those muses; to whom they attributed; 1. To Clio, history; 2. To Melpomene, tragedy; 3. To Thalia, comedy; 4. To Euterpe, flutes and other pneumatic instruments of music; 5. To Terpsichore, the harp and the dance; 6. To Erato, the lyre and the lute; 7. To Calliope, heroic-verse; 8. To Urania, astronomy; and 9. To Polyhymnia, rhetoric and eloquence. The Graces also sometimes quitted Venus to pay their court to Apollo.

Such was the idea they entertained of Parnassus and its inhabitants. There is no doubt but that, under these fabulous representations, these sensible images, were concealed allegoric and moral meanings; nor can it be denied but that their method of cultivating the arts and sciences, by this manner of expressing their ideas, was as ingenious and pleasing as it is possible to imagine. Every other subject that paganism embraced, it treated with the same genius, and in a manner equally pleasing; and though that religion was altogether fallacious, yet we must allow that it was extremely well calculated to promote the polite arts, by those refined, noble, graceful; brilliant images, by those charming subjects, which it constantly presented, and which it still offers to the poet, painter, sculptor, and every other artist.

But this was not a power sufficiently strong to secure paganism against that vicissitude, that decline and dissolution, which finally attends all the productions of this world. This religion, which had subsisted near 5000 years, and almost from the origin of the human race, gradually declined in proportion as the lights of christianity and philosophy illuminated the minds of mankind. For though the pagan religion, and the fables on which it was founded, were pleasing and favourable to the polite arts, they were not however calculated to satisfy the minds of philosophers, nor to promote the real good of mankind, by securing their temporal and eternal happiness. It is even surprising that so great a genius as the emperor Julian should attempt to revive the embers of paganism, which insensibly declined, and had received a mortal blow at the beginning of the fourth century by the emperor Constantine the great. Julian employed all the resources of his imagination, of his eloquence, of his power, and even of his own fatal example, to revive it; but in vain. The period of paganism was arrived, and nothing could save it from destruction. The furious Theodosius, to whom bigotted priests and historians have assigned the name of *great*, totally overthrew it towards the close of the same century, destroyed those temples and altars which yet subsisted, dispersed its colleges, and exterminated its priests. From that dire epoch, nothing of paganism has remained, except some ruins dispersed in the remote parts of the earth, and among people wretched and almost unknown; where this religion, once so flourishing and universal, is now degenerated into gross and disgusting idolatry.

MYTILUS, the MUSCLE in *Vermeology*, a genus belonging to the order *Tessacea*, which comprehends those animals which have shells, and are therefore called *Testaceous*; for a description of the Genus *Mytilus*, see the *System of CONCHOLOGY*, Genus 16.

The common sea or edible muscle, has, from its being always found fastened to the rocks, been supposed by many wholly incapable of progressive motion; but this is an erroneous opinion. It is a common practice in France, at such seasons of the year as do not afford sun enough to make salt, to throw the common sea-muscles, which the fishermen catch about the coasts, into the brine pits. They have an opinion that this renders their flesh the more tender and delicate, as the rain which falls at these seasons makes the water of the pits much less salt than the common sea-water. The muscles are on this occasion thrown carelessly in, in several different parts of the pits; yet, at whatever distances they have been thrown in, the fishermen, when they go to take them out, always find them in a cluster together; and as there is no current of water in these places, nor any other power of motion which can have brought the muscles together, it seems very evident that they must voluntarily have marched from the places where they were at first, to have met thus together. This progressive motion is wholly performed by means of what we call the *tongue* of the muscle, from its shape; but from its use in this case, appears rather to merit the name of a *leg*, or an *arm*, as, by laying hold of any distant substance, and then forcibly contracting itself again, it draws along the whole body of the fish; the same part, when it has moved the animal to a proper place, serves also to fix it there, being the organ by which it spins the threads which we call its *beard*, by which it is held to a rock, or to another muscle. The motion of the muscle, by means of this part, is just the same with that of a man laid flat on his belly, who would draw himself along by laying hold of any thing with one hand, and then drawing himself to it. Muscles are well known to have a power of fastening themselves either to stones, or to one another's shells, in a very strong and firm manner; but the method of doing this was not well understood till the observations of Mr. Reaumur explained it.

Every one who opens and examines a common muscle, will find that in the middle of the fish there is placed a little blackish

or brownish body, resembling a tongue. This in large muscles is near half an inch long, and a little more than the sixth of an inch in breadth, and is narrower at the origin than at the extremity: from the root of this tongue, or that part which is fastened to the body of the fish, there are produced a great number of threads, which, when fixed to any solid substance, hold the muscle firmly in its place: these threads are usually from an inch to two inches in length, and in thickness from that of a hair to that of a hog's bristle. They issue out of the shell in that part where it naturally opens, and fix themselves to any thing that lies in their way, to stones, to fragments of shells, or, which is the most common case, to the shells of other muscles; whence it happens that there are usually such large parcels of muscles found together. These threads are expanded on every side, and are usually very numerous, 150 having been found issuing from one shell: they serve the office of so many cables; and, each pulling in its proper direction, they keep the muscle fixed against any force that can be offered from whatever part it comes. The filaments are well known to all who eat muscles, whoever carefully separates them under the name of the beard; and Mr. Reaumur has found, that while the animal is living in the sea, if they are all torn away, the creature has a power of substituting others in their room: he found, that if a quantity of muscles were detached from one another, and put into a vessel of any kind, and in that plunged into the sea, they, in a little time, fastened themselves both to the sides of the vessel, and to one another's shells; the extremity of each thread seemed in this case to serve in the manner of a hand to seize upon any thing that it would fix to, and the other part, which was slenderer and smaller, to do the office of an arm in conducting it.

The muscle, like many other sea-fishes, abounds in a liquor; and if the bafe of their spinning organ be touched with the finger it draws away with it a viscid liquor in form of several threads, like those of a caterpillar, spider, and the other spinning land animals. The threads fix themselves with equal ease to the most smooth and glossy, as to rougher bodies; if the muscles are kept in glass-jars of sea-water, they as firmly fasten themselves to the glass as any other body.

Muscles, be they ever so young, have this property of spinning, and by this means they fasten themselves in vast numbers to any thing which they find in the sea. Mr. Reaumur has seen them when as small as millet seeds, spin plentifully; though their threads, proportioned to their own weight, are much finer and smaller than those of larger muscles. It is a question yet undetermined, whether the muscle has a power of breaking or otherwise getting rid of its threads, in order to its removing from the place where it is once fixed; but it appears probable that they have not, and that they must remain where they have once fastened themselves, though their destruction be the consequence of it. Mr. Reaumur tried the experiment in his jars: when they had well fixed themselves to the sides of them, he poured off part of the salt-water, so that it became the interests of the fish to leave their hold and go lower down, but they seemed to have no power to effect this.

The common muscle affords the curious observer a very pleasing object of examination by the microscope. The transparent membrane, which immediately appears on opening the shell, shews the circulation of blood for a long time together through an amazing number of vessels. And Mr. Lewenhoeck, in several which he dissected, discovered numbers of eggs or embryo muscles in the ovarium, appearing as plainly as if he had seen them by the naked eye, and all lying with their sharp ends fastened to the string of vessels by which they receive nourishment. The minute eggs, or embryos, are by the parent placed in due order, and in a very close arrangement on the outside of the shell, where, by means of a gluey matter, they adhere very fast, and continually increase in size and strength, till, becoming perfect muscles, they fall off and shift for themselves, leaving the holes where they were placed, behind them.

This abundance of muscle shells, plainly shew when examined by the microscope, and sometimes they are in a number of 2000 or 3000 on one shell; but it is not certain that these have been all fixed there by the muscle within; for these fish usually lying in great numbers near one another, the embryos of one are often affixed to the shell of another. The fringed edge of the muscle, which Lewenhoeck calls the *beard*, has in every the minutest part of it such variety of motions as is inconceivable; for being composed of longish fibres, each fibre has on both sides a vast many moving particles.

MYXINE, the HAG; a genus of insects belonging to the order of *Vermes Intestini*. It hath a slender body, carinated beneath; mouth at the extremity, ciliated; the two jaws pinnated; an adipose or rayles fin round the tail and under the belly. The only remarkable species is the *glutinosa*, about eight inches long. It inhabits the ocean; enters the mouths of fish when on the hooks of lines that remain a tide under water, and totally devours the whole, except skin and bones. The Scarborough fishermen often take it in the robbed fish, on drawing up their lines. Linnaeus attributes to it the property of turning water into glue.

N, A liquid consonant, or semi-vowel, and the thirteenth letter of the Greek, Latin, English, &c. alphabets. The *N* is a nasal consonant; its sound is that of a *d*, passed through the nose; so that when the nose is stopped by a cold, or the like, it is usual to pronounce *d* for *n*. M. l'Abbé de Dangeau observes, that in the French the *n* is frequently a mere nasal vowel, without any thing of the sound of a consonant in it. He calls it the Slavonic vowel.

N before *p*, *b*, and *m*, the Latins change into *m*, and frequently into *l* and *r*, as in *ludo*, *illudo*: in *rigo*, *irrigo*, &c. in which they agree with the Hebrews, who in lieu of *nun*, frequently double the following consonant; and the Greeks do the same, as when for Manlius, they write Μαλλιος, &c.

In English, *N* has an invariable sound: as *no name*, &c. After *m* it is sometimes almost lost, as *condemn*, &c.

NADIR, in astronomy, a point in the heavens diametrically opposite to the Zenith. The word is pure Arabic, where it signifies the same. The nadir is that point directly under our feet; or a point in the right line drawn from our feet through the centre of the earth, and terminating in the under hemisphere. The zenith and nadir are the two poles of the horizon, each being 90 deg. distance from it, consequently each in the meridian.

NAHUM, or the *Prophecy of NAHUM*, a canonical book of the Old Testament. Nahum, the seventh of the twelve lesser prophets, was a native of Elkoshai, a little village of Galilee. The subject of this prophecy is the destruction of Nineveh, which he describes in the most lively and pathetic manner: his style is bold and figurative, and can hardly be exceeded by the most perfect masters of oratory. This prophecy was verified at the siege of that city, Assyages, in the year of the world 4378, six hundred and twenty-two years before Christ. The time of Nahum's death is unknown; the Greek menologies, and the Latin martyrologies place his festival on the first day of December.

NAME, denotes a word whereby men have agreed to express some idea; or which serves to denote or signify a thing or subject spoken of. This the grammarians usually call a *NOUN*, *nomen*. See the System of GRAMMAR, Part I. Sect. I. There are a great number of things which have no name; and which, therefore, we are forced to call by other borrowed names; which may shew why, in the course of this Dictionary, we frequently give divers senses to the same word. It was Adam that first gave things their names, Genesis, ii, 19. Names are distinguished into *proper* and *appellative*.

Proper NAMES, are those which represent some individual thing or person, so as to distinguish it from all other things of the same species. As Socrates, which represents a certain philosopher.

Appellative or General NAMES, are those which signify common ideas; or which are common to several individuals of the same species; as, horse, animal, man, oak, &c.

NANTES, or swimming, is the name of an order of animals under the class AMPHIBIA; the characters of which are, that they are pinnated; and breathe by lateral branchiæ or gills. This order comprehends fourteen genera, and seventy-six species. To this order belong the *Petromizon*, *Reja*, *Squalus*, &c. See AMPHIBIOLOGY.

NAPHTHA, an inflammable substance of the bituminous kind, of a light brown colour, and incapable of decomposition, though frequently adulterated with heterogeneous mixtures. By long keeping it hardens in the air into a substance resembling a vegetable resin; and in this state it is always of a black colour, whether pure or mixed with other bodies. According to Mongez, there are three kinds of naphtha, the white, reddish, and green or deep-coloured; and it is in fact a true petrol or rock oil, of which the lightest and most inflammable is called naphtha. It is said to be of an extremely fragrant and agreeable smell, though very different in this respect from vegetable oils. It is also transparent, extremely inflammable, dissolves resins and balsams, but not gum-resins nor elastic gum. It dissolves in the essential oils of thyme and lavender, but is insoluble in spirit of wine and ether. It burns with a bluish flame, and is as inflammable as ether: like which it also attracts gold from *aqua-regia*.

Naphtha, according to Cronstedt, is collected from the surface of some wells in Persia; but Mr. Kirwan informs us, that it issues out of white, yellow, or black clays, in Persia and Media. The finest is brought from a peninsula in the Caspian Sea, called by Kempter *oxefra*. It issues out through the earth into cisterns and wells, purposely excavated for collecting it at Baku in Persia. Different kinds of this substance are also found in Italy, in the duchy of Modena, and in Mount Ciaro, 12 leagues from Plaisance.

The formation of naphtha and petroleum is by most naturalists and chymists ascribed to the decomposition of solid bitumens by the action of subterraneous fires; naphtha being the lightest oil, which the fire disengages first; which follows gradually acquiring the colour and consistence of petrol. Lastly, the petrolea, united with some earthy substances, or altered by acids, assume the appearance of mineral pitch, pissasphaltum, &c. This opinion seems to be supported by the phenomena attending the dis-

tillation of amber; where the first liquor that rises is a true naphtha; then a petroleum of a more or less brown colour; and lastly, a black substance like jet, which being farther urged by the fire, leaves a dry friable matter, &c. It is further observed, that nature frequently produces all the different kinds of petrolea near the same spot; of which we have an instance at Mount Testin in the duchy of Modena in Italy. Some, however, are of opinion, that these mineral oils or bitumens are formed from the vitriolic acid, and various oily and fat substances found in the bowels of the earth.

NARCOTICS, from the Greek *ναρκωτικός*, of *ναρκωσις*, *drowsiness* in Medicine, opiates, or medicines that excite drowsiness and sleep. See OPIUM. Narcotics, called also *hypnotics*, and *soporifics*, act by calming and diminishing the motion of the blood and spirits.

Authors are of various opinions as to the manner wherein narcotics operate: the ancients tell us, it is by their being cold in nature, whereby they stupify and deaden the sense. Et Muller, after Wallis, takes the animal spirits to be composed of a fluid, volatile salt; and thinks they are dissolved by the mixtures of sulphurs and oils, wherewith narcotics abound. Mr. Andry's opinion is, that the salt of narcotics dissolve in any liquor whatever; and that their ramous branches, becoming thus disengaged from the salts, are embarrassed among one another, and thus stop the course of the blood and spirits. Others think, that narcotics close the orifices of the nerves, and thus block up the passage of the spirits. Lastly, Linden, in his treatise de Venenis, thinks, that the operation of narcotics is not the same in all; drowsiness being producible from a great variety of different causes. See SLEEP.

In disorders of the stomach and intestines, all things which induce a stupor are very cautiously, or never at all, to be exhibited; because no kind of medicines are so pernicious and injurious to the tone and motion of the nervous parts. To preserve health, and prevent diseases, nothing is so effectual as to maintain the tone, strength, and motion of what they call the *prima via*, or first passages, because that most salutary excretion which is performed by stool and discharges the *solides*, which are the recrements remaining after digestion, or are collected from all parts of the body, depends chiefly thereon. Where this evacuation is suppressed, or else performed after a slow and remiss manner, a deluge of vicious humours is soon collected, and becomes the cause, as well as fomentor, of diseases. Now there is nothing which so effectually diminishes the peristaltic motion of the intestines, and suppresses intestinal excretion, as sedatives and anodynes, the truth of which is attested by experience; for all remedies, so especially those which are of a drastic quality, exert their efficacy first and principally upon the stomach and intestines.

NARCISSUS, in botany: A genus of the Monogyna order, belonging to the Hexandria class of plants.

1. The bastard narcissus, or common yellow English daffodil, grows wild in great plenty in many of our woods and coppices, and under hedges in several parts of England. In the counties round London the herb-gatherers bring prodigious quantities in the spring of the year, when in bloom, root and all, and sell them about the streets. Its commonness renders it of but little esteem with many; considered, however, as an early and elegant flower, of exceeding hardiness and easy culture, it merits a place in every garden.

2. The poeticus, poetic daffodil, or common white narcissus, is well known. Of this there are varieties with purple-cupped flowers—yellow-cupped flowers—double flowered: all of them with entire white petals. It is the ancient celebrated narcissus of the Greek and Roman poets, which they so greatly extol for its extreme beauty and fragrance.

3. The tazetta, or multiflorous daffodil, commonly called *polyanthus narcissus*. The varieties of this are very numerous, consisting of about eight or nine principal sorts, each of which having many intermediate varieties; amounting in the whole to greatly above an hundred in the Dutch florists catalogues, each variety distinguished by a name according to the fancy of the first raiser of it. They are all very pretty flowers, and make a charming appearance in the flower borders, &c. they are also finely adapted for blowing in glasses of water, or in pots, to ornament rooms in winter.

4. The jonquilla, or jonquil, sometimes called *rufus leaved daffodil*, hath an oblong, bulbous brown root. The varieties are, jonquil minor with single flowers—jonquil major with single flowers—starry flowered—yellow and white flowered—white flowered—femi-double-flowered—double-flowered—and large double inodorous jonquil: all of them multiflorous, the single in particular; but sometimes the doubles produce only two or three flowers from a spathe, and the singles commonly six or eight. All the sorts have so fine a shape, so soft a colour, and so sweet a scent, that they are some of the most agreeable spring flowers.

All these species of narcissus are of the bulbous-rooted tribe, and universally perennial in root, but annual in leaf and flower stalk; all of them rising annually in spring, immediately from the

the crown of the bulb, first the leaves, and in the midst of them the flower stalk, one only from each root, entirely naked, or leafless, each terminated by a spatha or sheath, which opens on one side to protrude the flowers, and then withers; the flowers, as before observed, are all hexapetalous, each furnished with a nectarium in the centre, and are universally hermaphrodite: they are large and conspicuous, appearing mostly in the spring season, generally from March or April until June, succeeded by ripe seed in July; then the leaves and flower stalks decay, and the roots desist from growing for some time; at which period of rest is the only proper time to take up or transplant the roots from one place to another, or to separate the offsets; for they all multiply abundantly by offset young bulbs from the main root, inasmuch that a single bulb will, in one or two years, be increased into a large cluster of several bulbs, closely placed together, and which every second or third year should be taken up at the above period in order to be separated; and each offset so separated commences a distinct plant; which being planted again in autumn, produces flowers the following summer, alike in every respect to those of their respective parent bulbs. All the species are so hardy, that they prosper in any common soil of a garden; observing, however, to allow the finer sorts of *polyanthus narcissus*, in particular, principally a warm dry situation; all the others may be planted any where in the open dry borders and flower beds.

NARRATION, in oratory, poetry, and history, a recital or rehearsal of a fact as it happened, or when it is supposed to have happened. See the System of ORATORY, Part II. Sect. II. Concerning narration and description we present the following rules and observations.

1. The first rule is, That in history the reflections ought to be chaste and solid; for while the mind is intent upon truth, it is little disposed to the operations of the imagination. Strada's Belgic history is full of poetical images, which, being discordant with the subject, are unpleasant; and they have a still worse effect, by giving an air of fiction to a genuine history.—Such flowers ought to be scattered with a sparing hand, even in epic poetry; and at no rate are they proper, till the reader be warmed, and by an enlivened imagination prepared to relish them: in that state of mind, they are agreeable; but while we are sedate and attentive to an historical chain of facts, we reject with disdain every fiction.

2. Vida, following Horace, recommends a modest commencement of an epic poem; giving for a reason, That the writer ought to husband his fire. Besides, bold thoughts and figures are never relished till the mind be heated and thoroughly engaged, which is not the reader's case at the commencement. Homer introduces not a single simile in the first book of the Iliad, nor in the first book of the Odyssey. On the other hand, Shakespeare begins one of his plays with a sentiment too bold for the most heated imagination.

Bedford. Hung be the heavens with black, yield day to night!
Comets, importing change of times and states,
Brandish your crystal tresses in the sky,
And with them scourge the bad revolting stars,
That have consorted unto Henry's death!
Henry the Fifth, too famous to live long!
England ne'er lost a king of so much worth.

First Part of Henry VI.

The passage with which Strada begins his history, is too poetical for a subject of that kind: and at any rate too high for the beginning of a grave performance.

3. In narration, as well as in description, objects ought to be painted so accurately as to form in the mind of the reader, distinct and lively images. Every useless circumstance ought, indeed, to be suppressed, because every such circumstance loads the narration; but if a circumstance be necessary, however slight, it cannot be described too minutely. The force of language consists in raising complete images; which have the effect to transport the reader, as by magic, into the very place of the important action, and to convert him as it were into a spectator, beholding every thing that passes. The narrative in an epic poem ought to rival a picture in the liveliness and accuracy of its representations: no circumstance must be omitted that tends to make a complete image; because an imperfect image, as well as any other imperfect conception, is cold and uninteresting.—We shall illustrate this rule by several examples, giving the first place to a beautiful passage from Virgil:

*Qualis pater moerens Philomela sub umbra
Amisus queritur fectus, quos datus anator
Observans pido implumes cecidit.*

Georg. lib. 4. l. 511.

The poplar, plowman, and unfledged young, though not essential in the description, tend to make a complete image, and, upon that account, are an embellishment.

In the following passage, the action, with all its material circumstances, is represented so much to the life, that it would scarce appear more distinct to a real spectator: and it is the manner of description that contributes greatly to the sublimity of the passage.

He spake; and, to confirm his words, our flew
Millions of flaming swords, drawn from the thighs
Of mighty cherubim; the sudden blaze
Far round illumin'd hell: highly they rag'd
Against the Highest, and hence with grasped arms,
Clash'd on their sounding shields the din of war,
Hurling defiance towards the vault of heaven.

Milton, l. 1.

The following passage from Shakespeare falls not much short of that now mentioned, in particularity of description.

O you hard hearts! you cruel men of Rome!
Knew you not Pompey? Many a time and oft
Have you climb'd up to walls and battlements,
To towers and windows, yea to chimney tops,
Your infants in your arms; and there have sat
The live-long day with patient expectation
To see great Pompey pass the streets of Rome;
And when you saw his chariot but appear,
Have you not made an universal shout,
That Tyber trembled underneath his banks,
To hear the replication of your sounds,
Made in his concave shores?

Julius Caesar, act. 1. sc. 1.

The following passage is scarcely inferior to either of those mentioned.

"Far before the rest, the son of Ossian comes; bright in the smiles of youth, fair as the first beams of the sun. His long hair waves on his back: his dark brow is half beneath his helmet. The sword hangs loose on the hero's side; and his spear glitters as he moves. I fled from his terrible eye, king of high Temora."

Some single circumstance, happily selected, has more power than the most laboured description. Macbeth, mentioning to his lady some voices he heard while he was murdering the king, says,

There's one did laugh in sleep, and one cry'd murder!
They wak'd each other, and I stood and heard them;
But they did say their prayers, and address'd them
Again to sleep.

Lady. There are two lodg'd together.
Macbeth. One cry'd God bless us! and Amen, the other;
As they had seen me with these hangman's hands.
Lifening their fears, I could not say, Amen,
When they did say, God bless us.

Lady. Consider it not so deeply.
Macbeth. But wherefore could not I pronounce, Amen?
I had most need of blessing, and Amen
Stuck in my throat.

Lady. These deeds must not be thought
After these ways; so, it will make us mad.
Macbeth. Methought, I heard a voice cry,
Sleep no more!

Macbeth doth murder sleep, &c.

Act. 1. sc. 3.

Describing Prince Henry:

I saw young Harry, with his beaver on,
His cuisses on his thighs, gallantly arm'd,
Rise from the ground like feather'd Mercury;
And vaulted with such ease into his seat,
As if an angel dropt down from the clouds,
To turn and wind a fiery Pegasus,
And witch the world with noble horsemanship.

First Part of Henry IV. act 4. sc. 2.

To draw a character is the master-stroke of description. In this Tacitus excels: his portraits are natural and lively, not a feature wanting or misplaced. Shakespeare, however, exceeds Tacitus in liveliness; some characteristic circumstance being generally invented or laid hold of, which paints more to the life than many words. The following instances will explain our meaning, and at the same time prove our observation to be just.

Why should a man, whose blood is warm within,
Sit like his grandfather cut in alabaster?
Sleep when he wakes, and creep into the jaundice,
By being peevish? I tell thee what, Anthonio,
(I love thee, and it is my love that speaks)
There are a sort of men, whose villages
Do cream and mantle like a standing pond;
And do a wilful stillness entertain,
With purpose to be dress'd in an opinion:
Of wisdom, gravity, profound conceit;
As who should say, I am Sir Oracle,
And when I ope my lips, let no dog bark!
O my Anthonio! I do know of those,
That therefore only are reputed wise,
For saying nothing.

Merchant of Venice, act 1. sc. 2.

In the following passage, a character is completed by a single stroke:

Shallow. O the mad days that I have spent; and to see how many of mine old acquaintance are dead.

Silence. We shall all follow cousin.

Shallow. Certain, 'tis certain, very sure, very sure: Death (as the Psalmist saith) is certain to all; all shall die. How good a yoke of Bullocks at Stamford fair.

Slender. Truly, cousin, I was not there.

Shallow. Death is certain. Is old Double of your town living yet?

Silence. Dead, Sir.

Shallow. Dead! see, see: he drew a good bow: and dead! He shot a fine shoot. How a score of ewes now?

Silence.

Silence. Thereafter as they be. A score of good ewes may be worth ten pounds.

Shallow. And is old Double dead?

Second Part Henry IV. act. 3. sc. 3.

Falstaff speaking of Ancient Pistol:

"He's no swaggerer, hostels: a tame cheater i' faith; you may stroak him as gently as a puppy-greyhound; he will not swagger with a Barbary hen, if her feathers turn back in any shew of resistance."

Second Part Henry IV. act. 2. sc. 9.

Having discussed what observations occurred upon the thoughts or things expressed, we proceed to what more peculiarly concerns the language or verbal dress. As words are intimately connected with the ideas they represent, the emotions raised by the sound and by the sense ought to be concordant. An elevated subject requires an elevated style; what is familiar, ought to be familiarly expressed: a subject that is serious and important, ought to be clothed in plain nervous language: a description, on the other hand, addressed to the imagination, is susceptible of the highest ornaments that sounding words and figurative expression can bestow upon it.

The language of Homer is suited to his subject, not less accurately than the actions and sentiments of his heroes are to their characters. Virgil, in that particular, falls short of perfection; his language is stately throughout: and though he descends at times to the simplest branches of cookery, roasting and boiling for example, yet he never relaxes a moment from the high tone. In adjusting his language to his subject no writer equals Swift. We can recollect but one exception, which at the same time is far from being gross: The Journal of a modern Lady is composed in a style blending sprightliness with familiarity, perfectly suited to the subject: in one passage, however, the poet, deviating from that style, takes a tone above his subject. The passage we have in view begins *l. 116. But let me now a while survey, &c.* and ends at *l. 125.*

It is proper to be observed upon this head, that writers of inferior rank are continually upon the stretch to enliven and enforce their subject by exaggeration and superlatives. This unluckily has an effect contrary to what is intended: the reader, disgusted with language that swells above the subject, is led by contrast to think more meanly of the subject than it may possibly deserve. A man of prudence besides, will be no less careful to husband his strength in writing than in walking: a writer too liberal of superlatives, exhausts his whole stock upon ordinary incidents, and reserves no share to express with greater energy, matters of importance.

Many writers of that kind abound so in epithets, as if poetry consisted entirely in high-sounding words. Take the following instance:

When black-brow'd night her dusky mantle spread,
And wrapt in solemn gloom the fable sky;
When soothing sleep her opiate dews had shed,
And seal'd in slumber ev'ry eye:
My wakeful thoughts admit no balm's rest,
Nor the sweet bliss of soft oblivion share;
But watchful woe distracts my aching breast,
My heart the subject of corroding care:
From haunts of men with wand'ring steps and slow
I solitary steal, and soothe my pensive woe.

Here every substantive is faithfully attended by some tumid epithet.

We proceed to a second remark, not less important than the former. No person of reflection but must be sensible, that an incident makes a stronger impression on an eye-witness, than when heard at second-hand. Writers of genius, sensible that the eye is the best avenue to the heart, represent every thing as passing in our sight; and, from readers or hearers, transform us as it were into spectators: a skilful writer conceals himself, and presents his personages: in a word, every thing becomes dramatic as much as possible. Plutarch, *de gloria Atheniensium*, observes, that Thucydides makes his reader a spectator, and inspires him with the same passions as if he were an eye-witness.

In the fine arts it is a rule, to put the capital objects in the strongest point of view; and even to present them oftener than once, where it can be done. In history-painting, the principal figure is placed in the front, and in the best light: an equestrian statue is placed in a centre of streets, that it may be seen from many places at once. In no composition is there greater opportunity for this rule than in writing:

----- Sequitur pulcherrimus Astur,
Astur equo fidens et versicoloribus armis. *Æneid. x. 180.*

----- Full many a lady
I've ey'd with best regard, and many a time
Th' harmony of their tongues hath into bondage
Brought my too diligent ear: for several virtues
Have I lik'd several women; never any
With so full soul, but some defect in her
Did quarrel with the noblest grace she ow'd,
And put it to the foil. But you, O you,
So perfect, and so peerless are created
Of every creature's best. *Tempest, act 3. sc. 1.*

Orlando. ----- Whate'er you are
That, in the desert inaccessible,
Under the shade of melancholy boughs,
Lose and neglect the creeping hours of time;
If ever you have look'd on better days;
If ever been where bells have knoll'd to church;
If ever sat at any good man's feast;
If ever from your eye-lids wip'd a tear,

No 115. VOL. III.

And know what 'tis to pity, and be pity'd;
Let gentleness my strong enforcement be,
In the which hope I blush, and hide my sword.

Duke sen. True is it that we have seen better days;
And have with holy bell been knoll'd to church;
And sat at good men's feasts; and wip'd our eyes
Of drops that sacred pity had engender'd;
And therefore sit you down in gentleness,
And take upon command what help we have,
That to your wanting may be minister'd. *As you like it.*

With thee converging I forget all time;
All seasons and their change, all please alike.
Sweet is the breath of morn, her rising sweet,
With charm of earliest birds; pleasant the sun
When first on this delightful land he spreads
His orient beams, on herbs, tree, fruit, and flow'r
Glistening with dew; fragrant the fertile earth
After soft show'rs; and sweet the coming on
Of grateful ev'ning mild, the silent night
With this her solemn bird, and this fair moon,
And these the gems of heav'n, her starry train;
But neither breath of morn, when the ascends
With charms of earliest birds, nor rising sun
On this delightful land, nor herb, fruit, flow'r,
Glistening with dew, nor fragrance after show'rs,
Nor grateful ev'ning mild, nor silent night,
With this her solemn bird, nor walk by moon,
Or glittering star-light, without thee is sweet.

Paradise Lost, book 4. l. 634.

A concise comprehensive style is a great ornament in narration; and a superfluity of unnecessary words, not less than of circumstances, a great nuisance. A judicious selection of the striking circumstances, clothed in a nervous style, is delightful. In this style, Tacitus excels all writers, ancient and modern. Instances are numberless: take the following specimen.

"Cæbra hinc prælia, et sæpius in modum latrocinii: per saltus, per paludes; et cuique fors aut virtus: temerè, provisò, ob iram, ob prædam, jussu, et aliquando ignavis ducibus." *Annal. lib. 12. § 39.*

If a concise or nervous style be a beauty, tautology must be a blemish; and yet writers, fettered by verse, are not sufficiently careful to avoid this slovenly practice: they may be pitied, but they cannot be justified. Take for a specimen the following instance, from the best poet, for versification at least, that England has to boast of:

High on his helm celestial lightnings play,
His beamy shield emits a living ray;
The unweary'd blaze incessant streams supplies,
Like the red star that fires th' autumnal skies. *Iliad, v. 5.*

We close this article with a curious inquiry. An object, however ugly to the sight is far from being so when represented by colours or by words. What is the cause of this difference? With respect to painting the cause is obvious: a good picture, whatever the subject be, is agreeable, by the pleasure we take in imitation; and this pleasure overbalancing the disagreeableness of the subject, makes the picture upon the whole agreeable. With respect to the description of an ugly object, the cause follows. To connect individuals in the social state no particular contributes more than language, by the power it possesses of an expeditious communication of thought and a lively representation of transactions. But nature hath not been satisfied to recommend language by its utility merely; independent of utility, it is made susceptible of many beauties, which are directly felt, without any intervening reflection. And this unfolds the mystery; for the pleasure of language is so great, as in a lively description to overbalance the disagreeableness of the image raised by it. This however is no encouragement to choose a disagreeable subject; for the pleasure is incomparably greater where the subject and the description are both of them agreeable.

The following description is upon the whole agreeable, though the subject described is in itself dismal:

Nine times the space that measures day and night
To mortal men, he with his horrid crew
Lay vanquish'd, rolling in the fiery gulf,
Confounded though immortal! but his doom
Reserv'd him to more wrath; for now the thought
Both of lost happiness and lasting pain
Torments him; round he throws his baleful eyes
That witness'd huge affliction and dismay,
Mix'd with obdurate pride and steadfast hate:
At once as far as angels ken he views
The dismal situation waste and wild:
A dungeon horrible, on all sides round
As one great furnace flam'd; yet from those flames
No light, but rather darkness visible
Serv'd only to discover sights of woe,
Regions of sorrow, doleful shades, where peace
And rest can never dwell, hope never comes
That comes to all; but torture without end
Still urges, and a fiery deluge, fed
With ever-burning sulphur consum'd!
Such place eternal justice had prepar'd
For those rebellious. *Paradise Lost, book 1. l. 50.*

An unmanly depression of spirits in time of danger is not an agreeable sight; and yet a fine description or representation of it will be agreeable:

K. Richard. What must the king do now! must he submit?
The king shall do it: must he be depos'd?
The king shall be contented: must he lose

*

D

The

N A T

The name of king? o' God's name, let it go;
I'll give my jewels for a set of beads;
My gorgeous palace, for a hermitage;
My gay apparel, for an almsman's gown;
My figur'd goblets, for a dish of wood;
My sceptre, for a palmer's walking staff;
My subjects, for a pair of carved saints;
And my large kingdom, for a little grave;
A little, little grave;—an obscure grave.
Or I'll be bury'd in the king's highway;
Some way of common trade, where subjects' feet
May hourly trample on their sovereign's head;
For on my heart they tread now, whilst I live;
And, bury'd once, why not upon my head?

Richard II. act 3. sc. 6.

Objects that strike terror in a spectator, have in poetry and painting a fine effect. The picture, by raising a slight emotion of terror agitates the mind; and in that condition every beauty makes a deep impression. May not contrast heighten the pleasure, by opposing our present security to the danger of encountering the object represented?

Ghost. ————— But that I am forbid
To tell the secrets of my prison house,
I could a tale unfold, whose lightest word
Would harrow up thy soul, freeze thy young blood,
Make thy two eyes, like stars, start from their spheres,
Thy knotted and combined locks to part,
And each particular hair to stand on end,
Like quills upon the fretful porcupine:
But this eternal blazon must not be
To ears of flesh and blood.

Hamlet, act 1. sc. 3.

NATES, in anatomy, a term expressing those two fleshy posterior parts of the body, popularly called the *buttocks*; by the Latins *clunes*, or *nates*.

NATION, a collective term, used for a considerable people, inhabiting a certain extent of ground, inclosed within fixed limits, and under the same government. Each *nation* has its peculiar character, and it is proverbially said, *Light as a Frenchman, Waggish as an Italian, Grave as a Spaniard, Serious as an Englishman, Fierce as a Scotchman, Drunken as a German, Idle as an Irishman, Deceitful as a Greek*, &c.

NATIONAL DEBT, the money owing by government.

Our limits permit us to give but a very general sketch of this subject: However, as it is of considerable importance to every inhabitant of these kingdoms, we shall endeavour to give as clear and comprehensive a view of it as the bounds necessarily prescribed us will admit. In order to this, it may not be improper to refer back to the times that have gone before us, that we may the better discover the nature of public revenues, the manner of their expenditure, and the causes of public debt.

In that rude state of society which precedes the extension of commerce and the improvements of manufactures, when those expensive luxuries which commerce and manufactures can alone introduce, are altogether unknown; the person who possesses a large revenue can spend or enjoy that revenue in no other way than by maintaining nearly as many people as it can maintain. Among our feudal ancestors, the long time during which estates used to continue in the same family, sufficiently demonstrates the general disposition of people to live within their income. Though the rustic hospitality constantly exercised by the great landholders may not to us in the present times seem consistent with that order which we are apt to consider as inseparably connected with good economy, yet we must certainly allow them to have been at least so far frugal as not commonly to have spent their whole income. Some part of this money, perhaps, they spent in purchasing the few objects of vanity and luxury with which the circumstances of the times could furnish them; but some part of it they seem commonly to have hoarded. They could not well indeed do any thing else but hoard whatever money they saved. To trade was disgraceful to a gentleman; and to lend money at interest, which at that time was considered as usury and prohibited by law, would have been still more so.

The same disposition to save and to hoard prevailed in the sovereign as well as in the subject. Among nations to whom commerce and manufactures are little known, the sovereign is in a situation which naturally disposes him to the parsimony requisite for accumulation. In that situation the expence even of a sovereign cannot be directed by that vanity which delights in the gaudy finery of a court. The ignorance of the times affords but few of the trinkets in which that finery consists. Standing armies are not then necessary; so that the expence even of a sovereign, like that of any other great lord, can be employed in scarce any thing but bounty to his tenants and hospitality to his retainers. But bounty and hospitality very seldom lead to extravagance: though vanity almost always does. All the ancient sovereigns of Europe accordingly had treasures. Every Tartar chief in the present times is said to have one.

In a commercial country abounding with every sort of expensive luxury, the sovereign, in the same manner as almost all the great proprietors in his dominions, naturally spends a great part of his revenue in purchasing those luxuries. His own and the neighbouring countries supply him abundantly with all the costly trinkets

N A T

which compose the splendid but insignificant pageantry of a court. His ordinary expence becomes equal to his ordinary revenue, and it is well if it does not frequently exceed it. The amassing of treasure can no longer be expected; and when extraordinary exigencies require extraordinary expences, he must necessarily call upon his subjects for an extraordinary aid. The late king of Prussia and his father are the only great princes of Europe who, since the death of Henry IV. of France in 1610, are supposed to have amassed any considerable treasure. The parsimony which leads to accumulation has become almost as rare in republican as in monarchical governments. The Italian republics, the United Provinces of the Netherlands, are all in debt. The canton of Berne is the single republic in Europe which has amassed any considerable treasure. The other Swiss republics have not. The taste for some sort of pageantry, for splendid buildings at least and other public ornaments, frequently prevails as much in the apparently sober senate house of a little republic as in the dissipated court of the greatest king.

The want of parsimony in time of peace imposes the necessity of contracting debt in time of war. When war comes, there is no money in the treasury but what is necessary for carrying on the ordinary expence of the peace establishment. In war an establishment of three or four times that expence becomes necessary for the defence of the state, and consequently a revenue three or four times greater than the peace revenue. Supposing that the sovereign should have, what he scarce ever has, the immediate means of augmenting his revenue in proportion to the augmentation of his expence; yet still the produce of the taxes, from which this increase of revenue must be drawn, will not begin to come into the treasury till perhaps ten or twelve months after they are imposed. But the moment in which war begins, or rather the moment in which it appears likely to begin, the army must be augmented, the fleets must be fitted out, the garrisoned towns must be put in a posture of defence; that army, that fleet, those garrisoned towns must be furnished with arms, ammunition and provisions. An immediate and great expence must be incurred in that moment of immediate danger, which will not wait for the gradual and flow returns of the new taxes. In this exigency government can have no other resources but in borrowing.

The same commercial state of society which, by the operation of moral causes, brings government in this manner into the necessity of borrowing, produces in the subjects both an ability and an inclination to lend. If it commonly brings along with it the necessity of borrowing, it also brings with it the facility of doing so.

A country abounding with merchants and manufacturers, necessarily abounds with a set of people through whose hands not only their own capitals, but the capitals of all those who either lend them money or trust them with goods, pass as frequently or more frequently, than the revenue of a private man, who without trade or business lives upon his income, passes through his hands. The revenue of such a man can regularly pass through his hands only once in a year. But the whole amount of the capital and credit of a merchant who deals in a trade of which the returns are very quick, may sometimes pass through his hands two, three, or four times in a year. A country abounding with merchants and manufacturers, therefore, necessarily abounds with a set of people who have it at all times in their power to advance, if they choose to do so, a very large sum of money to government. Hence the ability in the subjects of a commercial state to lend.

The progress of the enormous debts which at present oppress, and will in the long run probably ruin, all the great nations of Europe, has been pretty uniform. In England, after the Revolution, when new connections with Europe introduced a new system of foreign politics, the expences of the nation, not only in settling the new establishment, but in maintaining long wars, as principals, on the continent, for the security of the Dutch barrier, reducing the French monarchy, settling the Spanish succession, supporting the house of Austria, maintaining the liberties of the Germanic body, and other purposes, increased to an unusual degree: inasmuch, that it was not thought advisable to raise all the expences of any one year by taxes to be levied within that year, lest the unaccustomed weight of them should create murmurs among the people. It was therefore the policy of the times to anticipate the revenues of their posterity, by borrowing immense sums for the current service of the state, and to lay no more taxes upon the subject than would suffice to pay the annual interest of the sums so borrowed; by this means converting the principal debt into a new species of property, transferable from one man to another at any time and in any quantity. This system indeed seems to have had its original in the state of Florence, A. D. 1344; which government then owed about 60,000l. sterling; and being unable to pay it, formed the principal into an aggregate sum, called metaphorically a *mount* or *bank*, the shares whereof were transferable like our stocks, with interest at 5 per cent. the prices varying according to the exigencies of the state. This laid the foundation of what is called the *national debt*: for a few long annuities created in the reign of Charles II. will hardly deserve that name.

Nations, like private men, have generally begun to borrow upon what may be called *personal credit*, without assigning or mortgaging any particular fund for the payment of the debt; and when this resource

resources has failed them, they have gone on to borrow upon assignments or mortgages of particular funds.

What is called the *unfunded debt of Great Britain*, is contracted in the former of those two ways. It consists partly in a debt which bears, or is supposed to bear, no interest, and which resembles the debts which a private man contracts upon account; and partly in a debt which bears interest, and which resembles what a private man contracts upon his bill or promissory note. The debts which are due either for extraordinary services, or for services either not provided for or not paid at the time when they are performed; part of the extraordinaries of the army, navy, and ordnance, the arrears of subsidies to foreign princes, those of seamen's wages, &c. usually constitute a debt of the first kind. Navy and exchequer bills, which are issued sometimes in payment of a part of such debts, and sometimes for other purposes, constitute a debt of the second kind; exchequer bills bearing interest from the day on which they are issued, and navy bills six months after they are issued. The bank of England, either by voluntarily discounting those bills at their current value, or by agreeing with government for certain considerations to circulate exchequer bills, that is, to receive them at par, paying the interest which happens to be due upon them, keeps up their value, and facilitates their circulation, and thereby frequently enables government to contract a very large debt of this kind. During the great recoinage in King William's time, when the bank of England thought proper to put a stop to its usual transactions, exchequer bills and tallies are said to have sold from 25 to 60 per cent. discount; owing partly, no doubt, to the supposed instability of the new government established by the Revolution, but partly too to the want of the support of the bank of England.

When this resource is exhausted, and it becomes necessary, in order to raise money, to assign or mortgage some particular branch of the public revenue for the payment of the debt, government has upon different occasions done this in two different ways. Sometimes it has made this assignment or mortgage for a short period of time only, a year, or a few years, for example; and sometimes for perpetuity. In the one case, the fund was supposed sufficient to pay within the limited time both principal and interest of the money borrowed; in the other, it was supposed sufficient to pay the interest only, or a perpetual annuity equivalent to the interest; government being at liberty to redeem at any time this annuity upon paying back the principal sum borrowed. When money was raised in the one way, it was said to be raised *by anticipation*; when in the other, *by perpetual funding*, or, more shortly, *by funding*.

In the reign of King William, when the debt began to be amassed, and during a great part of that of Queen Anne, before we had become so familiar as we are now with the practice of perpetual funding, the greater part of the new taxes were imposed but for a short period of time (for four, five, six, or seven years only), and a great part of the grants of every year consisted in loans upon anticipation of the produce of those taxes. The produce being frequently insufficient for paying within the limited term the principal and interest of the money borrowed, deficiencies arose; to make good which it became necessary to prolong the term.

On the 31st of December 1697, the funded and unfunded debts amounted to 21,515,742*l.* 13*s.* 8*d.* at the same time, in 1714, they were 53,681,076*l.* 5*s.* 6*d.* In 1755, before the breaking out of the war, they amounted to 72,289,673*l.* and on the 5th of January, 1763, at the conclusion of the peace, they had accumulated to 122,603,336*l.* 8*s.* 2*d.* of funded debt, and of unfunded 13,027,589*l.* 2*s.* 2*d.* more. In 1775, they were very nearly 130 millions; and the last American war added upwards of 120 millions more to that enormous sum. The funded debt at the peace of 1763 amounted to 211,363,254*l.* and January 1st, 1794, to 249,238,848*l.* 5*s.* 2*d.* to pay the interest of which, and the charges of management, amounting annually to nearly eight millions and a half, the extraordinary revenues elsewhere enumerated (excepting only the land-tax and annual malt-tax) are in the first place mortgaged and made perpetual by parliament. Perpetual we say; but still redeemable by the same authority that imposed them: which, if it at any time can pay off the capital, will abolish those taxes which are raised to discharge the interest.

By this means, then, the quantity of property in the kingdom is greatly increased in idea compared with former times; yet if we coolly consider it, not at all increased in reality. We may boast of large fortunes, and quantities of money in the funds. But where does this money exist? It exists only in name, in paper, in public faith, in parliamentary security: and that is undoubtedly sufficient for the creditors of the public to rely on. But then what is the pledge which the public faith has pawned for the security of these debts? The land, the trade, and the personal industry of the subject; from which the money must arise that supplies the several taxes. In these therefore, and these only, the property of the public creditors does really and intrinsically exist; and of course the land, the trade, and the personal industry of individuals, are diminished in their true value just so much, as they are pledged to answer. If A's income amounts to 100*l.* per annum; and he is so far indebted to B, that he pays him 50*l.* per annum for his interest: one half of the value of A's property is

transferred to B the creditor. The creditor's property exists in the demand which he has upon the debtor, and no where else; and the debtor is only a trustee to his creditor for one half of the value of his income. In short, the property of a creditor of the public consists in a certain portion of the national taxes; by how much therefore he is the richer, by so much the nation, which pays these taxes, is the poorer.

The only advantage that can result to a nation from public debts, is the increase of circulation, by multiplying the cash of the kingdom, and creating a new species of currency, assignable at any time and in any quantity; always therefore ready to be employed in any beneficial undertaking, by means of this its transferable quality, and yet producing some profit even when it lies idle and unemployed. A certain proportion of debt seems to be highly useful to a trading people; but what that proportion is, it is not for us to determine. This much is indisputably certain, that the present magnitude of our national incumbrances very far exceeds all calculations of commercial benefits, and is productive of the greatest inconveniences. For, first, the enormous taxes that are raised upon the necessities of life for the payment of the interest of this debt, are a hurt both to trade and manufactures; by raising the price as well of the artificer's subsistence as of the raw material, and of course, in a much greater proportion, the price of the commodity itself. Nay, the very increase of paper-circulation itself, when extended beyond what is requisite for commerce or foreign exchange, has a natural tendency to increase the price of provisions as well as of all other merchandise. For as its effect is to multiply the cash of the kingdom, and this to such an extent that much must remain unemployed, that cash (which is the universal measure of the respective values of all other commodities) must necessarily sink in its own value, and every thing grow comparatively dearer. Secondly, if part of this debt be owing to foreigners, either they draw out of the kingdom annually a considerable quantity of specie for the interest; or else it is made an argument to grant them unreasonable privileges in order to induce them to reside here. Thirdly, if the whole be owing to subjects only, it is then charging the active and industrious subject, who pays his share of taxes to maintain the indolent and idle creditor who receives them. Lastly, and principally, it weakens the internal strength of a state, by anticipating those resources which should be reserved to defend it in case of necessity. The interest we now pay for our debts would undoubtedly be sufficient to maintain the most vigorous war that any national motives could possibly require. If indeed our ancestors in King William's time had annually paid, so long as their exigencies lasted, a far less sum than we now annually raise upon their account, they would not in time of war have borne so great burthens as they have bequeathed to and settled upon their posterity in time of peace; and might have been eased the instant the exigence was over. See FUNDS.

On the whole then, the national debt is undoubtedly a subject of vast importance, and as such it has been always considered; for much has been said and written upon it, and many schemes have been proposed at various times and by various persons for gradually removing it, it being considered by the most judicious as a most pernicious incumbrance to a commercial country. Some we are aware, think it of vast utility; but this opinion is too eccentric, and in our estimation too feebly supported, to be convincing. The public debt is indisputably a great grievance; and every lover of his country must surely wish to see it removed: the period, however, when this blessing shall take place, if indeed it ever arrives, must at least be very distant.

It is neither our business nor intention (even if the limits prescribed to the article did not prevent it) to be minute on the subject, or to propose any schemes for alleviating the burthens of the nation. That indeed has been already done by far abler hands than we profess to be: we must therefore refer such as wish for further information on this interesting topic to those (and they are not a few) who have treated it at full length. Smith's *Wealth of Nations*, and Sir John Sinclair's *History of the Revenue*, go to the bottom of the matter. The writings of Dr. Price likewise deserve considerable attention, especially as one of his plans for the reduction of the debt has in fact been adopted, and in consequence established by the legislature: His three plans may be found in a late pamphlet by William Morgan, intitled, a *Review of Dr. Price's Writings on the subject of the Finances of this Kingdom*.

NATURAL Beauty, or the beauty of natural objects, is that quality or those qualities in the works of nature, or more properly of God, which are calculated to excite pleasing sensations in the minds of all such persons of true taste as attentively observe them. It will not, we trust, be deemed improper or impertinent, therefore, to introduce a few observations on this subject, previous to our treating of natural history.—To many, it is hoped, it will appear to be a very proper introduction to that important article. That sensibility to beauty, which when cultivated and improved, we term taste, is universally diffused through the human species; and it is most uniform with respect to those objects, which being out of our power are not liable to variation from accident, caprice, or fashion. The verdant lawn, the shady grove, the variegated landscape, the boundless ocean, and the starry firmament,

N A T

ment, are contemplated with pleasure by every attentive beholder. But the emotions of different spectators, though similar in kind, differ widely in degree; and to relish with full delight the enchanting scenes of nature, the mind must be uncorrupted by avarice, sensuality, or ambition; quick in her sensibilities; elevated in her sentiments; and devout in her affections. He who possesses such exalted powers of perception and enjoyment, may almost say, with the poet,

I care not, Fortune! what you me deny;
You cannot rob me of free Nature's grace;
You cannot shut the windows of the sky,
Through which Aurora shows her bright'ning face;
You cannot bar my constant feet to trace
The woods and lawns, by living stream, at eve:
Let health my nerves and finer fibres brace,
And I their toys to the great children leave:
Of fancy, reason, virtue, nought can me bereave.

"Perhaps such ardent enthusiasm may not be compatible with the necessary toils and active offices which Providence has assigned to the generality of men. But there are none to whom some portion of it may not prove advantageous; and if it were cherished by each individual, in that degree which is consistent with the indispensable duties of his station, the felicity of human life would be considerably augmented. From this source, the refined and vivid pleasures of the imagination are almost entirely derived: and the elegant arts owe their choicest beauties to a taste for the contemplation of nature. Painting and sculpture are express imitations of visible objects; and where would be the charms of poetry, if divested of the imagery and embellishments which she borrows from rural scenes? Painters, statuary, and poets, therefore, are always ambitious to acknowledge themselves the pupils of nature; and as their skill increases, they grow more and more delighted with every view of the animal and vegetable world. But the pleasure resulting from admiration is transient; and to cultivate taste, without regard to its influence on the passions and affections, 'is to rear a tree for its blossoms, which is capable of yielding the richest and most valuable fruit.' Physical and moral beauty bear so intimate a relation to each other, that they may be considered as different gradations in the scale of excellence: and the knowledge and relish of the former should be deemed only a step to the nobler and more permanent enjoyments of the latter.

"Whoever has visited the Leafowes, in Warwickshire, must have felt the force and propriety of an inscription which meets the eye at the entrance into those delightful grounds.

Would you then taste the tranquil scene?
Be sure your bosoms be serene;
Devoid of hate, devoid of strife,
Devoid of all that poisons life:
And much it 'vails you, in their place,
To graft the love of human race.

"Now such scenes contribute powerfully to inspire that serenity which is necessary to enjoy and to heighten their beauties. By a secret contagion, the soul catches the harmony which she contemplates; and the frame within assimilates itself to that which is without. For,

Who can forbear to smile with Nature? Can
The stormy passions in the bosom roll,
While every gale is peace, and every grove
Is melody?

"In this state of sweet composure, we become susceptible of virtuous impressions, from almost every surrounding object. The patient ox is viewed with generous complacency; the guileless sheep with pity; and the playful lamb raises emotions of tenderness and love. We rejoice with the horse, in his liberty and exemption from toil, while he ranges at large through enamelled pastures; and the frolics of the colt would afford unmixed delight, did we not recollect the bondage which he is soon to undergo. We are charmed with the song of birds, soothed with the buzz of insects, and pleased with the sportive motions of fishes, because these are expressions of enjoyment: and we exult in the felicity of the whole animated creation. Thus an equal and extensive benevolence is called forth into exertion; and having felt a common interest in the gratifications of inferior beings, we shall be no longer indifferent to their sufferings, or become wantonly instrumental in producing them.

"It seems to be the intention of Providence, that the lower order of animals should be subservient to the comfort, convenience, and sustenance of man. But his right of dominions extends no farther; and if this right be exercised with mildness, humanity, and justice, the subject of his power will be no less benefited than himself. For various species of living creatures are annually multiplied by human art, improved in their perceptive powers by human culture, and plentifully fed by human industry. The relation, therefore is reciprocal between such animals and man; and he may supply his own wants by the use of their labour, the produce of their bodies, and even the sacrifice of their lives, whilst he co-operates with all-gracious Heaven in promoting happiness, the great end of existence.

"But though it be true, that partial evil, with respect to different orders of sensitive beings, may be universal good; and that

N A T

it is a wise and benevolent institution of nature, to make destruction itself, within certain limitations, the cause of an increase of life and enjoyment; yet a generous person will extend his compassionate regard to every individual that suffers for his sake: and, whilst he sighs

Even for the kid or lamb that parts its life
Beneath the bloody knife,

he will mutually be solicitous to mitigate pain, both in duration and degree, by the gentlest modes of inflicting it.

"But the taste for natural beauty is subservient to higher purposes than those which have been enumerated: and the cultivation of it not only refines and humanises, but dignifies and exalts the affections. It elevates them to the admiration and love of that Being who is the author of all that is fair, sublime, and good in the creation. Scepticism and irreligion are hardly compatible with the sensibility of heart which arises from a just and lively relish of the wisdom, harmony and order subsisting in the world around us: and emotions of piety must spring up spontaneously in the bosom that is in unison with all animated nature. Actuated by this divine inspiration, man finds a fane in every grove; and glowing with devout fervor, he joins his song to the universal chorus, or mutes the praise of the Almighty, in more expressive silence. Thus they

Whom Nature's works can charm, with God himself
Hold converse; grow familiar, day by day,
With his conceptions; act upon his plan;
And form to his, the relish of their souls."

On the whole then, it certainly appears, that the advantages resulting from a taste for natural beauties are great and important: it is equally certain, that as it is useful, so it is a continual source of real enjoyment; for a more rational pleasure cannot possibly occupy the attention or captivate the affections of mankind, than that which arises from a due consideration of the works of nature. Pleasure, we know, is a necessary ingredient in human life, in order in some measure to counterbalance the pains, the evils and listlessnesses, which are at times perhaps unavoidable, and in order to render life tolerable. It is the part then of the moralist, and it has been frequently his business, to point out and recommend such pleasures as are highly gratifying, and are yet perfectly innocent. The Spectator, whose works will be admired as long as the language in which they are written is understood, recommends strongly and elegantly the pleasure of a garden; and a later writer, of no common degree of merit, and of very considerable fame, has an essay on the same subject, from which we shall select a few observations, and so conclude the article.

"Not he alone (says this elegant writer) is to be esteemed a benefactor to mankind, who makes an useful discovery; but he also who can point out and recommend an innocent pleasure. Of this kind are the pleasures arising from the observation of nature; and they are highly agreeable to every taste uncorrupted by vicious indulgence. Rural scenes of almost every kind are delightful to the mind of man. But the misfortune is, that the greater part are hurried on in the career of life with too great rapidity to be able to give attention to that which solicits no passion. The darkest habitation, in the dirtiest street of the metropolis, where money can be earned, has greater charms with many than the groves of Hagley.

"The patron of refined pleasure, the elegant Epicurus, fixed the seat of his enjoyment in a garden. He was of opinion, that a tranquil spot, furnished with the united sweets of art and nature, was the best adapted to delicate repose. And even the severer philosophers of antiquity were wont to discourse in the shade of a spreading tree, in some cultivated plantation. It is obvious, on intuition, that nature often intended solely to please the eye in her vegetable productions. She decorates the floweret that springs beneath our feet in all the perfections of external beauty. She has clothed the garden with a constant succession of various hues. Even the leaves of the tree undergo a pleasing vicissitude. The fresh verdure which they exhibit in the spring, the various shades which they assume in summer, the yellow and russet tinge of autumn, and the nakedness of winter, afford a constant pleasure to a lively imagination. From the snow-drop to the mofs-rose, the flower garden displays an infinite variety of shape and colour. The taste of the florist has been ridiculed as trifling; yet surely without reason. Did nature bring forth the tulip and the lily, the rose and the honeysuckle, to be neglected, by the haughty pretender to superior reason? To omit a single social duty for the cultivation of a polyanthus were ridiculous as well as criminal; but to pass by the beauties lavished before us, without observing them, is no less ingratitude than stupidity. A bad heart finds little amusement but in a communication with the active world, where scope is given for the indulgence of malignant passions; but an amiable disposition is commonly known by a taste for the beauties of the animal and the vegetable creation. In short, since the world was made for our use, since the beauties of nature are alike displayed before all men, and since they are unquestionably an inexhaustible fund of innocent amusement; that subject must be of vast importance which enables us to relish them properly.

TREATISE ON NATURAL HISTORY.

NATURAL HISTORY is that science which not only gives complete descriptions of natural productions in general, but also teaches the method of arranging them into classes, orders, genera, and species. It includes three kingdoms, 1. Zoology, 2. Botany, 3. Mineralogy, &c. But as these kingdoms are so comprehensive, that they could neither with propriety nor advantage be completely discussed under the general title of Natural History, we shall refer our readers to the different parts which compose the several kingdoms under the following divisions.

The first kingdom, which is called **ZOOLOGY** or the **ANIMAL KINGDOM**, comprises every living creature, and is divided into six classes, viz. 1. Mammalia or animals that give suck; 2. Aves, Birds, or Ornithology; 3. Amphibia, Amphibious Animals, or Amphibiology; 4. Pisces, Fish or Ichthyology; 5. Insecta, Insects or Entomology; 6. Vermes, Worms, or Vermeeology.

The second kingdom, called **BOTANY**, or the **VEGETABLE KINGDOM**, is divided into 24 classes, viz. 1. Monandria; 2. Diandria; 3. Triandria; 4. Tetrandria; 5. Pentrandria; 6. Hexandria; 7. Heptandria; 8. Octandria; 9. Enneandria; 10. Decandria; 11. Dodecandria; 12. Icosandria; 13. Polyandria; 14. Didynamia; 15. Tetradynamia; 16. Monadelphia; 17. Diadelphia; 18. Polyadelphia; 19. Syngenesia; 20. Gynandria; 21. Monoecia; 22. Dioecia; 23. Polygamia; 24. Cryogamia.

The third kingdom is called **MINERALOGY** or the **MINERAL KINGDOM**, and is divided into three classes. 1. Petrea, Stony or Rocky Substances; 2. Minerea, or Minerals; 3. Fossila, or Fossils.

The several classes above enumerated, are divided into orders. Those orders are divided into genera and those genera are again subdivided into species. We must refer those who wish to pursue the study of this delightful and entertaining science to the respective Systems for the enumeration of the several orders of the genera; for the description of the genera and species to the alphabet at large; and for their representation to the respective Plates.

In the present article it is proposed to give a general and philosophical view of the subject: To set forth, in a summary way, whatever curious, worthy to be known, or not obvious to every observer, occurs in the three kingdoms of nature; with their constitution, laws, and economy; or, in other words, that all-wise disposition of the Creator in relation to natural things, by which they are fitted to produce general ends and reciprocal uses.

SECT. I.

OF THE TERRAQUEOUS GLOBE IN GENERAL AND ITS CHANGES.

The world, or the terraqueous globe which we inhabit, is every where surrounded with elements, and contains in its superficies the three **KINGDOMS of Nature**, as they are called: the mineral, which constitutes the cruit of the earth: the vegetable, which adorns the face of it, and draws the greatest part of its nourishment from the mineral kingdom; and the animal, which is sustained by the vegetable kingdom. Thus these three kingdoms cover, adorn, and vary the superficies of our earth.

As to the **STRATA** of the **EARTH** and **MOUNTAINS**, as far as we have hitherto been able to discover, the upper parts consist of rag-stone; the next of slate; the third of marble filled with petrifications; the fourth again of slate; and lastly, the lowest of free-stone. The habitable part of the earth, though it is scooped into various inequalities, yet is every where high in comparison with the water; and the farther it is from the sea, it is generally higher. Thus the waters in the lower places are not at rest, unless some obstacle confines them, and by that means form lakes and marshes.

The **SEA** surrounds the continent, and takes up the greatest part of the earth's superficies as **GEOGRAPHY** informs us. Nay, that it once spread over much the greatest part, we may be convinced by its yearly decrease, by the rubbish left by the tides, by shells, strata, and other circumstances.

The sea-shores are usually full of dead testaceous animals, wrack, and such like bodies, which are yearly thrown out of the sea. They are also covered with sands of various kinds, stones, and heaps of other things not very common. It happens, moreover, that while the more rapid rivers rush through narrow valleys, they wear away the sides; and thus the friable and soft earth falls in, and its ruins are carried to distant and winding shores; whence it is certain, that the continent gains no small increase, as the sea subsides.

The **CLOUDS** collected from exhalations, chiefly from the sea, but likewise from other waters, and moist grounds, and condensed in the lower regions of the **ATMOSPHERE**, supply the earth with **RAIN**; but since they are attracted by the mountainous parts of the earth, it necessarily follows, that those parts, which are fit, a larger share of water than the rest. **SPRINGS**, most generally rush out at the foot of mountains, take their rise from this very rain-water and vapours condensed, that trickle through the holes and interstices of loose bodies, and are received into caverns. These afford a pure **WATER**, purged by straining; and rarely dry up in summer, or freeze in winter, so that animals never want a wholesome and refreshing liquor. The chief sources of **RIVERS** are fountains and hills growing by gradual supplies into still larger and larger streams; till at last, after a conflux of a vast number of them, they find no stop, but falling into the sea with much rapidity, they there deposit the united stores they have gathered, along with so-

rein matter, and such earthy substances as they tore off in their way. Thus the water returns in a circle whence it first drew its origin, that it may act over the same scene again.

Marshes, arising from water retained in low grounds, are filled with mossy tumps, which are brought down by the water from the higher parts, or are produced by putrified plants.

We often see new meadows arise from marshes dried up. This happens sooner when the *sphagnum* (a kind of moss) has laid a foundation; for this in process of time changes into a very porous mould, till almost the whole marsh is filled with it. After that the rush strikes root, and along with the cotton grasses constitutes a turf, raised in such a manner that the roots get continually higher, and thus lay a more firm foundation for other plants, till the whole marsh is changed into a fine and delightful meadow; especially if the water happens to work itself a new passage.

Hillocks that abound in low grounds, occasion the earth to increase yearly, more than the countryman would wish, and seem to do hurt: but in this the great industry of nature deserves to be taken notice of. For by this means the barren spots become sooner rich meadow and pasture land. These hillocks are formed by the ant, by stones and roots, and the trampling of cattle, but the principal cause is the force of the winter-cold, which in the spring raises the roots of plants so high above the ground, that being exposed to the air, they grow, and perish; after which the golden maiden-hairs fill the vacant places.

Mountains, hills, vallies, and all the inequalities of the earth, though some think they take away much from its beauty, are so far from producing such an effect, that on the contrary they give a more pleasing aspect, as well as great advantages. For thus the terrestrial superficies is larger; different kinds of plants thrive better, and are more easily watered; and the rain-waters run in continual streams into the sea; not to mention many other uses in relation to winds, heat, and cold. The Alps are the highest mountains, that reach to the second region of the air, where trees cannot grow erect. The higher these Alps are, the colder they are, *ceteris paribus*. Hence the Alps in Sweden, Siberia, Switzerland, Peru, Brasil, Armenia, Asia, Africa, are perpetually covered with snow, which becomes almost as hard as ice. But if by chance the summer-heats be greater than ordinary, some part of these stores melts, and runs through rivers into the lower regions, which by this means are much refreshed.

It is scarcely to be doubted, but that the rocks and stones dispersed over the globe were formed originally in, and from, the earth; but when torrents of rain have softened, as they easily do, the soluble earth, and carried it down into the lower parts, we imagine it happens, that these solid and heavy bodies, being laid bare, stick out above the surface; we might also take notice of the wonderful effect of the tide, such as we see happen from time to time on the sea shore, which being daily and nightly assaulted, with repeated blows, at length gives way, and breaks off. Hence we see in most places the rubbish of the sea, and shores.

The winter by its frost prepares the earth and mould, which thence are broken into very minute particles, and thus, being put into a mouldering state, become more fit for the nourishment of plants; nay, by its snow it covers the seeds, and roots of plants, and thus by cold defends them from the force of cold. We must add also, that the piercing frost of the winter purifies the atmosphere and putrid waters, and makes them more wholesome for animals.

The perpetual succession of heat and cold with us renders the summers more pleasing; and though the winter deprives us of many plants and animals, yet the perpetual summer within the tropics is not much more agreeable, as it often destroys men and other animals by its immoderate heat; though it must be confessed, that those regions abound with exquisite fruits. Our winters, though very troublesome to a great part of the globe on account of their vehemence and intense cold, yet are less hurtful to the inhabitants of the northern parts, as experience testifies. Hence it happens, that we may live very conveniently on every part of the earth, as every different country has different advantages from nature.

The seasons, like every thing else, have their vicissitudes; their beginnings, their progress, and their end. The age of man begins from the cradle; pleasing childhood succeeds; then active youth; afterwards manhood, firm, severe and intent upon self-preservation; lastly, old age creeps on, debilitates, and at length totally destroys our tottering bodies.

The seasons of the year proceed in the same way. Spring, the jovial, playful infancy of all living creatures, represents childhood and youth: for then plants spread forth their luxuriant flowers, fishes exult; birds sing, every part of nature is intent upon generation. The summer, like middle age, exhibits plants, and trees every where clothed with green: it gives vigour to animals, and plumps them up; fruits then ripen, meadows look cheerful, every thing is full of life. On the contrary, autumn is gloomy; for then the leaves of trees begin to fall, plants to wither, insects to grow torpid, and many animals to retire to their winter-quarters.

The day proceeds with just such steps, as the year. The morning makes every thing alert, and fit for business: the sun pours forth his ruddy rays; the flowers, which had as it were slept all night, awake and expand themselves again; the birds with their sonorous

*

E

sonorous

NATURAL HISTORY.

sonorous voices and various notes make the woods ring, meet together in flocks, and sacrifice to Venus. Noon tempts animals into the fields and pastures; the heat puts them upon indulging their ease, and even necessity obliges them to it. Evening follows; and makes every thing more sluggish; flowers shut up, and animals retire to their lurking places. Thus the spring, the morning, and youth, are proper for generation; the summer, noon, and manhood, are proper for preservation; and autumn, evening, and old age, are not unfitly likened to destruction.

In order to perpetuate the established course of nature, in a continued series, the Divine Wisdom has thought fit that all living creatures should constantly be employed in *producing* individuals; that all natural things should contribute and lend a helping hand towards *preserving* every species; and lastly, that the *death* and *destruction* of one thing should always be subservient to the production of another. Hence the objects of our present inquiry fall to be considered in a threefold view, that of *propagation*, *preservation*, and *death* or *destruction*.

SECT. II.

THE FOSSIL KINGDOM.

I. PROPAGATION.

It is agreed on all hands, that stones are not organical bodies, like plants and animals; and therefore it is as clear that they are not produced from an egg, like the tribes of the other kingdoms. Hence the variety of fossils is proportionate to the different combinations of coalescent particles, and hence the species in the fossil kingdom are not so distinct as in the other two. Hence also the laws of generation in relation to fossils have been in all ages extremely difficult to explain; and lastly, hence have arisen so many different opinions about them, that it would be endless to enumerate them all. We therefore for the present will content ourselves with giving a very few observations on this subject. That clay is the sediment of the sea is sufficiently proved by observation, for which reason it is generally found in great plenty along the coasts. The journals of seamen clearly evince, that a very minute sand covers the bottom of the sea; nor can it be doubted, but that it is daily crystallised out of the water. It is now acknowledged by all, that testaceous bodies and petrifications resembling plants were once real animals or vegetables; and it seems likely that shells, being of a calcareous nature, have changed the adjacent clay, sand, or mould, into the same kind of substance. Hence we may be certain that marble may be generated from petrifications; and therefore it is frequently seen full of them.

Rag-stone, the common matter of our rocks, appears to be formed from a sandy kind of clay; but this happens more frequently where the earth is impregnated with iron. Free-stone is a product of sand; and the deeper the bed where it is found, the more compact it becomes; and the more dense the sand, the more easily it concretes. But if an alkaline clay chances to be mixed with the sand, the free-stone is generated more readily, as in the free-stone called *cos friatilis*, *particulis argillo-glarenfis*. The flint is almost the only kind of stone, certainly the most common stone, in chalky mountains. It seems therefore to be produced from chalk. Whether it can be reduced again to chalk, is left to others to enquire. Stalactites, or drop-stone, is composed of calcareous particles, adhering to a dry, and generally a vegetable body. Incrustations (*Syst. Nat.* 32. 5, 6, 7, 8.) are often generated, where a vitriolic water connects clayey and earthy particles together. Slate, by the vegetables that are often inclosed in it, seems to take its origin from a marshy mould.

Metals vary according to the nature of the matrix in which they adhere; e. g. the pyrites cupri Fahlunensis contains frequently sulphur, arsenic, iron, copper, a little gold, vitriol, alum, sometimes lead-ore, silver, and zinc. Thus gold, copper, iron, zinc, arsenic, pyrites, vitriol, come out of the same vein. That very rich iron-ore at Normark in Vermilandia, where it was cut transversely by a vein of clay, was changed into pure silver. The number therefore of species and varieties of fossils, each serving for different purposes according to their different natures, will be in proportion as the different kinds of earths and stones are variously combined.

II. PRESERVATION.

As fossils are destitute of life and organization; are hard and not obnoxious to putrefaction; so they last longer than any other kind of bodies. How far the air contributes to this duration, it is easy to perceive; since air hardens many stones upon the superficies of the earth, and makes them more solid, compact, and able to resist the injuries of time. Thus it is known from vulgar observation, that lime, that has been long exposed to the air, becomes hardened. The chalky marl which they use in Flanders for building houses, as long as it continues in the quarry is friable, but when dug up and exposed to the air it grows gradually harder.

However ignorant we may be of the cause why large rocks are every where to be seen split, whence vast fragments are frequently torn off; yet this we may observe, that fissures are closed up by water, which gets between them, and is detained there, and are consolidated by crystal and spar. Hence we scarcely ever find any crystal, but in those stones which have retained for some time in its chinks water loaded with stony particles. In the same manner crystals fill the cavities in mines, and concrete into quartz, or a debased crystal.

It is manifest that stones are not only generated, augmented, and changed perpetually from incrustations brought upon moss, but are also increased by crystal and spar. Not to mention that the adjacent earth, especially if it be impregnated with iron particles, is commonly changed into a solid stone. It is said, that the marble quarries in Italy, from whence fragments are cut, grow up again. Ores grow by little and little, whenever the mineral particles, conveyed by the means of water through the clefts of mountains, are retained there; so that, adhering to the homogeneous matter a long while, at last they take its nature, and are changed into a similar substance.

III. DESTRUCTION.

Fossils, although they are the hardest of bodies, yet are found subject to the laws of destruction, as well as all other created substances. For they are dissolved in various ways by the elements exerting their force upon them; as by water, air, and the solar rays; as also by the rapidity of rivers, violence of cataracts, and eulides; which continually beat upon, and at last reduce to powder the hardest rocks. The agitations of the sea, and lakes, and the vehemency of the waves, excited by turbulent winds, pulverise stones, as evidently appears by their roundness along the shore. Nay, as the poet says

The hardest stone insensibly gives way
To the soft drops that frequent on it play.

So that we ought not to wonder that these very hard bodies moulder away into powder, and are obnoxious like others to the consuming tooth of time. Sand is formed of free-stone, which is destroyed partly by frost, making it friable; partly by the agitation of water and waves, which easily wear away, dissolve, and reduce into minute particles, what the frost had made friable. Chalk is formed of rough marble, which the air, the sun, and the winds, have dissolved. The slate earth, or humus schisti, (*Syst. Nat.* 512.) owes its origin to slate, showers, air, and snow melted. Ocre is formed of metals dissolved, whose forces present the very same colours which we always find the ore tinged with when exposed to the air. Vitriol in the same manner mixes with water from ore destroyed.

The muria saxatilis, (*Syst. Nat.* 14, 6.) a kind of talky stone, yielding salt in the parts that are turned to the sun, is dissolved into sand, which falls by little and little upon the earth, till the whole is consumed; not to mention other kinds of fossils. Lastly, from these there arise new fossils, as we mentioned before; so that the destruction of one thing serves for the generation of another.

Testaceous worms ought not to be passed over on this occasion, for they eat away the hardest rocks. That species of shell-fish called the *razor-shell*, bores through stones in Italy, and hides itself within them; so that the people who eat them are obliged to break the stones before they can come at them. The cochlea, (*Foss. Succ.* 1299.) a kind of snail that lives on craggy rocks, eats and bores through the chalky hills, as worms do through wood. This is made evident by the observations of the celebrated De Geer.

SECT. III.

THE VEGETABLE KINGDOM.

I. PROPAGATION.

Anatomy abundantly proves, that all plants are organic and living bodies: and that all organic bodies are propagated from an egg, has been sufficiently demonstrated by the industry of the moderns. We therefore the rather, according to the opinion of the skilful, reject the equivocal generation of plants; and the more so, as it is certain that every living thing is produced from an egg. Now the seeds of vegetables are called eggs; these are different in every different plant, that the means being the same, each may multiply its species, and produce an offspring like its parent. We do not deny, that very many plants push forth from their roots fresh offsets for two or more years. Nay, not a few plants may be propagated by branches, buds, suckers, and leaves, fixed in the ground, as likewise many trees. Hence their stems being divided into branches, may be looked on as roots above ground; for in the same way the roots creep under ground, and divide into branches. And there is the more reason for thinking so, because we know that a tree will grow in an inverted situation, viz. the roots being placed upwards, and the head downwards, and buried in the ground; for then the branches will become roots, and then the roots will produce leaves and flowers. The lime-tree will serve for an example, on which gardeners have chiefly made the experiment. Yet this by no means overturns the doctrine, that all vegetables are propagated by seeds; since it is clear that in each of the foregoing instances nothing vegetates but what was the part of a plant, formerly produced from seed; so that, accurately speaking, without seed no new plant is produced.

Thus again plants produce seeds; but they are entirely unfit for propagation, unless fecundation precedes, which is performed by an intercourse between different sexes, as experience testifies. Plants therefore must be provided with organs of generation; in which respect they hold an analogy with animals. Since in every plant the flower always precedes the fruit, and the fecundated seeds visibly arise from the fruit; it is evident that the organs of generation are contained in the flower, which organs are called *antheræ* and *stigmata*, and that the impregnation is accomplished within the flower. This impregnation is performed by means of the dust of the antheræ falling

NATURAL HISTORY.

falling upon the moist stigmata, where the dust adheres, is burst, and sends forth a very subtle matter, which is absorbed by the style, and is conveyed down to the rudiments of the seed, and thus renders it fertile. This fact is experimentally demonstrated in our treatise on gardening. See KITCHEN GARDEN, Month of April.

When this operation is over, the organs of generation wither and fall, nay a change in the whole flower ensues. We must however observe, that in the vegetable kingdom one and the same flower does not always contain the organs of generation of both sexes, but oftentimes the male organs are on one plant, and the female on another. But that the business of impregnation may go on successfully, and that no plant may be deprived of the necessary dust, the whole most elegant apparatus of the antheræ and stigmata in every flower is contrived with wonderful wisdom. For in most flowers the stamina surround the pistils, and are of about the same height: but there are many plants in which the pistil is longer than the stamina: and in these it is wonderful to observe, that the Creator has made the flowers recline, in order that the dust may more easily fall into the stigma; e. g. in the campanula, cowslip, &c. This curious phenomenon did not escape the poetical-eye of Milton, who describes it in the following enlivened imagery.

With cowslips wan, that hang the pensive head.

But when the fecundation is completed, the flowers rise again, that the ripe seeds may not fall out before they are dispersed by the winds. In other flowers, on the contrary, the pistil is shorter, and there the flowers preserve an erect situation; nay, when the flowering comes on, they become erect, though before they were drooping, or immersed under water. Lastly, whenever the male flowers are placed below the female ones, the leaves are exceedingly small and narrow, that they may not hinder the dust from flying upwards like smoke, as we see in the pine, fir, yew, sea-grape, juniper, cypress, &c. And when in one and the same species one plant is male and the other female, and consequently may be far from one another, there the dust, without which there is no impregnation, is carried in abundance by the help of the wind, from the male to the female; as in the whole dioecious class. Again, a more difficult impregnation is compensated by the longevity of the individuals, and the continuation of life by buds, suckers, and roots; so that we may observe every thing most wisely disposed in this affair. Moreover, we cannot without admiration observe that most flowers expand themselves when the sun shines forth; whereas when clouds, rain, or the evening comes on, they close up, lest the genital dust should be coagulated, or rendered useless, so that it cannot be conveyed to the stigmata. But what is still more remarkable and wonderful, when the fecundation is over, the flowers, neither upon showers, nor evening coming on, close themselves up. Hence when rain falls in the flowering time, the husbandman and gardener foretell a scarcity of fruits. To mention only one particular more: The organs of generation, which in the animal kingdom are by nature generally removed from sight, in the vegetable are exposed to the eyes of all; and that when their nuptials are celebrated, it is wonderful what delight they afford to the spectator, by their most beautiful colours and delicious odours. At this time bees, flies, and other insects suck honey out of their nectaries, not to mention the humming-bird; and that from their effete dust the bees gather wax.

As to the dissemination of seeds after they come to maturity, it being absolutely necessary, since without it no crop could follow; the Author of nature has wisely provided for this affair in numberless ways. The stalks and stems favour this purpose: for these raise the fruit above the ground, that the winds, shaking them to and fro, may disperse far off the ripe seeds. Most of the pericarps are shut at top, that the seeds may not fall before they are shook out by stormy winds. Wings are given to many seeds, by the help of which they fly far from the mother-plant, and oftentimes spread over a whole country. These wings consist either of a down, as in most of the composite-flowered plants; or of a membrane, as in the birch, alder, ash, &c. Hence woods, which happen to be consumed by fire, or any other accident, will soon be restored again by new plants disseminated by this means. Many kinds of fruits are enriped with a remarkable elasticity, by the force of which the ripe pericarps throw the seeds to a great distance; as the wood-forrel, the spurge, the phyllanthus, the dittany. Other seeds or pericarps are rough, or provided with hooks; so that they are apt to stick to animals that pass by them, and by this means are carried to their holes, where they are both sown and manured by nature's wonderful care: and therefore the plants of these seeds grow where others will not; as hounds-tongue, agrimony, &c.

Berries and other pericarps are by nature allotted for aliment to animals; but with this condition, that while they eat the pulp they shall sow the seeds; for when they feed upon it, they either disperse them at the same time; or, if they swallow them, they are returned with interest, for they always come out unharmed. It is not therefore surprising, that, if a field be manured with recent mud or dung not quite rotten, various other plants, injurious to the farmer, should come up along with the grain that is sowed.

Many have believed that barley or rye has been changed into oats, although all such kinds of metamorphoses are repugnant to the laws of generation; not considering that there is another cause of this phenomenon, viz. that the ground perhaps has been manured

with horse-dung, in which the seeds of oats coming entire from the horse, lie hid and produce that grain. The millet always grows upon other trees, because the thrush that eats the seeds of it, casts them forth with its dung; and as bird-catchers make their bird-lime of this same plant, and daub the branches of trees with it, in order to catch the thrush, the proverb hence took its rise;

The thrush, when he besouls the bough,
Sows for himself the seeds of woe.

It is not to be doubted, but that the greatest part of the junipers that fill our woods, are sown by thrushes, and other birds, in the same manner; as the berries, being heavy, cannot be dispersed far by the winds. The cross-bill that lives on the fir-cones, and the hawk-finch that feeds on the pine-cones, at the same time sow many of their seeds; especially when they carry the cone to a stone, or trunk of a tree, that they may more easily strip it of its scales. Swine likewise, by turning up the earth, and moles by throwing up hillocks, prepare the ground for seeds in the same manner as the ploughman does.

We pass over many other things which might be mentioned concerning the sea, lakes, and rivers, by the help of which oftentimes seeds are conveyed unhurt to distant countries. A variety of other ways in which nature provides for the dissemination of plants, has been pointed out by Linnæus in an *Oration concerning the augmentation of the habitable earth*. As there is something very ingenious and quite new in the treatise here referred to, we shall, for the sake of those who cannot read the original, add a short abstract of it. His design is to shew that there was only one pair of all living things, created at the beginning. According to the account of Moles, says the author, we are sure that this was the case in the human species; and by the same account we are informed that this first pair was placed in Eden, and that Adam gave names to all the animals. In order therefore that Adam might be enabled to do this, it was necessary that all the species of animals should be in Paradise; which could not happen unless also all the species of vegetables had been there likewise. This he proves from the nature of their food; particularly in relation to insects, most of which live upon one plant only. Now had the world been formed in its present state, it could not have happened that all the species of animals should have been there. They must have been dispersed over all the globe, as we find they are at present; which he thinks improbable for other reasons which we shall pass over for sake of brevity.

To solve all the phenomena, then, he lays down, as a principle, that at the beginning all the earth was covered with the sea, unless one island large enough to contain all animals and vegetables. This principle he endeavours to establish by several phenomena, which make it probable that the earth has been and is still gaining upon the sea, and does not forget to mention fossil shells and plants every where found, which he says cannot be accounted for by the deluge. He then undertakes to shew how all vegetables and animals might in this island have a soil and climate proper for each, only by supposing it to be placed under the equator, and crowned with a very high mountain. For it is well known that the same plants are found on the Swift, the Pyrenean, the Scots Alps, on Olympus, Lebanon, Ida, as on the Lapland and Greenland Alps. And Tournefort found at the bottom of mount Ararat the common plants of Armenia, a little way up those of Italy, higher, those which grow about Paris, afterwards the Swedish plants, and lastly, on the top, the Lapland Alpine-plants; and I myself, adds the author, from the plants growing on the Dalecarlian Alps could collect how much lower they were than the Alps of Lapland. He then proceeds to shew how from one plant of each species the immense number of individuals now existing might arise. He gives some instances of the surprising fertility of certain plants; v. g. the elecampane, one plant of which produced 3000 seeds: of spelt, 2000; of the sun-flower, 4000; of the poppy, 3200; of tobacco, 40,320. But supposing any annual plant producing yearly only two seeds, even of this, after 20 years, there would be 1,048,576 individuals. For they would increase yearly in a double proportion, viz. 2, 4, 8, 16, 32, &c. He then gives some instances of plants brought from America, that are now become common over many parts of Europe. Lastly, he enters upon a detail of the several methods which nature has taken to propagate vegetables, which is extremely curious, but too long to insert in this place.

II. PRESERVATION.

The great Author and Parent of all things decreed, that the whole earth should be covered with plants, and that no place should be void, none barren. But since all countries have not the same changes of seasons, and every soil is not equally fit for every plant; he therefore, that no place should be without some, gave to every one of them such a nature as might be chiefly adapted to the climate: so that some of them can bear an intense cold, others an equal degree of heat; some delight in dry ground, others in moist, &c. Hence the same plants grow only where there are the same seasons of the year, and the same soil.

The Alpine plants live only in high and cold situations; and therefore often on the Alps of Armenia, Switzerland, the Pyreneans, &c. whose tops are equally covered with eternal snows as those of the Lapland Alps, plants of the same kind are found, and

it

NATURAL HISTORY.

it would be in vain to seek for them any where else. It is remarkable, in relation to the Alpine plants, that they blow, and ripen their seeds very early, lest the winter should steal upon them on a sudden, and destroy them. Our northern plants, although they are extremely rare every where else, yet are found in Siberia; and about Hudson's Bay; as the arbutus, bramble, winter green, &c.

Plants impatient of cold live within the torrid zones; hence both the Indies, though at such a distance from one another, have plants in common. The Cape of Good Hope, we know not from what cause, produces plants peculiar to itself; as all the mesembryanthema, and almost all the species of aloes. Grasses, the most common of all plants, can bear almost any temperature of air; in which the good providence of the Creator particularly appears; for all over the globe they, above all plants, are necessary for the nourishment of cattle; and the same thing is seen in relation to our most common grains. Thus neither the scorching sun, nor the pinching cold hinders any country from having its vegetables. Nor is there any soil which does not bring forth many kinds of plants. The pond-weeds the water lilly, lobelia, inhabit the waters. The fluviatiles fuci, conservæ, cover the bottoms of rivers, and sea. The sphagna fill the marshes. The brya clothe the plains. The driest woods, and places scarce ever illuminated by the rays of the sun, are adorned with the hypna. Nay stones and trunks of trees are not excepted, for these are covered with various kinds of liver wort. The desert and most sandy places, have their peculiar trees and plants; and as rivers or brooks are very seldom found there, we cannot without wonder observe that many of them distil water, and by that means afford the greatest comfort both to men and beasts that travel there. Thus the tillandsia, which is a parasitical plant, and grows on the tops of trees in the deserts of America, has its leaves turned at the base into the shape of a pitcher, with the extremity expanded; in these the rain is collected, and preserved for thirsty men, birds, and beasts.

The water-tree in Ceylon produces cylindrical bladders, covered with a lid; into these is secreted a most pure and refreshing water, that tastes like nectar to men and other animals. There is a kind of cuckow pint in New France, that, if you break a branch of it, will afford you a pint of excellent water. How wise, how beautiful, is the agreement between the plants of every country, and its inhabitants and other circumstances.

Plants oftentimes by their very structure contribute remarkably both to their own preservation and that of others. But the wisdom of the Creator appears no where more, than in the manner of growth of trees. For as their roots descend deeper than those of other plants, provision is thereby made that they shall not rob them too much of nourishment; and what is still more a stem not above a span in diameter often shoots up its branches very high; these bear perhaps many thousand buds, each of which is a plant, with its leaves, flowers and stipulæ. Now if all these grew upon the plain, they would take up a thousand times as much space as the tree does; and in this case there would scarcely be room in all the earth for so many plants as at present the trees alone afford. Besides, plants that shoot up in this way are more easily preserved from cattle by a natural defence; and farther, their leaves falling in autumn cover the plants growing about against the rigour of the winter, and in the summer they afford a pleasing shade not only to animals, but to plants, against the intense heat of the sun. We may add, that trees, like all other vegetables, imbibe the water from the earth, which water does not circulate again to the root, as the ancients imagined; but being dispersed like small rain, by the transpiration of the leaves, moistens the plants that grow around. Again, many trees bear fleshy fruits of the berry or apple kind, which being secure from the attack of cattle, grow ripe for the use of man and other animals, while their seeds are dispersed up and down after digestion. Lastly, the particular structure of trees contribute very much to the propagation of insects; for these chiefly lay their eggs upon the leaves, where they are secure from the reach of cattle. Ever-green trees and shrubs in the northern parts are chiefly found in the most barren woods, that they may be a shelter to animals in the winter. They lose their leaves only every third year, as their seeds are sufficiently guarded by the mosses, and do not want any other covering. The palms in the hot countries perpetually keep their leaves, for there the seed stand in no need of any shelter whatever.

Many plants and shrubs are armed with thorns, e. g. the buck-thorn, sloe, carduus, cotton thistle, &c. that they may keep off the animals, which otherwise would destroy their fruit. These at the same time cover many other plants, especially of the annual kind, under their branches. Nay, it has frequently been observed upon commons where furze grows, that wherever there was a bush left untouched for years by the commoners, some tree has sprung up, being secured by the prickles of that shrub from the bite of cattle. So that while the adjacent grounds are robbed of all plants by the voracity of animals, some may be preserved to ripen flowers and fruit, and stock the parts about with seeds, which otherwise would be extirpated.

All herbs cover the ground with their leaves, and by their shade hinder it from being totally deprived of that moisture which is necessary to their nourishment. They are moreover an ornament to the earth; especially as leaves have a more agreeable verdure on the upper than on the under side.

The mosses which adorn the most barren places at the same time preserve the lesser plants when they begin to shoot, from cold and drought: as we find by experience in our gardens, that plants are preserved in the same way. They also hinder the fermenting earth from forcing the roots of plants upwards in the spring; as we see happen annually to trunks of trees, and other things put into the ground. Hence very few mosses grow in the warmer climates, as not being so necessary to that end in those places.

The English sea mat-weed, or marran, will bear no soil but pure sand, which nature has allotted to it. Sand, the produce of the sea, is blown by winds oftentimes to very remote parts, and deluges, as it were, woods and fields. But where this grass grows, it frequently fixes the sand, gathers it into hillocks, and thrives so much, that, by means of this alone, at last an entire hill of sand is raised. Thus the sand is kept in bounds, other plants are preserved free from it, the ground is increased, and the sea is repelled, by this wonderful disposition of nature.

How solicitous nature is about the preservation of grasses is abundantly evident from hence, that the more the leaves of the perennial grasses are eat, the more they creep by the roots, and send forth offsets. For the Author of nature intended that vegetables of this kind, which have very slender and erect leaves, should be copious, and very thick-set, covering the ground like a carpet; and thus afford food sufficient for so vast a quantity of grazing animals. But what chiefly increases our wonder is, that although the grasses are the principal food of such animals, yet they are forbid as it were to touch the flower and seed-bearing stem, that so the seeds may ripen and be sown. The caterpillar, or grub of the moth, although it feeds upon grasses, to the great destruction of them in meadows, yet it seems to be formed in order to keep a due proportion between these and other plants; for grasses, when left to grow freely, increase to that degree, that they exclude all other plants; which would consequently be extirpated, unless this insect sometimes prepared a place for them. Hence always more species of plants appear in those places where this caterpillar has laid waste the pastures the preceding year, than at any other time.

III. DESTRUCTION.

Daily experience teaches us, that all plants, as well as all other living things, must submit to death. They spring up, they grow, they flourish, they ripen their fruit, they wither, and at last, having finished their course, they die, and return to the dust again, from whence they first took their rise. Thus all black mould, which every where covers the earth, for the greatest part is owing to dead vegetables. For all roots descend into the sand by their branches, and after a plant has lost its stem the root remains; but this too rots at last, and changes into mould. By this means this kind of earth is mixed with sand, by the contrivance of nature, nearly in the same way as dung thrown upon fields is wrought into the earth by the industry of the husbandman. The earth thus prepared offers again to plants, from its bosom, what it has received from them. For when seeds are committed to the earth, they draw to themselves, accommodate to their nature, and turn into plants, the more subtle parts of this mould, by the co-operation of the sun, air, clouds, rain, and winds; so that the tallest tree is, properly speaking, nothing but mould wonderfully compounded with air and water, and modified by a virtue communicated to a small seed by the Creator. From these plants, when they die, just the same kind of mould is formed as gave birth to them originally; but in such a manner, that it is in greater quantity than before. Vegetables therefore increase the black mould, whence fertility remains continually uninterrupted. Whereas the earth could not make good its annual consumption, unless it were constantly recruited by new supplies.

The crustaceous liverworts are the first foundation of vegetation: and therefore are plants of the utmost consequence in the oeconomy of nature, though so despised by us. When rocks first emerge out of the sea, they are so polished by the force of the waves, that scarce any herb can find a fixed habitation upon them; as we may observe every where near the sea. But the very minute crustaceous liverworts begin soon to cover these dry rocks, although they have no other nourishment but that small quantity of mould and imperceptible particles which the rain and air bring thither. These liverworts dying at last turn into a very fine earth; on this earth the imbricated liverworts find a bed to strike their roots in. These also die after a time, and turn to mould; and then the various kinds of mosses, e. g. the hypna, the brya, polytricha, find a proper place and nourishment. Lastly, these dying in their turn, and rotting, afford such plenty of new formed mould, that herbs and shrubs easily root and live upon it.

That trees, when they are dry or are cut down, may not remain useless to the world, and lie as it were melancholy spectacles, nature hastens on their destruction in a singular way: first the liverworts begin to strike root in them; afterwards the moisture is drawn out of them; whence putrefaction follows. Then the mushroom kinds find a fit place for nourishment on them, and corrupt them still more. The beetle called the *dermestes*, next makes himself a way between the bark and the wood. The musk-beetle, the copper tale-beetle, and the caterpillar or *cossus* 812 (S.N.) bores an infinite number of holes through the trunk. Lastly, the woodpeckers come, and while they are seeking for insects, wear away the tree already

NATURAL HISTORY.

already corrupted; till the whole passes into earth. Such industry does nature use to destroy the trunk of a tree! Nay, trees immersed in water, would scarcely ever be destroyed, were it not for the worm that eats ships, which performs this work; as the sailor knows by sad experience.

Thistles, as the most useful of plants, are armed, and guarded by nature herself. Suppose there were a heap of clay, on which for many years no plant has sprung up, let the seeds of the thistle blow there and grow, the thistles by their leaves attract the moisture out of the air, send it into the clay by means of their roots, will thrive themselves, and afford a shade. Let no other plants come hither, and they will soon cover the ground. All succulent plants make the ground fine, of a good quality, and in great plenty; as sedum, crassula, aloe, algæ. But dry plants make it more barren, as heath, pines, mofs; and therefore nature has placed the succulent plants on rocks, and the driest hills.

SECT. IV.

THE ANIMAL KINGDOM.

I. PROPAGATION.

The generation of animals holds the first place among all things that raise our admiration, when we consider the works of the Creator; and chiefly that appointment by which he has regulated the conception of the fœtus, and its exclusion, that it should be adapted to the disposition and way of living of each animal is most worthy of our attention. We find no species of animals exempt from the sting of love, which is put into them to the end that the Creator's mandate may be executed, *increase and multiply*; and that thus the egg, in which is contained the rudiment of the fœtus, may be fecundated; for without fecundation, all eggs are unfit to produce an offspring.

Foxes and wolves, struck with these stings, every where howl in the woods; crowds of dogs follow the female; bulls shew a terrible countenance, and very different from that of oxen. Stags every year have new horns, which they lose after rutting time. Birds look more beautiful than ordinary, and warble all day long, through lasciviousness. Thus small birds labour to out-sing one another, and cocks to out-crow. Peacocks spread forth again their gay and glorious trains. Fishes gather together, and exult in the water; and grasshoppers chirp and pipe, as it were amongst the herbs. The ants gather again into colonies, and repair to their citadels. We pass over many other particulars, which this subject affords, to avoid prolixity.

2. The fecundated egg requires a certain proportionate degree of heat for the expansion of the stamina of the embryo. That this may be obtained, nature operates in different manners; and therefore we find in different classes of animals a different way of excluding the fœtus. The females of quadrupeds have an uterus, contrived for easy gestation, temperate and cherishing warmth, and proper nourishment of the fœtus, as most of them live upon the earth, and are there fed.

Birds, in order to get subsistence, and for other reasons, are under a necessity of shifting place; and that not upon their feet, but wings. Gestation therefore would be burthensome to them. For this reason they lay eggs, covered with a hard shell. These they sit upon by a natural instinct, and cherish till the young ones come forth. The ostrich and cassowary are almost the only birds that do not observe this law; these commit their eggs to the sand, where the intense heat of the sun excludes the fœtus.

Fishes inhabit cold waters, and most of them have cold blood; whence it happens that they have not heat sufficient to produce the fœtus. The all-wise Creator therefore has ordained, that most of them should lay their eggs upon the shore; where by means of the solar rays the water is warmer, and also fitter for that purpose; because it is there less impregnated with salt, and consequently milder; and also because water-insects abound more there, which afford the young fry nourishment.

Salmons in the like manner, when they are about to lay their eggs, are led by instinct to go up the stream, where the water is fresh and more pure. The butter-fly-fish is an exception, for that brings forth its fœtus alive. The fishes of the ocean, which cannot reach the shores by reason of the distance, are also exempt from this law. The Author of nature has given to this kind, eggs that swim; so that they are hatched amidst the swimming fucus, called *sargazo*. The cetaceous fish have warm blood; and therefore they bring forth their young alive, and suckle them with their teats. Many amphibious animals bring forth their fœtuses, as the viper and the toad, &c. But the species that lay their eggs, lay them in places where the heat of the sun supplies the warmth of the parent. Thus the rest of the frog kind, and the lizard kind, lay their eggs in warm waters; the common snake in dunghills, and such like warm places; and give them up to nature, as a provident nurse, to take care of them. The crocodile and sea-tortoises go ashore to lay their eggs under the sand, where the heat of the sun hatches them.

Most of the insect kind neither bear young nor hatch eggs: yet their tribes are the most numerous of all living creatures; inasmuch, that if the bulk of their bodies were proportionate to their quantity, they would scarce leave room for any other kinds of animals. Let us see therefore with what wisdom the Creator has man-

naged about the propagation of these minute creatures. The females by natural instinct meet and copulate with the males; and afterwards lay their eggs; but not indiscriminately in every place. For they all know how to choose such places as may supply their offspring in its tender age with nourishment, and other things necessary to satisfy their natural wants: for the mother, soon after she has laid her eggs, dies; and were she to live, she would not have it in her power to take care of her young.

Butterflies, moths, some beetles, weevils, bugs, cuckow-spit insects, gall insects, tree-bugs, &c. lay their eggs on the leaves of plants, and every different tribe chooses its own species of plant. Nay, there is scarce any plant which does not afford nourishment to some insect; and still more, there is scarcely any part of a plant which is not preferred by some of them. Thus one insect feeds upon the flower; another upon the trunk; another upon the roots; and another upon the leaves. But we cannot help wondering particularly, when we see how the leaves of some trees and plants, after eggs have been let into them, grow into galls; and form dwellings, as it were for the young ones, where they may conveniently live. Thus when the gall insect has fixed her eggs in the leaves of an oak, the wound of the leaf swells, and a knob like an apple arises, which includes and nourishes the embryo.

When the tree-bug has deposited its eggs in the boughs of the fir-tree, excrescences arise shaped like pearls. When another species of the tree-bug has deposited its eggs in the mouse-ear chickweed or the speedwell, the leaves contract in a wonderful manner into the shape of an head. The water spider excludes eggs either on the extremities of the juniper, which from thence forms a lodging, that looks like the arrow headed grass: or on the leaves of the poplar, from whence a red globe is produced. The tree-louse lays its eggs on the leaves of the black poplar, which upon that turn into a kind of inflated bag; and so in other instances. Nor is it upon plants only that insects live and lay their eggs. The gnats commit theirs to stagnating waters. The water-insect called *monoculus* often increases so immensely on pools, that the red legions of them have the appearance of blood. Others lay their eggs in other places: e. g. the beetle, in dunghills; the dermestis, in skins; the fleshy-fly, in putrid flesh; the cheese-maggot, in the cracks of cheese, from whence the caterpillars issuing forth, oftentimes consume the whole cheese, and deceive many people, who fancy the worms are produced from the particles of the cheese itself, by a generation called *equivocal*, which is extremely absurd. Others exclude their eggs upon certain animals. The mill-beetle lays its eggs between the scales of fishes; the species of gad fly, on the back of cattle; the species 1025 (*S. N.*) on the back of the rein-deer; the species 1026 in the noses of sheep. The species 1028, lodges during the winter in the intestinal tubes, or the throat of horses, nor can it be driven out till the summer comes on. Nay, insects themselves are often surrounded with the eggs of other insects, inasmuch that there is scarcely an animal to be found which does not feed its proper insect, not to say any more of all the other places where they deposit their eggs. Almost all the eggs of insects, when laid, are ordered to undergo, by a wonderful law of nature, various metamorphoses, e. g. the egg of the butterfly, being laid in the cabbage, first of all becomes a caterpillar, that feeds upon grass, crawls, and has 16 feet. This afterwards changes into a nymph, that has no feet, is smooth, and eats not; and lastly, this bursts into a butterfly that flies, has variety of colours, is rough, and lives upon honey. What can be more worthy of admiration than that one and the same animal should appear on the stage of life under so many characters, as if it were three distinct animals. Linnæus, (*Amœn. Academ. tom. ii.*) in a treatise on the wonders relating to insects, says, "As surprising as these transformations may seem, yet much the same happens when a chicken is hatched; the only difference is, that this chicken breaks all three coats at once, the butterfly one after another."

The laws of generation of worms are still very obscure; as we find they are sometimes produced by eggs, sometimes by offsets just in the same manner as happens to trees. It has been observed with the greatest admiration, that the polypus or hydra (*S. N. 221.*) lets down shoots and live branches, by which it is multiplied. Nay, more, if it be cut into many parts, each segment, put into the water, grows into a perfect animal, so that the parts which were torn off are restored from one scrap.

3. The multiplication of animals is not tied down to the same rules in all; for some have a remarkable power of propagating, others are confined within narrower limits in this respect. Yet in general we find, that nature observes this order, that the least animals, and those which are useful and serve for nourishment to the greatest number of other animals, are endowed with a greater power of propagating than others. Mites and many other insects, will multiply to a thousand within the compass of a very few days; while the elephant scarcely produces one young in two years. The hawk kind generally lay not above two eggs, at most four; while the poultry kind rises to 50. The diver, or loon, which is eaten by few animals, lays also two eggs; but the duck kind, the moor-game, partridges, &c. and small birds lay a very large number. If you suppose two pigeons to hatch nine times a year they may produce in four years 14760 young. They are endued with this remarkable fertility, that they may serve for food, not only to man, but to hawks and other birds of prey. Nature has made harmless

*

F

and

NATURAL HISTORY.

and esculent animals fruitful. She has forbid the bird kind to fall short of the number of eggs allotted to each species; and therefore, if the eggs which they intend to sit upon be taken away a certain number of times, they presently lay others in their room; as may be seen in the swallow, duck, and small birds.

II. PRESERVATION.

Preservation follows generation; this appears chiefly in the tender age, while the young are unable to provide for their own support. For then the parents, though otherwise ever so fierce in their disposition, are affected with a wonderful tenderness or sense of love towards their progeny, and spare no pains to provide for, guard, and preserve them; and that not by an imaginary law, but one given by the Lord of nature himself.

Quadrupeds give suck to their tender young, and support them by a liquor perfectly easy of digestion, till their stomachs are able to digest, and their teeth are fit to chew more solid food. Nay, their love toward them is so great, that they endeavour to repel with the utmost force every thing which threatens danger or destruction to them. The ewe, which brings forth two lambs at a time, will not admit one to her teats unless the other be present and suck also; lest one should famish, while the other grows fat.

Birds build their nests in the most artificial manner, and line them as soft as possible, for fear the eggs should get any damage. Nor do they build promiscuously in any place, but there only where they may quietly lie concealed, and be safe from the attacks of their enemies.

The hanging-bird makes its nest of the fibres of withered plants, and the down of the poplar seeds, and fixes it upon the bough of some tree hanging over the water, that it may be out of reach.

The diver places its swimming nest upon the water itself, amongst the rushes. We designedly pass over many instances of the like kind.

Again, birds sit on their eggs with so much patience, that many of them choose to perish with hunger, rather than expose the eggs to danger by going to seek for food.

The male rooks and crows, at the time of incubation, bring food to the females.

Pigeons, small birds, and other birds which pair, sit by turns; but where polygamy prevails, the males scarcely take any care of the young.

Most of the duck kind pluck off their feathers in great quantity, and cover their eggs with them, lest they should be damaged by the cold when they quit their nest for the sake of food; and when the young are hatched, who knows not how solicitous they are in providing for them till they are able to fly and shift for themselves?

Young pigeons would not be able to make use of hard seeds for nourishment, unless the parents were to prepare them in their crops, and thence feed them.

The owl called the *eagle-owl* makes its nest on the highest precipices of mountains, and in the warmest spot, facing the sun; that the dead bodies brought there may by the heat melt into a soft pulp, and become fit nourishment for the young.

As an exception indeed to this fostering care of animals, may be mentioned the cuckoo, which lays its eggs in the nest of other small birds, generally the wag-tail, yellow-hammer, or white-throat, and leaves the incubation or preservation of the young to them. This custom of the cuckoo is so extraordinary, and out of the common course of nature, that it would not be credible were it not for the testimony of the most knowing and curious natural-historians, such as Ray, Willoughby, Gmelin, Aldrovandus, Aristotle, &c. But this seeming want of instinct is accounted for from the structure and situation of its stomach, which disqualifies it for incubation; and its instructive care is still conspicuous in providing a proper, though a foreign nidus for its eggs.

Amphibious animals, fishes, and insects, which cannot come under the care of their parents, yet owe this to them, that they are put in places where they easily find nourishment.

As soon as animals come to maturity, and want no longer the care of their parents, they attend with the utmost labour and industry, according to the law and oeconomy appointed for every species, to the preservation of their lives. But that so great a number of them, which occur every where, may be supported, and a certain and fixed order may be kept up amongst them, behold the wonderful disposition of the Creator, in assigning to each species certain kinds of food, and in putting limits to their appetites. So that some live on particular species of plants, which particular regions and soils only produce: some on particular animalcula; others on carcases; and some even on mud and dung. For this reason, Providence has ordained that some should swim in certain regions of the watery element; others should fly: some should inhabit the torrid, the frigid, or the temperate zones: and others should frequent deserts, mountains, woods, pools, or meadows, according as the food proper to their nature is found in sufficient quantity. By this means there is no terrestrial tract, no sea, no river, no country, but what contains and nourishes various kinds of animals. Hence also an animal of one kind cannot rob those of another kind of its aliment; which if it happened, would endanger their lives or health: and thus the world at all times affords nourishment to so many and so large inhabitants, at the same time that nothing which it produces is useless or superfluous.

It will not be here amiss to produce some instances by which it will appear how providentially the Creator has furnished every animal with such clothing as is proper for the country where they live, and also how excellently the structure of their bodies is adapted to their particular way of life; so that they seem to be destined solely to the places where they are found.

Monkeys, elephants, and rhinoceroses, feed upon vegetables that grow in hot countries, and therefore therein they have their allotted places. When the sun darts forth its most fervid rays, these animals are of such a nature and disposition, that it does them no manner of hurt; nay, with the rest of the inhabitants of those parts, they go naked; whereas, were they covered with hairy skins, they must perish with heat.

On the contrary, the place of rein-deer is fixed in the coldest part of Lapland, because their chief food is the liverwort, which grows no where so abundantly as there; and where, as the cold is most intense, the rein-deer are clothed, like the other northern animals, with skins filled with the densest hair, by the help of which they easily defy the keenness of the winter. In like manner the rough-legged partridge passes its life in the very Lapland Alps, feeding upon the seeds of the dwarf birch; and, that they may run up and down safely amidst the snow, their feet are feathered.

The camel frequents the sandy and burning deserts, in order to get the barren camel's-hay. How wisely has the Creator contrived for him! he is obliged to go through the deserts, where oftentimes no water is found for many miles about. All other animals would perish with thirst in such a journey; but the camel can undergo it without suffering; for his belly is full of cells, where he reserves water for many days. It is reported by travellers, that the Arabians, when in travelling they want water, are forced to kill their camels, and take water out of their bellies that is perfectly good to drink, and not at all corrupted.

The pelican likewise lives in desert and dry places; and is obliged to build her nest far from the sea, in order to procure a greater share of heat to her eggs. She is forced therefore to bring water from afar for herself and her young; for which reason Providence has furnished her with an instrument most adapted to this purpose: She has a very large bag under her throat, which she fills with a quantity of water sufficient for many days; and this she pours into the nest, to refresh her young, and teach them to swim.

The wild beasts, lions, and tygers, come to this nest to quench their thirst, but do no hurt to the young.

Oxen delight in low grounds, because there the food most palatable to them grows.

Sheep prefer naked hills, where they find a particular kind of grass called the *fescua*, which they love above all things. Goats climb up the precipices of mountains, that they may browse on the tender shrubs; and in order to fit them for it, they have feet made for jumping. Horses chiefly resort to woods, and feed upon leafy plants. Nay, so various is the appetite of animals, that there is scarcely any plant which is not chosen by some, and left untouched by others. The horse gives up the water-hemlock to the goat. The cow gives up the long-leaved water-hemlock to the sheep. The goat gives up the monks-hood to the horse, &c. for that which certain animals grow fat upon, others abhor as poison. Hence no plant is absolutely poisonous, but only respectively. Thus the spurge, that is noxious to man, is a most wholesome nourishment to the caterpillar. That animals may not destroy themselves for want of knowing this law, each of them is guarded by such a delicacy of taste and smell, that they can easily distinguish what is pernicious from what is wholesome; and when it happens that different animals live upon the same plants, still one kind always leaves something for the other, as the mouths of all are not equally adapted to lay hold of the grass; by which means there is sufficient food for all. To this may be referred an oeconomical experiment well known to the Dutch, that when eight cows have been in a pasture, and can no longer get nourishment, two horses will do very well there for some days; and when nothing is left for the horses, four sheep will live upon it.

Swine get provision by turning up the earth; for there they find the succulent roots, which to them are very delicious. The leaves and fruits of trees are intended as food for some animals, as the sloth, the squirrel; and these last have feet given them fit for climbing. Besides myriads of fishes, the calf, the sea-calf, and others, inhabit the water, that they may there be fed; and their hinder-feet are fit for swimming, and perfectly adapted to their manner of life. The whole order of the goose-kind, as ducks, merganser, &c. pass their lives in water, as feeding upon water-insects, fishes, and their eggs. Who does not see, that attends ever so little, how exactly the wonderful formation of their beaks, their necks, their feet, and their feathers suit their kind of life; which observation ought to be extended to all other birds.

The way of living of the sea-swallow deserves to be particularly taken notice of; for as he cannot so commodiously plunge into the water, and catch fish, as other aquatic birds, the Creator has appointed the sea-gull to be his caterer, in the following manner. When this last is pursued by the former, he is forced to throw up part of his prey, which the other catches; but in the autumn, when the fishes hide themselves in deep places, the merganser supplies the gull with food, as being able to plunge deeper into the sea. The chief

NATURAL HISTORY.

chief granary of small birds is the knot-grass, that bears heavy seeds, like those of the black bind-weed. It is a very common plant, not easily destroyed, either by the road side by trampling upon it, or any where else; and is extremely plentiful after harvest in fields, to which it gives a reddish hue by its numerous seeds. These fall upon the ground, and are gathered all the year round by the small birds. To which we may add, that many small birds feed upon the seeds of plantain, particularly linnetts. It is generally known that the gold-finch lives upon the seed of thistles, from which he has his name in Latin and French. Thus bountiful nature feeds the fowls of the air.

The Creator has taken no less care of some amphibious animals, as the snake and frog kind; which, as they have neither wings to fly, nor feet to run swiftly and commodiously, would scarcely have any means of taking their prey, were it not that some animals run, as it were of their own accord, into their mouths. When the rattlesnake, a native of America, with open jaws fixes his eyes on a bird, fly, or squirrel, sitting on a tree, they fly down his throat, a bird rendered stupid, and giving themselves up as destitute of all being rendered stupid, and giving themselves up as destitute of all refuge. How dreadful this serpent is to other animals will appear by an account we have in a treatise entitled *Radix Senega*. Where the author (*Ann. Acad. tom. 2.*) says, one of these terrible serpents got clandestinely into the house of governor Blake at Carolina; where it would have long lain concealed, had it not been that all the domestic animals, as dogs, hogs, turkeys and fowls, admonished the family by their unusual cries, equally shewing their horror and consternation, their hair, bristles, and crests, standing up an end. On the other hand, we cannot but adore the Creator's great goodness towards man, when we consider the rattle which terminates this serpent's tail: for by means of that we have an opportunity of guarding against this dreadful enemy, the sound warning us to fly; which if we were not to do, and we should be wounded by him, the whole body would be turned into a putrid corruption in six hours, nay sometimes in half an hour.

The limits of this article will not permit us to produce more examples of this kind. But whoever will be at the pains to take ever so slight a view of the wonderful works of the Author of nature, will readily see how wisely the plan, order, and fitness of things with divine ends, are disposed.

We cannot without the utmost admiration behold how providently the Creator has acted as to the preservation of those animals which, at a certain time of the year, are by the rigour of the season excluded from the necessities of life. Thus the bear in the autumn creeps into the moss which he has gathered and there lies all winter; subsisting upon no other nourishment but his fat, collected during the summer in the cellularous membrane, and which without doubt, during his fast, circulates through his vessels, and supplies the place of food; to which perhaps is added that fat juice which he sucks out of the bottom of his feet.

The hedge-hog, badger, and mole, in the same manner fill their winter-quarters with vegetables, and sleep during the frosts. The bat seems cold and quite dead all the winter. Most of the amphibious animals get into dens, or to the bottom of lakes and pools.

In the autumn, as the cold approaches, and insects disappear, swallows migrate into other climes in search of food and a temperature of air more friendly to their constitution: though the latter hatches, or those young birds which are incapable of distant flights, seek for an asylum against the violence of the cold in the bottom of lakes amongst the reeds and rushes; from whence, by the wonderful appointment of nature, they come forth again. The peristaltic motion of the bowels ceases in all these animals, while they are obliged to fast; whence the appetite is diminished, and so they suffer the less from hunger. To this head may be referred the observations of the celebrated Lister concerning those animals; that their blood, when let into a basin does not coagulate, as that of all other animals: and so is no less fit for circulation than before.

The moor-fowls work themselves out-walks under the very snow. They moult in the summer; so that about the month of August they cannot fly, and are therefore obliged to run into the woods; but then the moor-berries and bilberries are ripe, from whence they are abundantly supplied with food. Whereas the young do not moult the first summer; and therefore though they cannot run so well, are able to escape danger by flight.

The rest of the birds who feed upon insects migrate every year to foreign regions, in order to seek for food in a milder climate; while all the northern parts, where they live well in the summer, are covered with snow.

By these migrations, birds also become useful to many different countries, and are distributed over almost all the globe. And it must excite our admiration that all of them exactly observe the times of coming and going, and that they do not mistake the way.

Insects in the winter generally lie hid within their cases, and are nourished by the surrounding liquor, like the foetus of other animals; from whence, at the approach of spring, they awake, and fly forth, to the astonishment of every one.

However, all animals which lie hid in winter, do not observe these laws of fasting. Some provide store-houses in summer and autumn, from which they take what is necessary; as mice, jays, squirrels, and bees.

III. DESTRUCTION.

We have observed before, that all animals do not live upon vegetables, but that there are some which feed upon certain animals. Nay, there are some which subsist only by rapine, and daily destroy numbers of the peaceable kind.

These animals are destroyed, but in such a manner that the weaker generally are infested by the stronger in a continued series. Thus the tree louse lives upon plants. The fly called *musca aphidivora* lives upon the tree louse; the hornet and wasp-fly, upon the *musca aphidivora*; the dragon-fly, upon the hornet and wasp-fly; the spider, on the dragon-fly; the small birds on the spider; and lastly, the hawk kind on the small birds.

In like manner, the monoculus delights in putrid waters, the gnat eats the monoculus, the frog eats the knat, the pike eats the frog, the sea calf eats the pike.

The bat and goat-fucker make their excursions only at night, that they may catch the moths, which at that time fly about in vast quantities.

The woodpecker pulls out the insects which lie hid in the trunks of trees.

The swallow pursues those which fly about in the open air.

The mole pursues worms. The large fishes devour the small. Nay, we scarcely know an animal which has not some enemy to contend with.

Amongst quadrupeds wild beasts are most remarkably pernicious and dangerous to others, as the hawk kind among birds. But that they may not, by too atrocious a butchery, destroy whole species, even these are circumscribed within certain bounds. First, as to the most fierce of all, it deserves to be noted how few they are in proportion to other animals. Secondly, the number of them is not equal in all countries. Thus France and England breed no wolves, and the northern countries no tigers or lions. Thirdly, these fierce animals sometimes fall upon and destroy one another. Thus the wolf devours the fox. The dog infests both the wolf and fox: nay, wolves in a body will sometimes venture to surround a bear. The tiger often kills its own male whelps. Dogs are sometimes seized with madness, and destroy their fellows, or with the mange destroy themselves.

Lastly, wild beasts seldom arrive at so great an age as animals which live on vegetables. For they are subject from their alkaline diet, to various diseases, which bring them sooner to an end.

But although all animals are infested by their peculiar enemies, yet they are often able to elude their violence by stratagems and force. Thus the hare often confounds the dog by her windings.

When the bear attacks sheep and cattle, these draw up together for mutual defence. Horses join heads together, and fight with their heels. Oxen join tails, and fight with their horns.

Swine get together in herds, and boldly oppose themselves to any attack, so that they are not easily overcome; and it is worth while to observe, that all of them place their young, as less able to defend themselves, in the middle, that they may remain safe during the battle.

Birds, by their different ways of flying oftentimes escape the hawk. If the pigeon had the same way of flying as the hawk, she would hardly ever escape his claws.

It deserves also to be remarked, how much some animals consult their safety by night. When horses sleep in woods, one by turn remains awake, and as it were, keeps watch. When monkeys in Brasil sleep upon trees, one of them keeps awake, in order to give the sign when the tyger creeps towards them; and in case the guard should be caught asleep, the rest tear him to pieces. Hence the hunting of rapacious animals is not always successful, and they are often obliged to labour for a whole day to no purpose. For this reason the Creator has given them such a nature, that they can bear fasting a long time. Thus the lion lurks in his den many days without famishing; and the wolf, when he has once well satisfied his hunger, can fast many weeks without any difficulty.

If we consider the end for which it pleased the Supreme Being to constitute such an order of nature, that some animals should be, as it were, created only to be miserably butchered by others, it seems that his Providence not only aimed at sustaining, but also keeping a just proportion amongst all the species; and so prevent any one of them from increasing too much, to the detriment of men and other animals. For if it be true, as it is most assuredly, that the surface of the earth can support only a certain number of inhabitants, they must all perish, if the same number were doubled or tripled. There are some viviparous flies which bring forth 2000 young. These in a little time would fill the air, and like clouds intercept the rays of the sun, unless they were devoured by birds, spiders, and many other animals.

Storks and falcons free Egypt from frogs, which, after the inundation of the Nile, cover all the country. The same birds also free Palestine of mice. Bellonius on this subject says as follows: "The storks come to Egypt in such abundance, that the fields and meadows are white with them. Yet the Egyptians are not displeased with this sight; as frogs are generated in such numbers there, that did not the storks devour them, they would overrun every thing. Besides, they also catch and eat serpents. Between Balba and Gaza, the fields of Palestine are often desert on account of the abundance of mice and rats; and were they not destroyed by the

NATURAL HISTORY.

the falcons, that come here by instinct, the inhabitants could have no harvest."

The white fox is of equal advantage in the Lapland Alps; as he destroys the Norway rats, which are generated there in great abundance, and thus hinders them from increasing too much in proportion, which would be the destruction of vegetables.

The whole earth would be overwhelmed with carcases and stinking bodies, if some animals did not delight to feed upon them. Therefore when an animal dies, bears, wolves, foxes, ravens, &c. do not lose a moment till they have taken all away. But if a horse, *e. g.* dies near the public road, you will find him, after a few days, swollen, burst, and at last filled with innumerable grubs of carnivorous flies, by which he is entirely consumed, and removed out of the way, that he may not become a nuisance to passengers by his poisonous stench.

When the carcases of fishes are driven upon the shore, the voracious kinds, such as the thornback, the hound-fish, the conger-eel, &c. gather about and eat them. But because the flux and reflux soon change the state of the sea, they themselves are often detained in pits, and become a prey to the wild beasts, that frequent the shores.

Thus the earth is not only kept clean from the putrefaction of carcases, but at the same time, by the oeconomy of nature, the necessities of life are provided for many animals. In the like manner many insects at once promote their own good, and that of other animals.

Thus gnats lay their eggs in stagnant, putrid, and stinking waters, and the grubs that arise from these eggs clear away all the putrefaction: and this will easily appear, if any one will make the experiment by filling two vessels with putrid water, leaving the grubs in one, and taking them all out of the other; for then he will soon find the water that is full of grubs pure and without any stench, while the water that has no grubs will continue stinking.

Lice increase in a wonderful manner in the heads of children that are scabby; nor are they without their use, for they consume the redundant humours.

The beetle kind in summer extract all moist and glutinous matter out of the dung of cattle, so that it becomes like dust, and is spread by the wind over the ground. Were it not for this, the vegetables that lie under the dung would be so far from thriving, that all that spot would be rendered barren.

As the excrements of dogs is so filthy and sceptic a nature that no insect will touch them, and therefore they cannot be dispersed by that means, care is taken that these animals should exonerate upon stones, trunks of trees, or some high place, that vegetables may not be hurt by them.

Cats bury their dung. In a word, nothing is so mean, nothing so little, in which the wonderful order and wise disposition of nature do not shine forth.

Lastly, all these treasures of nature, so artfully contrived, so wonderfully propagated, so providentially supported throughout her three kingdoms, seem intended by the Creator for the sake of man. Every thing may be made subservient to his use, if not immediately, yet mediately; not so that of other animals. By the help of reason man tames the fiercest animals; pursues and catches the swiftest; nay, he is able to reach even those which lie hid in the bottom of the sea. By the help of reason, he increases the number of vegetables immensely; and does that by art, which nature, left to herself, could scarcely effect. By ingenuity he obtains from vegetables whatever is convenient or necessary for food, drink, cloathing, medicine, navigation, and a thousand other purposes.

He has found the means of going down into the abyss of the earth, and almost searching its very bowels. With what artifice has he learned to get fragments from the most rocky mountains, to make the hardest stones fluid like water, to separate the useful metal from the useless dross, and to turn the finest sand to some use! In short, when we follow the series of created things, and consider how providentially one is made for the sake of another, the matter comes to this, that all things are made for the sake of man; and for this end more especially, that he, by admiring the works of the Creator, should extol his glory, and at once enjoy all those things of which he stands in need, in order to pass his life conveniently and pleasantly.

It is sufficient for us, that nothing is made by Providence in vain; and that whatever is made, is made with supreme wisdom. For it does not become us to pry too boldly into all the designs of God. Let us not imagine, when these rapacious animals sometimes do us mischief, that the Creator planned the order of nature according to our private principles of oeconomy: for the Laplanders have one way of living; the European husbandman another; the Hottentots and savages a third; whereas the stupendous oeconomy of the Deity is one throughout the globe; and if Providence does not always calculate exactly according to our way of reckoning, we ought to consider this affair in the same light, as when different seamen wait for a fair wind, every one with respect to the part he is bound to, who we plainly see cannot all be satisfied.

This subject concerning the works of nature, a very small part of which we have been able to touch upon, is of such importance and dignity, that if it were to be properly treated in all its parts, men

would find wherewithal to employ almost all the powers of the mind. Nay, time itself would fail before even the most acute human sagacity would be able to discover the amazing oeconomy, laws, and exquisite structure, of the least insect; since, as Pliny observes, nature no where appears more herself than in her most minute works.

Summary as it is, however, the preceding view, as it were in a map, of the several parts of nature, their connections and dependencies, may, among other uses, convey an useful lesson, and such an one as the best of us often need to have inculcated.

From a partial consideration of things, we are very apt to criticise what we ought to admire; to look upon as useless what perhaps we should own to be of infinite advantage to us, did we see a little farther; to be peevish where we ought to give thanks; and at the same time to ridicule those who employ their time and thoughts in examining what we were (*i. e.* some of us most assuredly were) created and appointed to study. In short, we are apt to treat the Almighty worse than a rational man would treat a good mechanic, whose works he would either thoroughly examine, or be ashamed to find any fault with them. This is the effect of a partial consideration of nature, but he who has the candour of mind and had not to look farther, will be inclined to wonder and adore.

The late Rev. Mr. Hervey, author of several pious and ingenious productions, has beautifully depicted the works of the creation, as adapted to the uses of the human race, in the following elegant style and manner.

The earth is assigned us for a dwelling. The skies are stretched over us like a magnificent canopy, dyed in the purest azure, and beautified, now with pictures of floating silver; now with colourings of reflected crimson. The grass is spread under us, as a spacious carpet, wove with silken threads of green, and damasked with flowers of every hue. The sun, like a golden lamp, is hung out in the ethereal vault; and pours his effulgence all the day to lighten our paths. When night approaches, the moon takes up the friendly office, and the stars are kindled in twinkling myriads, to cheer the darkness with their milder lustre, not disturb our repose by too intense a glare. The clouds, besides the rich paintings they hang around the heavens, act the part of a shifting screen, and defend us, by their seasonable interposition, from the scorching beams of summer.

May we not also regard them, as the great watering-pots of the globe, which, wafted on the wings of the wind, disperse their moisture evenly through the universal garden; and fructify, with their showers, whatever our hands plant? The fields are our exhaustless granary. The ocean is our vast reservoir. The animals spend their strength to dispatch our business, resign their cloathing to replenish our wardrobe, and surrender their very lives to provide for our tables. In short, every element is a store-house of conveniences; every season brings us the choicest productions; all nature is our caterer. And which is a most endearing recommendation of these favours, they are all as lovely as they are useful. You observe nothing mean or inelegant. All is clad in beauty's fairest robe, and regulated by proportion's nicest rule. The whole scene exhibits a fund of pleasures to the imagination, at the same time that it more than supplies all our wants.

The Science of Natural History is so unboundedly extensive, that those who pursue the study of it with assiduous and unremitting application, and trace its minutiae, as far as human wisdom can penetrate, find the subject so comprehensive, that to attain a perfect knowledge of any one of the three Kingdoms, would occupy the general career of human life.

In consequence of this admitted fact, we have given the various Classes of Natural History in different parts of the work; conceiving that it would render the knowledge of each respective branch less intricate and more attainable; nor could the respective Classes with propriety or advantage be discussed under this general head.

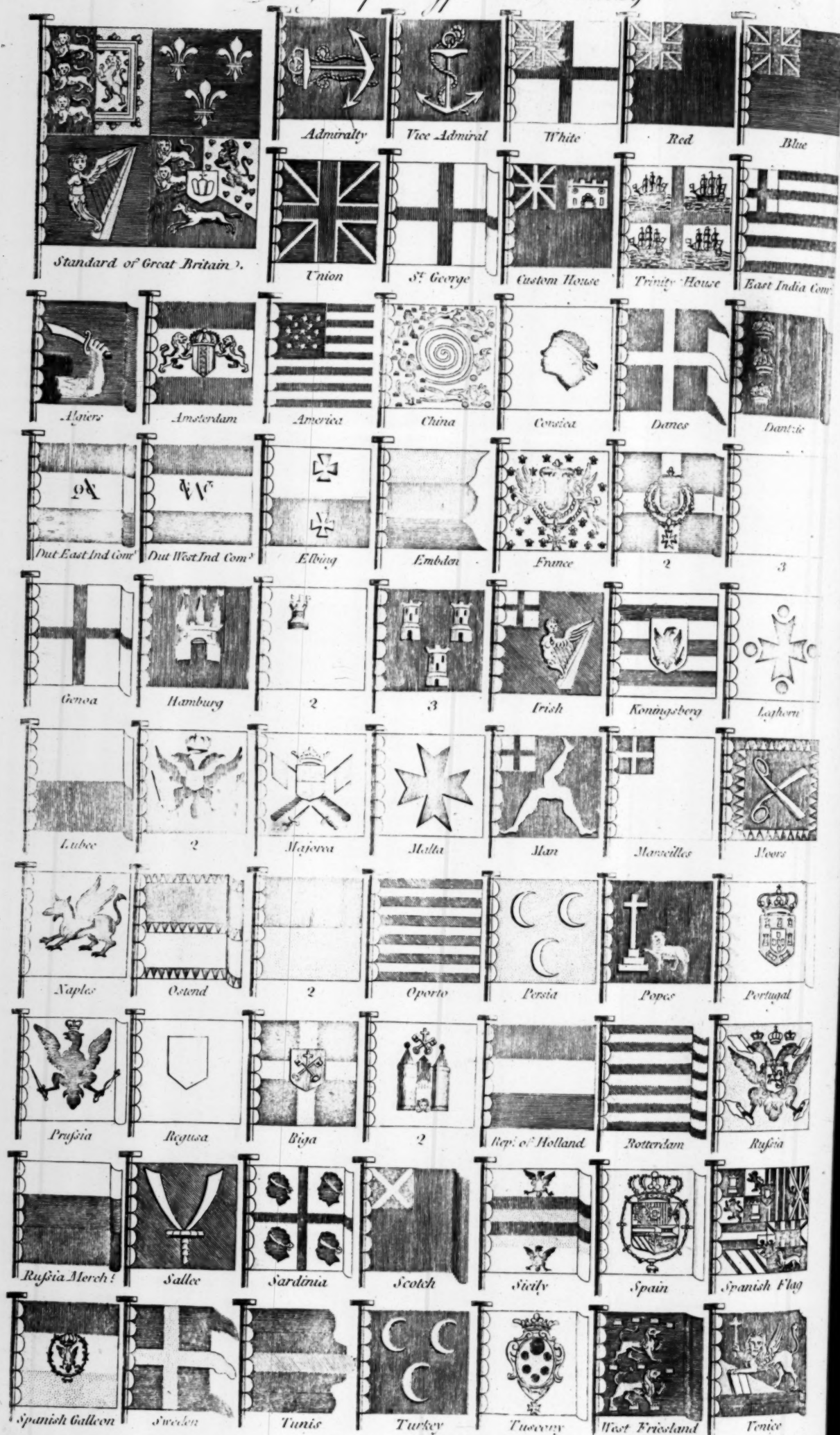
Another circumstance which we have strictly attended to, and which much facilitates the knowledge of this fashionable and entertaining science, is a judicious selection, arrangement, and classification of the representations.

The immortal Linnæus, in his *Systema Naturæ*, pursued the plan of classification, but he omitted to illustrate his descriptions with representations; in consequence of which it rendered his work infinitely less complete; therefore to supply the want of so important a point towards the study of Natural History, we have given representations of each genus, according to the Linnæan mode of classification; and as this plan was never before adopted in any System of Natural History, we conceive our plates will elucidate many parts of Linnæus, and considerably illustrate this Work, as well as Natural History in general; as they exhibit that chain of connection which runs throughout the three kingdoms, render the knowledge of the subject infinitely more instructive and entertaining, and induce us to pursue it with greater ardour, and to wonder and adore the works of the divine and omnipotent Creator.

Some few writers on Natural History have totally neglected Classification, an omission that may be justly compared to collecting a number of valuable materials for erecting a building, without laying a foundation for the superstructure.

ed
nd
r-
a
ed
ng
to
up
di,
re-
nt-
en,
ing
oots
ense
ify,
our
ani-
their
ives
oule
ons;
re-
are
id in
rule.
tion,
sive,
itted
can
per-
occupy
arious
con-
ective
ective
eneral
s, and
e and
s, and
ne plan
ith re-
finitely
a point
tations;
cation;
Natural
arts of
Natural
which
e of the
duce us
lore the
eglected
ollecting
without

Flags of Different Nations



NAVAL AFFAIRS.

MARITIME STATE OF GREAT BRITAIN.

SECT. I. LAWS, DISCIPLINE, AND PRIVILEGES.

THE maritime state of Britain is nearly connected with the military; though much more agreeable to the principles of our free constitution. The royal navy of England hath ever been its greatest defence and ornament; it is its ancient and natural strength, the wooden walls; the floating bulwark of the island; an army, from which, however strong and powerful, no danger can ever be apprehended to liberty: and accordingly it has been assiduously cultivated from the earliest ages. To so much perfection was our naval reputation arrived in the 12th century, that the code of maritime laws, which are called the *laws of Oleron*, and are received by all nations in Europe as the ground and superstructure of all their marine constitutions, was confessedly compiled by our Richard I. at the Isle of Oleron on the coast of France, then part of the possessions of the crown of England. And yet, so vastly inferior were our ancestors in this point to the present age, that even in the maritime reign of queen Elizabeth, Sir Edward Coke thinks it matter of boast, that the royal navy of England then consisted of *three and thirty ships*. The present condition of our marine is in great measure owing to the salutary provisions of the statutes called the *navigation acts*; whereby the constant increase of English shipping and seamen was not only encouraged, but rendered unavoidably necessary. By the statute 5 Ric. II. c. 3, in order to augment the navy of England, then greatly diminished, it was ordained, that none of the king's liege people should ship any merchandize out of or into the realm, but only in ships of the king's liegance, on pain of forfeiture. In the next year, by statute 6 Ric. II. c. 8, this wise provision was enervated, by only obliging the merchants to give English ships (if able and sufficient) the preference. But the most beneficial statute for the trade and commerce of these kingdoms is that navigation act, the rudiments of which were first framed in 1650, with a narrow partial view; being intended to mortify our own sugar-islands, which were disaffected to the parliament, and still held out for Charles II. by stopping the gainful trade which they then carried on with the Dutch, and at the same time to clip the wings of those our opulent and aspiring neighbours. This prohibited all ships of foreign nations from trading with any English plantations, without licence from the council of state. In 1651, the prohibition was extended also to the mother-country: and no goods were suffered to be imported into England, or any of its dependencies, in any other than English bottoms; or in the ships of that European nation of which the merchandize imported was the genuine growth or manufacture. At the restoration, the former provisions were continued, by stat. 12 Car. II. c. 1, with this very material improvement, that the master and three-fourths of the mariners shall also be English subjects.

Many laws have been made for the supply of the royal navy with seamen; for their regulation when on board; and to confer privileges and rewards on them during and after their service.

1. For their supply. The principal, but the most odious, though often necessary, method for this purpose, is by impressing; see IMPRESSING. But there are other ways that tend to the increase of seamen, and manning the royal navy. Parishes may bind out poor boys apprentices to the masters of merchantmen, who shall be protected from impressing for the first three years; and if they are impressed afterwards, the masters shall be allowed their wages: great advantages in point of wages are given to volunteer seamen, in order to induce them to enter into his majesty's service: and every foreign seaman, who, during a war, shall serve two years in any man of war, merchantman, or privateer, is naturalized *ipso facto*. About the middle of king William's reign, a scheme was set on foot for a register of seamen to the number of 30,000, for a constant and regular supply of the king's fleet; with great privileges to the registered men, and, on the other hand, heavy penalties in case of their non-appearance when called for: but this registry, being judged to be rather a badge of slavery, was abolished by stat. 9 Ann. c. 21.

2. The method of ordering seamen in the royal fleet, and keeping up a regular discipline there, is directed by certain express rules, articles, and orders, first enacted by the authority of parliament soon after the Restoration; but since new-modelled and altered after the peace of Aix-la-Chapelle, to remedy some defects which were of fatal consequence in conducting the preceding war. In these articles of the navy almost every possible offence is set down, and the punishment thereof annexed: in which respect the seamen have much the advantage over their brethren in the land-service; whose articles of war are not enacted by parliament, but framed from time to time at the pleasure of the crown. Yet from whence this distinction arose, and why the executive power, which is limited so properly with regard to the navy, should be so extensive with regard to the army, it is hard to assign a reason; unless it proceeded from the perpetual establishment of the navy, which rendered a permanent law for their regulation expedient, and the temporary duration of the army, which subsisted only from year to year, and might therefore with less danger be subjected to discretionary government. But whatever was apprehended at the first formation of the mutiny act, the regular renewal of our standing force at the entrance of every year has made this distinction idle. For, if from experience past, we may judge of future events, the army is now

lastingly ingrafted into the British constitution; with this singularly fortunate circumstance, that any branch of the legislature may annually put an end to its legal existence, by refusing to concur in its continuance.

SECT. II. NAVAL TACTICS.

Naval tactics is a science which teaches that arrangement or order, in which a fleet of ships of war are disposed to engage an enemy.

The disposition, which is the best calculated for the operations of naval war, is formed by drawing up the ships in a long file or right-line, prolonged from the keel of the hindmost to that of the foremost, and passing longitudinally through the keels of all the others from the van to the rear, so that they are, according to the sea phrase, in the wake of each other. In this line or order of battle, all the ships of which it is composed are close hauled upon the starboard or larboard tack, about 50 fathoms distant from each other.

A fleet is more particularly drawn up in the line, when in presence of an enemy. It ought to be formed in such a manner as that the ships should mutually sustain and reinforce each other, and yet preserve a sufficient space in their stations to work or direct their movements with facility, during the action. Thus they will be enabled effectually to cannonade the enemy without incommoding the ships of their own squadron.

The line close hauled is peculiarly chosen as the order of battle, because if the fleet which is to windward were arranged in any other line, the enemy might soon gain the weather-gage of it; and even if he thinks it expedient to decline that advantage, it will yet be in his power to determine the distance between the adverse fleet in an engagement, and to compel the other to action. The fleet to leeward being in a line close hauled, parallel to the enemy, can more readily avail itself of the change of the wind, or of the neglect of its adversary, by which it may, by a dextrous management, get to windward of him: or should he fail in his attempt, he will nevertheless be enabled, by the favourable state of the wind, to avoid coming to action if the enemy is greatly superior, or to prevent him from escaping if he should attempt it.

Besides these advantages, this order of battle is singularly convenient and proper in other respects. The sails of each ship are disposed in such a manner as to counteract each other, so that the ships in general neither advance nor retreat during the action. By this circumstance they are enabled to retain their stations with greater stability, and to prosecute the battle with vigour and resolution, yet without perplexity or disorder. The uniformity of the line will be preserved, so that the Admiral's orders may be readily communicated by signals from the van to the rear. The distress of any particular ship that is disabled, and rendered incapable to continue the action, will be presently discovered, and her place accordingly supplied by one of the ships in reserve. The circumstances and situation of the enemy's line will be ever open to the view of the commander in chief, so that he may be enabled to convert any disaster that may happen therein to his own advantage.

It may be alleged, indeed, that the same reasons hold good with regard to the enemy, to whom this arrangement will be equally beneficial. It may also be observed, that particular occasions have rendered it necessary to break the order of the line, and that sometimes this expedient has been practised with equal judgment and success. To the first of these allegations it may be answered that in war, as well as in politics, there are certain general rules absolutely necessary to be observed by the hostile powers; rules which are founded on mutual convenience, and authorized by the invariable example of all ages. Whatever tends to facilitate the designs of the adverse parties on each other, or whatever operates to shorten the period of war, and render it less destructive and fatal, are objects which ought never to be disregarded. Disorder has not only a tendency to protract the war, but to make it more bloody and ruinous, and to aggravate all the calamities with which it is inseparably attended.

The incessant fire of so large an assembly of ships, in a very short time covers the scene of action with a cloud of smoke, which is constantly accumulating. The winds that enable the two fleets to approach each other are soon become extremely feeble, or perhaps perfectly lulled, by the explosions of a vigorous cannonade. They are of course incapable any longer to dissipate the smoke, which then darkens the air, and is almost impenetrable to the eye.

If in this situation the hostile ships are promiscuously scattered, the whole will be inevitably exposed to distraction. Not only is the most comprehensive skill of the commander in chief rendered useless; the smaller ships, abandoned to their ill fortune, may be torn to pieces by superior force, without relief or succour. And, what is infinitely worse than all, the ships of the same fleet may cannonade each other, with all the resolution and spirit which they exert against their enemies. If the design of war is conquest and not massacre, it is thus totally perverted. The battle, instead of being brought to a speedy issue, and decided by a victory and defeat, is unhappily protracted into a scene of slaughter and ruin, equally fatal to both parties.

If then disorder and confusion are fraught with such dangerous consequences in a naval armament, it is no less certain, that the principal sinews of its strength are discipline, regularity, vigilance, and activity. If the ships are farther apart than those of the enemy's line, many single ships will suffer the fire of two at once. Hence the fleet is rendered inferior to that of the enemy at the

NAVAL AFFAIRS.

onset of battle; a circumstance which evinces the superiority of larger ships accompanied with weightier metal. The enemy is defeated by the efforts of a more numerous and more powerful artillery.

Besides these advantages, the larger ships are in other respects highly preferable in a line of battle; they overlook those of an inferior rate, which are accordingly laid open to the fire of their musquetry. In a high sea they can more safely employ the artillery of their lower deck than a smaller ship, and if both are obliged to shut their lower deck ports, the advantage of the three decked ships, with regard to their cannon, will yet be considerable. They have three tiers against two, and two against one; the same superiority subsists in case they are dismasted, or when the upper deck is incumbered with the ruins.

The large ships, being higher between decks, are less incommoded with the smoke, and their cannon are managed with greater facility. The large ships having greater solidity of frame, are better calculated to resist the effects of battle and tempest. In general also they sail better than the small ones, except in fine weather; for in a fresh wind, when the sea becomes agitated, they have always a superiority. The fire-ships do not succeed so well against large ships as the smaller ones; the artillery will sink them, or oblige them sooner to relinquish their design, and they are easily towed away by the great long-boats. The line of a fleet which has abundance of capital ships, need not be so much inclosed as that of an enemy who has fewer. The former may be also less numerous without being weaker.

An open line will, on many occasions, work more easily than one which is more inclosed; and, if it is less numerous, the movements thereof are more expeditious, the signals better attended, the general order more exactly preserved, and the ships less liable to be separated. Hence it will be less embarrassed by a change of wind, and the order will be soon reestablished. A less numerous line will more readily approach or escape from an enemy or hostile shore; and, finally, when cruising in a smaller space, it will not be so much contracted. From the preceding reflections, it results, that the line which contains more capital ships will be stronger than one more numerous if composed of smaller ships. This reflection, however, does not exclude a certain number of the third and fourth rates, which is necessary in the naval armaments.

We have already pointed out the advantages of a weather line; but here we must observe that it has, nevertheless, its defects, which sometimes counterbalance the advantages above recited. If the sea is rough and the wind boisterous, it cannot readily fight with the lower-deck battery: it cannot decline the action without the dangerous expedient of forcing through the enemy's line; and, if it keeps the wind, the lee-line may inclose and totally destroy it, especially if it is inferior in number to the latter, or if the ships thereof are in a bad condition; for it then can find no other resource but in the dexterity of its manœuvres, unless it is favoured by wind or any oversight of the enemy. The disabled ships of the weather-line must tack to avoid falling into the enemy's fleet; and if they are much shattered, they may be altogether separated from their own fleet, particularly if they are in the rear of the line.

The line to leeward has also its advantages, which have occasionally been preferred to those of the weather-line. The ships of the former may use the guns of their lower decks without the hazard of taking in much water at the ports in stormy weather; whereas the line to windward dare not open them without the greatest danger. If the lee-line, although more numerous, cannot so easily double upon the van and rear of the enemy, and inclose them between two fires, it may nevertheless have opportunities of tacking, and cutting off part of the enemy's rear, by obliging them to bear away, or separate from the rest. The disabled ships to leeward are much more readily removed from the line than those to windward: without being obliged to tack and continue exposed to the enemy's fire, they bear away and remain at a competent distance from the fleet in a state of safety; finally, the lee-line can with more facility avoid the action than its adversary, a circumstance which is extremely favourable to an inferior squadron.

The defects of the lee-line, on the contrary, are, that it cannot decide the time and distance of the battle, which may commence before it is sufficiently formed, and it will perhaps be attacked by an enemy, who bears away upon it in regular order. The fire and smoke of the weather-line are a great inconvenience to it, and it cannot easily break the enemy's line with its fire-ships, which are very slowly and with great difficulty conveyed to windward.

It must be remarked, that the admiral's ship attentively preserves her station in the centre of the line; for if the commander in chief should give way to the caprice or inattention of any of those under his direction it would introduce an endless disorder into the squadron. In an engagement, the ships are generally brought to with the main top-sails laid back, and their fore top-sails full, for the purpose of bearing away more readily when occasion requires. The line is said to be formed a-breast when the ships sides are all parallel to each other in a line which crosses their keels at right-angles. This is more frequently used in pursuing or retreating, with the wind right-aft, so that the line forms a perpendicular with the direction of the wind.

SECT. III. MANNER OF A NAVAL ENGAGEMENT.

Having shewn how to form the line, the next thing necessary to be known is the manner of an engagement at sea, which consists in the preparation, the action, and the repair or refitting for the purpose of navigation.

The preparation is begun by issuing the order to clear the ship for action, which is repeated by the boatswain and his mates at all the hatchways, or staircases, leading to the different batteries. As the management of the artillery in a vessel of war requires a considerable number of men, it is evident that the officers and sailors must be restrained to a narrow space in their usual habitations, in order to preserve the internal regularity of the ship. Hence the hammocks, or hanging beds, to the latter, are crowded together as close as possible between the decks, each of them being limited to the breadth of fourteen inches. They are hung parallel to each other in rows, stretching from one side of the ship to the other; as the cannon therefore cannot be worked while the hammocks are suspended in this situation, it becomes necessary to move them as quick as possible. By this circumstance a double advantage is obtained: the batteries of cannon are immediately cleared of an encumbrance, and the hammocks are converted into a sort of parapet, to prevent the execution of small shot on the quarter-deck, tops, and forecastle. At the summons of the boatswain, "Up all hammocks," every sailor repairs to his own, and, having folded his bedding properly, he cords it up firmly with a lashing, or line, provided for that purpose. He then carries it to the quarter-deck, poop, or forecastle, or wherever it may be necessary. As each side of the quarter-deck and poop is furnished with a network, supported by iron cranes, fixed immediately above the gunwale, or top of the ship's side, the hammocks, thus corded, are firmly slowed by the quarter-master between the two parts of the netting, so as to form an excellent barrier; the tops, waist, or forecastle, are then fenced in the same manner.

While these offices are performed below, the boatswain and his mates are employed in securing the sail-yards, to prevent them from tumbling down when the ship is cannonaded, as the might thereby be disabled, and rendered incapable of attack, retreat, or pursuit. The yards are now likewise secured by strong chains, or ropes, additional to those by which they are usually suspended. The boatswain also provides the necessary materials to repair the rigging wherever it may be damaged by the shot of an enemy, and to supply whatever parts of it may be entirely destroyed. The carpenter and his crew, in the mean while, prepare his shot plugs and mauls to close up any dangerous breach that may be made near the surface of the water, and provide the iron-work necessary to refit the chain pumps, in case their machinery should be wounded in the engagement.

The gunner, with his mate and quarter-gunner, is busied in examining the cannon of the different batteries, to see that their charges are thoroughly dry and fit for execution, to have every thing ready for furnishing the great guns and small arms with powder as soon as the action begins, and to keep a sufficient number of cartridges continually filled to supply the place of those expended in battle. The master and his mates are attentive to have the sails properly trimmed according to the situation of the ship, and to reduce or multiply them, as occasion requires, with all possible expedition. The lieutenant visits the different decks to see that they are effectually cleared of all encumbrance, so that nothing may retard the execution of the artillery, and to enjoin other officers to diligence and alertness in making the necessary disposition of the expected engagement, so that every thing may be in readiness at a moment's warning.

When the hostile ships have approached each other, to a competent distance, the drums beat to arms, the boatswain and his mates pipe all hands to quarters, at every hatchway. All the persons appointed to manage the great guns immediately repair to their respective stations; the crews, handspikes, rammers, sponges, powder-horns, matches, and turn-tackles, are placed in order by the side of every cannon: the hatches are immediately laid, to prevent any one from deserting his post by escaping into the lower apartments: the marines are drawn up in rank and file on the quarter-deck, poop, and forecastle: the lashing of the great guns are cast loose, and the tompions withdrawn: the whole artillery, above and below, is run out at the ports, and levelled to the point-blank range ready for firing. The necessary preparations being completed, and the officers and crew ready at their respective stations to obey the order; the commencement of the action is determined by the mutual distance and situation of the adverse ships, or by the signal of the commander in chief of the fleet or squadron. The cannon being levelled in parallel rows, projecting from the ship's side, the most natural order of battle is evidently to range the ships a-breast of each other, especially if the engagement be general. The most convenient distance is properly within the point of a blank range of a musket, so that all the artillery may do effectual execution.

The combat usually begins by a vigorous cannonade, accompanied with the whole efforts of the swivel-guns and the small arms. The method of firing in the platoons, or volleys of cannon at once, appears inconvenient in the sea-service, and perhaps should never be attempted unless in the battering of a fortification. The sides and deck of the ship, although sufficiently strong for all the purposes

ry to
sists
the

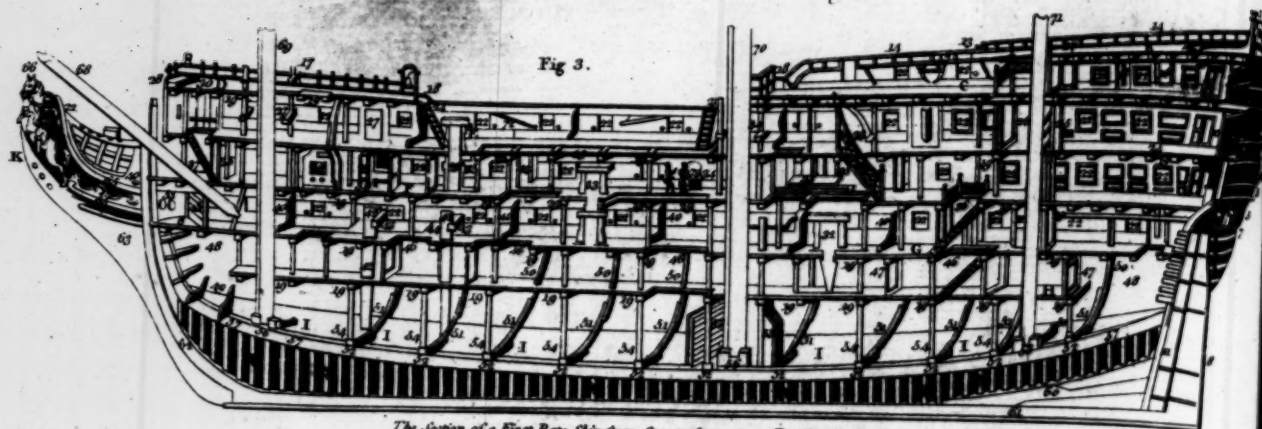
ship
at all
eries.
res a
and
bata-
ence
ether
nited
each
r; as
as are
em as
is ob-
m en-
of pa-
deck,
Up all
towod
g, or
atter.
As
a net-
gun-
firmly
etting,
calle,

and his
them
might
eat, or
chains,
ended.
pair the
ay, and
The
e plugs
e made
necef-
ould be

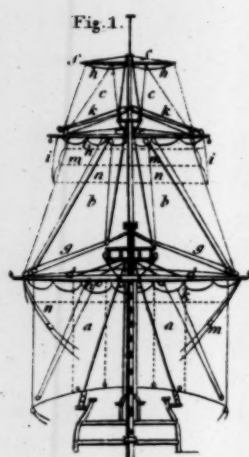
in ex-
at their
e every
th pow-
mber of
xpendd
the sails
nd to re-
sible ex-
see that
nothing
in other
ry dispo-
ay be in

a compe-
his mates
e persons
to their
ges, pow-
er by the
o prevent
wer apart-
e quarter-
ns are call
above and
lank range
pleted, and
to obey the
ed by the
the signal
he cannon
's side, the
aps a-bread
The most
lank range
ecution.
de, accom-
d the small
of cannon
haps should
ution. The
for all the
purposes

*External and Internal Views of a first rate Ship of War.
See Treatise on Naval Affairs.*



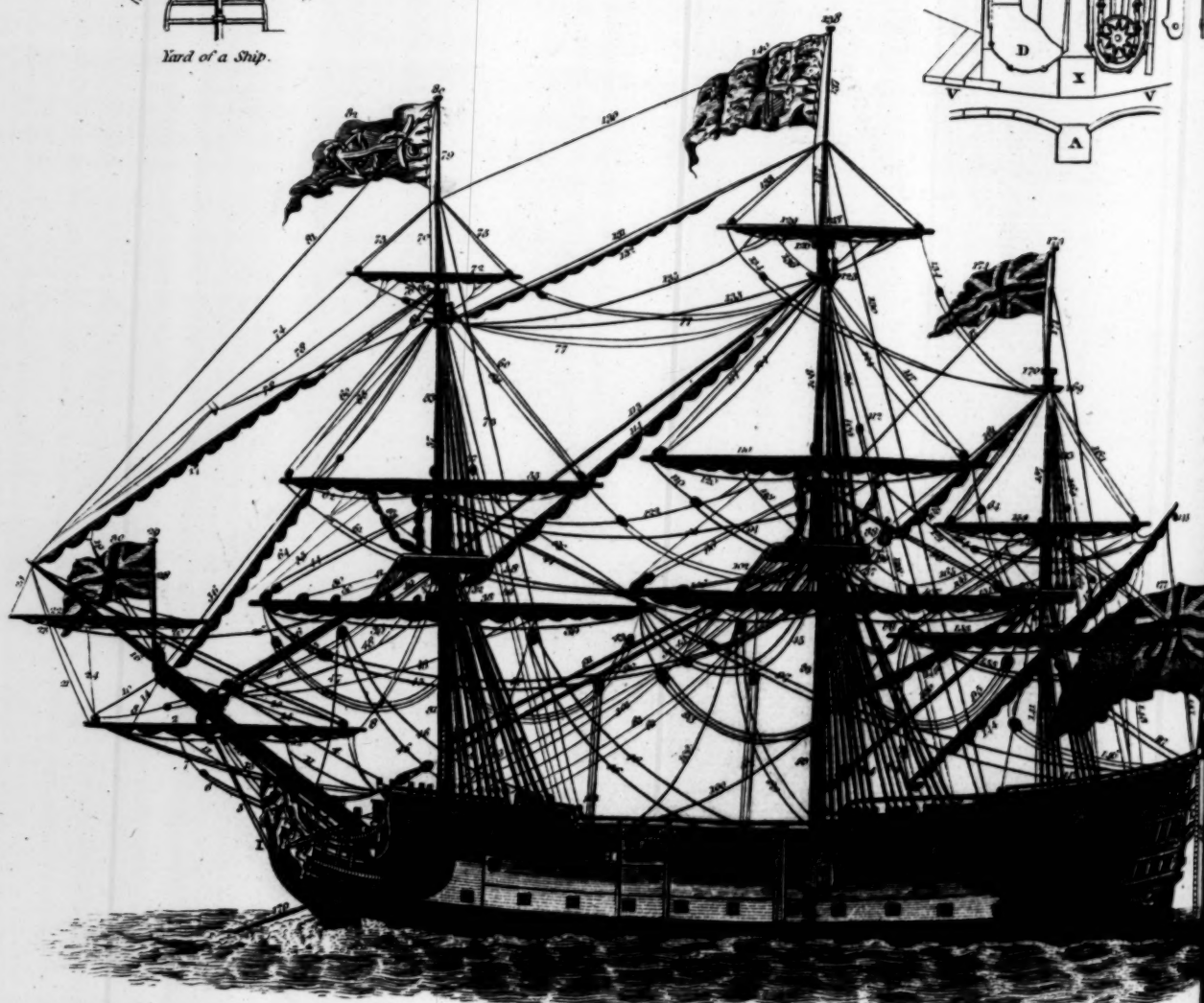
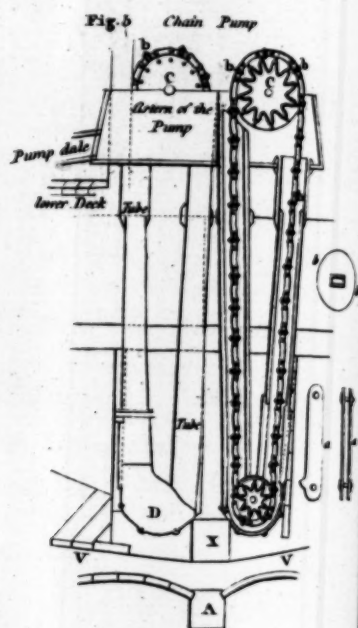
The Section of a First Rate Ship, from Stem to Stern, at one Place discovering the Decks, Guns, Cabins &c.



Yard of a Ship.



Fig. 2. Ship with the Sails set



A First Rate Ship of War with Rigging &c. at Anchor. Fig. 4.

Engraved by W. M. L. Engraving, & Printed by C. Cooke, 17, Paternoster Row.

NAVAL AFFAIRS.

purposes of war, would be too much shaken by so violent an explosion and recoil. The general rule observed on this occasion, throughout the ship, is to load, fire, and sponge the guns with all possible expedition, yet without confusion or precipitation. The captain of each gun is particularly enjoined to fire only when the piece is properly directed to its object, that the shot may not be fruitlessly expended. The lieutenants, who command the different batteries, traverse the decks to see that the battle is prosecuted with vivacity, and to exhort and animate the men to their duty. The midshipmen second the injunctions, and give the necessary assistance, wherever it may be required, at the guns committed to their charge. The gunner should be particularly attentive that all the artillery is sufficiently supplied with powder, and that the cartridges are carefully conveyed along the deck in covered boxes.

The havoc produced by the continuation of this mutual assault may be conjectured by the reader's imagination: battering, penetrating, and splintering the sides and decks, shattering or dismounting the cannon, mangling or destroying the rigging, cutting alunder, or carrying away the masts and yards, piercing and tearing the sails, so as to render them useless, and wounding, disabling, or killing the ship's company. The comparative vigour and resolution of assailants to effect these pernicious consequences in each other, generally determine their success or defeat. We say generally; because the fate of the combat may sometimes be decided by an unforeseen incident. The defeated ship having acknowledged the victory by striking her colours, is immediately taken possession of by the conqueror, who secures her officers and crew as prisoners in his own ship, and invests his principal officers with the temporary command of the prize.

The engagement being concluded, they begin the repair; the cannon are secured by their breechings and tackles with all convenient expedition. Whatever sails have been rendered unserviceable are unbent, and the wounded masts and yards struck upon the deck, and fitted or replaced by others. The standing rigging is knotted, and the running rigging spliced, wherever necessary. Proper sails are bent in the room of those which have been displaced as useless. The carpenter and his crew are employed in repairing the breaches made in the ship's hull by shot-plugs, pieces of plank, and sheet lead. The gunner and his assistants are busied in replenishing the allotted number of charged cartridges to supply the space of those which have been expended, and in refitting whatever furniture of the cannon may have been damaged by the late action. Such is the usual process and consequences of an engagement between two ships of war, which may be considered as an epitome of a general battle between a fleet or squadron. The latter, however, involves a greater variety of incidents, and necessarily requires more comprehensive skill and judgment in the commanding officer.

The stratagem of boarding is chiefly practised by privateers upon merchant-ships, who are not so well provided with men, and rarely attempted in the royal navy; the battle being generally decided in men of war, by the vigorous execution of a close cannonade. An officer should maturely consider the danger of boarding a ship of war, before he attempts it, and be well assured that his adversary is weakly manned; for perhaps he wishes to be boarded, and if so, a great slaughter will necessarily follow. The swell of the sea ought also to be considered; because it may run so high as to expose both the ships to the danger of sinking. There is, perhaps, very little prudence in boarding a ship of equal force, and when it is attempted it may be either to windward or to leeward, according to the comparative force or situation of the ships; if there be any swell or sea it may be more advisable to lay the enemy aboard on the lee-side, as the water is there the smoothest; besides, if the boarder is repulsed, in that situation he may more easily withdraw his men, and stand off from his adversary; but as the weather-ship can generally fall to leeward at any time, it is perhaps more eligible to keep to windward, by which she will be enabled to rake her antagonists, and fire the broadside into her stern, as she crosses it in passing to leeward, which will do great execution amongst her men, by scouring the whole length of her deck.

Boarding may be performed in different places of the ship, according to the circumstances, preparation, and position of both the assailants, having previously selected a number of men armed with pistols and cutlasses, a number of powder-flakes or flasks, charged with gunpowder, and fitted with a fuse, are also provided to be thrown upon the enemy's deck, immediately before the assault. Besides this, the boarder is generally furnished with an earthen swell, called a stink-pot, which, on that occasion, is suspended from his yard-arms or bowsprit-end. The machine is also charged with powder mixed with other inflammable and suffocating materials, with a lighted fuse at the aperture. Thus prepared for the action, and having gaped his adversary, the boarder displays his signal to begin the assault; the fuses of the stink-pot and powder-flasks being lighted, they are immediately thrown upon the deck of the enemy, where they burst and catch fire, producing an intolerable stench and smoke, and filling the deck with tumult and distraction; amidst the confusion occasioned by this infernal apparatus, the detachment provided rush aboard sword in hand, under cover of this smoke, on their antagonist, who is in the same predicament with a citadel stormed by the besiegers, and generally overpowered, unless he is furnished with extraordinary

means of defence; or equipped with close quarters, to which he can retreat with some probability of safety.

Close-quarters are strong barriers of wood, stretching across a merchant-ship in several places. They are used as a place of retreat when a ship is boarded by her adversary, and are therefore fitted with several small loop-holes, through which to fire the small arms, whereby the ship's crew may defend themselves and annoy the enemy. They are likewise furnished with several small caissons, called powder-chests, which are fixed upon the deck, and filled with powder, old nails, &c. and may be fired at any time from the close quarters upon the boarders.

SECT. IV. CONSTRUCTION OF SHIPS.

All edifices, whether civil or military, are erected in consequence of certain established plans, which have been previously altered or improved till they have arrived at the desired point of perfection. The construction of ships appears also to require at least as much correctness and precision as the buildings which are founded upon *terra firma*. A modern ship is undoubtedly the noblest machine that ever was invented, and consists of so many parts that it would require a whole volume to describe it minutely. And as the several pieces of timber of which the fabric is composed, with their assemblage and union, would be uninteresting to the generality of our readers; we have therefore, to give a collective view of a first-rate ship, exhibited a representation of one of those floating citadels, with all her masts, yards, and rigging erect, and the several sails furled to their yards and flays. We have also given a section of a first-rate, shewing the interior parts. To the representation we have also annexed the following explanations.

SECTION OF THE INTERNAL PARTS OF A FIRST-RATE SHIP, FROM STEM TO STERN. See the Plate annexed.

The principal parts are distinguished by A, the stern abait. B, the poop. C, the quarter-peak. D, the fore-castle. E, the upper-deck. F, the middle-deck. G, the gun-deck. H, the orlop. I, the hold. K, the head.

All particulars in either of these parts are distinguished by numbers, 1, 2, 3, &c. against which there is placed the letter of the alphabet which refers to the principal part or parts where that particular is to be found, viz. 1, The taffarel. 2, The upper lights and balcony. 3, The lower lights and balcony. 4, The ward room lights. 5, The counter. 6, The transoms. 7, The fashion-pieces. 8, The rudder. 9, The tiller. 10, Timbers of the stern, head, &c. 11, The stern-post. 12, Rails. 13, Brackets. 14, The file rails on one side. 15, The companion. 16, Cabins for lieutenants, masters, and mates. 17, Timber-heads. 18, Hances or falls, on the ship's side. 19, Beams of the decks. 20, Bulk heads. 21, Gangway and stairs. 22, Ports. 23, Entrance into the gallery. 24, The state-room. 25, The bulk-head of the state-room. 26, Bulk-head of the coach. 27, Cabins for boatwain, carpenter, and mates. 28, Bulk-head, bulk-head. 29, Gratings. 30, Cats-tail. 31, Cook-room chimney. 32, Main-capsitan. 33, Jeer-capsitan. 34, Bits and cross pieces. 35, Standing cabins for midshipmen. 36, Flying and winding stairs. 37, Ladders. 38, Common table. 39, Cook-room and furnaces. 40, Standards to the side and head. 41, Cabins for gunner and mates. 42, Bit-pins. 43, Cross pieces for the cables. 44, Standards. 45, Manger. 46, Hatch-ways. 47, Partitions for steward and store-rooms. 48, Bread-room abait, powder-room afore. 49, Breast-hooks. 50, Upper futtock-ridders. 51, Lower futtocks. 52, Floor-riders. 53, Hawse-holes. 54, Upright-pillars. 55, Well-pump and shot lockers. 56, Steps for the masts. 57, The kelson. 58, The appearance of the floor-timbers cut. 59, Lower ends of the futtocks. 60, The rising or dead-wood. 61, The keel. 62, The stem. 63, Knee of the head. 64, The trail-boards. 65, Cheeks. 66, Figure. 67, Funnel for ease. 68, Bowsprit. 69, Foremast. 70, Mainmast. 71, Mizemast. 72, Pisdell. 73, Entering-port.

EXPLANATION OF A REPRESENTATION OF A FIRST-RATE SHIP OF WAR, LYING AT ANCHOR, WITH HER RIGGING, &c. See the Plate annexed.

Parts of the Hull. A, the cat-head; B, the fore-chains; C, the main-chains; D, the mizen-chains; E, the entering port; F, the hawse holes; G, the poop-lanterns; H, the chels-tree; I, the head; K, the stern.

L, The bowsprit. 1, 2, Yard and sail. 3, Gammoning. 4, Horse. 5, Bob-stay. 6, Sprit-sail-sheets. 7, Pendants. 8, Braces and pendants. 9, Halliards. 10, Lifts. 11, Clew-lines. 12, Sprit-sail-horses. 13, Bunt-lines. 14, Standing-lifts. 15, Sprit-sail-top. 16, Flying-jib-boom. 17, Flying-jib-stay and sail. 18, Halliards. 19, Sheets. 20, Horses.

M, The sprit-sail-top-mast. 21, Shrouds. 22, 23, Yard and sail. 24, Sheet. 25, Lifts. 26, Braces and pendants. 27, Cap. 28, Jack-staff. 29, Truck. 30, Jack-flag.

N, The fore-mast. 31, Runner and tackle. 32, 33, Shrouds. 34, Laniards. 35, Stay and laniard. 36, Preventer-stay and laniard. 37, Wooding the mast. 38, Yard and sail. 39, Horses. 40, Top. 41, Crow foot. 42, Jeers. 43, Yard-tackles. 44, Lifts. 45, Braces and pendants. 46, Sheets. 47, Fore-tacks. 48, Bow-lines and bridles. 49, Fore-bunt-lines. 50, Fore-leech-lines. 51, Fore-top-ropes. 52, Puttock shrouds.

O, The

NAVAL AFFAIRS.

O, The fore-top-mast. 53, 54, Shrouds and laniards. 55, Yard and fail. 56, Stay and fail. 57, Runner. 58, Back stays. 59, Halliards. 60, Lifts. 61, Braces and pendants. 62, Horfes. 63, Clew-lines. 64, Bow-lines and bridles. 65, Reef-tackles. 66, Sheets. 67, Bunt-lines. 68, Crofs-trees. 69, Cap.

P, The fore-top-gallant-mast. 70, 71, Shrouds and laniards. 72, Yard and fail. 73, Back stays. 74, Stay. 75, Lifts. 76, Clew-lines. 77, Braces and pendants. 78, Bow-lines and bridles. 79, Flag staff. 80, Truck. 81, Flag-staff stay. 82, Flag of lord high-admiral.

Q, The main-mast. 83, 84, Shrouds. 85, Laniards. 86, Runner and tackle. 87, Pendant of the gornet. 88, Guy of ditto. 89, Sail of ditto. 90, Stay. 91, Preventer-stay. 92, Stay tackle. 93, Woodding the mast. 94, Jeers. 95, Yard tackles. 96, Lifts. 97, Braces and pendants. 98, Horfes. 99, Sheets. 100, Tacks. 101, Bow-lines and bridles. 102, Crow-foot. 103, Top-rope. 104, Top. 105, Bunt-lines. 106, Leech-lines. 107, Yard and fail.

R, The main-top-mast. 108, 109, Shrouds and laniards. 110, Yard and fail. 111, Puttock shrouds. 112, Back stays. 113, Stay. 114, Stay fail and stay halliards. 115, Runnets. 116, Halliards. 117, Lifts. 118, Clew-lines. 119, Braces and pendants. 120, Horfes. 121, Sheets. 122, Bow-lines and bridles. 123, Bunt-lines. 124, Reef-tackles. 125, Crofs-trees. 126, Cap.

S, The main-top-gallant-mast. 127, 128, Shrouds and laniards. 129, Yard and fail. 130, Back-stays. 131, Stay. 132, Stay fail and halliards. 133, Lifts. 134, Braces and pendants. 135, Bow-lines and bridles. 136, Clew-lines. 137, Flag-staff. 138, Truck. 139, Flag-staff stay. 140, Flag standard.

T, The mizen-mast. 141, 142, Shrouds and laniards. 143, Pendants and burtons. 144, Yard and fail. 145, Crow-foot. 146, Sheet. 147, Pendant-lines. 148, Peck brails. 149, Stay-fail. 150, Stay. 151, Deric and span. 152, Top. 153, Crofs jack yard. 154, Crofs jack lifts. 155, Crofs jack braces. 156, Crofs jack slings.

V, The mizen-top-mast. 157, 158, Shrouds and laniards. 159, Yard and fail. 160, Back-stays. 161, Stay. 162, Halliards. 163, Lifts. 164, Braces and pendants. 165, Bow-lines and bridles. 166, Sheets. 167, Clew-lines. 168, Stay-fail. 169, Crofs-trees. 170, Cap. 171, Flag-staff. 172, Flag-staff-stay. 173, Truck. 174, Flag-union. 175, Ensign-staff. 176, Truck. 177, Ensign. 178, Poop ladder. 179, Bower cable.

Description of a naval chain-pump, a well known machine, used to discharge the water from the ship's bottom into the sea, whose lower end rests upon the ship's bottom, between the timbers, in an apartment called the *well*, inclosed for this purpose near the middle of the ship's length.

Considerable improvements have been made on the naval chain-pump, by Mr. Cole, under the direction of Captain Bentinck. The chain of this machine is more simple and mechanical, and much less exposed to damage. It is exactly similar to that of the fire-engine; and appears to have been first applied to the pump by Mr. Mylne, to exhaust the water from the caissons at Blackfriar's-bridge. It has thence been transferred to the marine by Captain Bentinck, after having received some material additions to answer that service. The principal superiority of this pump to the old one is, 1. That the chain is more simple and more easily worked, and of course less exposed to injuries by friction. 2. That the chain is secured upon the wheel, and thereby prevented from jerking back when charged with a column of water. 3. That it may be easily taken up and repaired when broken or choked with ballast, &c. 4. That it discharges a much greater quantity of water with an inferior number of men.

In this figure a section of this machine at large is exhibited, as fixed in a frigate of war, wherein A is the keel, V the floor-timbers, X the kelson, *a a a* the several links of the chain, *b b* the valves, C the upper wheels, D the lower wheels, *c c* the cavities upon the surface of the wheels to receive the valves as they pass round thereon, and *d d* the bolts fixed across the surface of the wheels to fall in the interval between every two links, to prevent the chain from sliding back.

The links of the chain, which are no other than two long plates of iron with a hole at each end, and fixed together by two bolts serving as axles, are represented on a larger scale, *a a*. The valves are two circular plates of iron with a piece of leather between them; these are also exhibited at large, by *b b*.

Having thus exhibited a view of a first-rate ship of war, with the sails furled to the respective yards, stays, &c. we shall proceed to a description of the sails, masts, and yards, with their respective names and uses, as illustrated by representations in Fig. 1 and 2, which last figure represents a ship with three masts in full sail.

All *sails* derive their name from the mast, yard, or stay, upon which they are extended. Thus the principal *sail* extended upon the main-mast is called the main-sail, *d*, fig. 2, the next above, which stands upon the main-top-mast, is termed the main-top-sail, *e*; and the highest, which is spread across the main-top-gallant-mast, is named the main-top-gallant-sail, *b*. In the same manner there is the fore-sail, *g*; the fore-top-sail, *h*; and the fore-top-gallant-sail, *i*; the mizen *k*; the mizen-top-sail, *l*; and mizen-top-gallant-sail, *m*. Thus also there is the main-stay-sail, *o*; main-top-mast-stay-sail, *p*; and main-top-gallant-stay-sail, *q*; with a

middle-stay-sail, which stands between the two last. All these stay-sails are between the main and fore masts. The stay-sails, between the main-mast and mizen-mast are the mizen-stay-sail, and the mizen-top-mast-stay-sail, and sometimes a mizen-top-gallant-stay-sail above the latter. The stay-sails between the fore-mast and bowsprit are the fore-stay-sail, *t*; the fore-top-mast-stay-sail, and the jib, *x*. There are, besides, two square sails extended by yards under the bowsprit, one of which is called the sprit-sail, *y*, and the other the sprit-sail-top-sail, *z*.

The studding-sails, being extended upon the different yards of the main-mast and fore-mast, are likewise named according to their stations, the lower, top-mast, or top-gallant-studding-sails. The ropes by which the lower yards of a ship are hoisted up to their proper height are called the *JEARS*. In all other sails the ropes employed for this purpose are called *HALLIARDS*. The principal sails are expanded by halliards, sheets, and bow-lines, except the courses, which are always stretched out below by a tack and sheet. They are drawn up together or trussed up, by bunt-lines, clue-lines *d d*, fig. 2. leech-lines, *ee*; reel-tackles, *ff*; slab-line, *gg*; and spilling-lines. The bunt-lines and leech-lines, which pass on the other side of the sail, are expressed by dotted lines in the figure. The courses, top-sails, and top-gallant-sails, are wheeled about the mast, so as to suit the various directions of the wind, by braces. The higher studding-sails, and in general all the stay-sails, are drawn down, so as to be furled or taken in by down-hauls.

The principal sails of a ship are the courses, or lower sails, *a, a*, in fig. 2, the top-sails, *b*, which are next in order above the courses, and the top-gallant-sails, *c*, which are expanded above the top-sails. The courses are the main-sail, fore-sail, and mizen-main-stay-sail, fore-stay-sail, and mizen-stay-sail; but more particularly the three first. The main-stay-sail is rarely used, except in small vessels.

In all quadrangular sails the upper edge is called the head; the sides or skirts are called leeches; and the bottom or lower edge is called the foot. If the head is parallel to the foot, the two lower corners are denominated clues, and the upper corners earings.

In all triangular sails, and in those four-sided sails, wherein the head is not parallel to the foot, the foremost corner at the foot is called the tack, and the after lower-corner the clue; the foremost perpendicular or sloping edge is called the fore-leech, and the hindmost the after-leech. The heads of all four-sided sails, and the fore-leeches of lateen sails, are attached to their respective yard or gaff by a number of small cords called robands; and the extremities are tied to the yard-arms, or to the peck of the gaff, by earings. The stay-sails are extended upon stays between the masts, on which they are drawn up or down occasionally, as a curtain slides upon its rod, and their lower parts are stretched out by a tack and sheet. The clues of a top-sail are drawn out to the extremities of the lower yard by two large ropes called the top-sail-sheets; and the clues of the top-gallant-sails are in like manner extended upon the top-sail-yard-arms, as exhibited in the figure. The studding-sails are set beyond the leeches or skirts of the main-sail and fore-sail, or of the top-sails, or top-gallant-sails of a ship, their upper and lower edges are accordingly extended by poles, run out beyond the extremities of the yards for this purpose. Those sails, however, are only set in favourable winds and moderate weather.

Yards of a ship are long pieces of timber, tapering at each end, fitted across the several masts, to carry the sails, and extend them to the wind. The sails are fastened to the yards at the heads; so as to be hoisted up, and let down together with them, by ropes, called halliards. The main-yard is that of the main-mast. The mizen-yard, the bolt-sprit-yard, &c. are those of the mizen, &c. See the ship at anchor, *n. 2. 20. 37. 44. 67. 86. 93. 109. 126. 138.*

All yards are either square or lateen; the former of which are suspended across the mast at right-angles, and the latter obliquely. The square-yards, Fig. 2, are nearly of a cylindrical surface; they taper from the middle, which is called the *slings*, towards the extremities, which are termed the *yard-arms*; and the distance between the slings and the yard-arms on each side is divided, by the artificers, into quarters, which are distinguished into the first second, third, quarters, and yard-arms. The middle quarters are formed into eight squares, and each of the end-parts is figured like the frustum of a cone. All the yards of a ship are square, except that of the mizen.

The lifts of the main-yard are exhibited by *g*; in fig. 2. the horfes and their stirrups by *h, i*; the reef-tackles, and their pendants, by *k, l*; and the braces, and brace-pendants, by *m, n*.

The lateen-yards evidently derive their names, from having been peculiar to the ancient Romans. They are usually composed of several pieces, fastened together by wooddings, which also serve as steps, whereby the sailors climb to the peck, or upper extremity, in order to furl or cast loose the sail. The mizen-yard of a ship, and the main-yard of a bilander, are hung obliquely on the mast, almost in the same manner as the lateen-yard of a xebec, fetter, or polacre.

We desire to acknowledge with gratitude the assistance we have received in the early part of the subject from an ingenious correspondent, under the signature of NAUTICUS; we have not treated on Naval Architecture, as it would go far beyond our bounds, and prove very uninteresting to our readers; but those who wish to consult this department of naval affairs are referred to Falconer's Marine Dictionary, quarto.

these
sails,
sail,
top-
fore-
stay-
ended
sail,

yards
ing to
sails.
up to
is the
prin-
cept
and
lines,
line,
pals
n the
celed
by
sails,
s.

a, as
rles,
sails.
sail,
three
s.

the
ge is
wer
s.

the
ot is
nost
nd-
the
d or
ities
The
hey
rod,
The
wer
ues
op-
are
or
wer
ex-
ver,

nd,
nem
fo
pes,
the
&c.
8.

are
ely.
ce;
ards
dil-
vid-
into
dale
arts
are

the
ben-
een
d of
e as
r, in
and
nost
re.
ave
cor-
not
our
hose
red



A New and Complete
CHART
of the
WORLD;
Displaying the Tracks of
CAPT. COOK,
and other Modern
NAVIGATORS.



EXPLANATION.
Red line shows track in 1770 & 1771
Blue line shows track in 1772 & 1773
Green line shows track in 1774 & 1775
Black line shows track in 1776 & 1777

SYSTEM OF NAVIGATION.

PART I.

INTRODUCTORY PRINCIPLES OF NAVIGATION.

NAVIGATION is the art of conducting a ship through the ocean to some distant port; and is either *mechanical* or *theoretical*.

Mechanical Navigation comprehends the art of working a ship, so as to observe such course or direction as is assigned by the navigator, and more properly comes under the article *NAVY AFFAIRS*, to which I refer the reader, though it is almost impossible that it should be attained, otherwise than by actual practice and manual exercise at sea.

Theoretical Navigation comprehends those methods by which a navigator determines the latitude and longitude of a ship at sea, and what course or courses she must steer, so as to arrive safe at the intended port. This rests chiefly in computations founded on observations made on the sun, moon, and stars, and the course and distance which the ship has run: with the use of proper charts, &c. In this branch we shall lay down those methods which appear the best adapted to practice, and which are of the most general use; referring our more curious readers to that excellent and elaborate work, entitled, "*Elements of Navigation*," by J. Robertson, late librarian to the Royal Society, and master of the Royal Academy at Portsmouth.

SECT. I. DEFINITIONS.

1. *The Course* of any ship is the angle which the ship's way makes with the meridian.

2. *The Departure*, is the whole easting or westing which a ship continually makes, in passing from one meridian to another.

3. *Rhumb Line*, is the path that a ship describes during any one course. A rhumb line makes the same angle with all meridians; and therefore upon the globe it is a spiral line, which constantly approaches the pole, except in an east and west course, where it coincides with the parallel, and in a north and south course, which is upon the meridian.

4. *Lee-way* of a ship, is the angle which a ship's real course makes with her intended course, occasioned by contrary winds and a rough sea.

5. *Log-line*, is used to measure the distance the ship has run, and consists of a cord divided into several equal parts, called knots, each knot, or part, containing 46 or 47 feet. This line is fastened to a board about 7 inches long, called the log; to the other end of which is fixed as much lead as will cause it to swim upright in the water. In dividing the log-line, there must be allowed 12, 15, or 18 fathom of stray-line, according to the largeness of the ship, so that the log, when thrown overboard, may be out of the ship's wake, before they begin to count; and for the more readily discovering this point of commencement, there is usually fastened to it a piece of red rag. The log-line being thus prepared, it is wound about a reel which turns easily round, so that when hove overboard the line veers out as fast as the ship sails. When in the veering out of the line, the red rag comes to hand, a half minute glass, ready for that purpose, must be instantly turned; and when the glass has run out, the line must be stopped, and it must be noted how many knots are run off, for so many miles does the ship sail in an hour. In point of exactness, each knot should be about 50 feet; for in order that it may give the rate of the ship correct, it ought to be the same part of a nautical mile (or 60th part of a degree) that a half minute is of an hour, viz. 120th part; but it is found by experience that the log will drag a little after the ship, and so make the distance run out too little. Experience in a great measure must settle the point as to the distance of each knot; besides some useful glasses of 28 seconds, as half minute glasses, and so the length between each knot must be left on that account.

6. *The Mariner's Compass*, is an instrument used to point out the way which a ship goes, or is to go at sea. It consists of three parts, namely, the box, the card or fly, and the needle (see Fig. 2.) The box which contains the card and needle, is a circular brass plate, hung within a square wooden one, by two concentric rings, called jimbals, so fixed by cross centres to the two boxes, that the inner one or compass box shall retain an horizontal position in all motions of the ship. The card or fly, is a circle of stiff paper, representing the horizon, and is divided into 32 equal parts, each of which is called a rhumb or point of the compass. These points are all named according to their positions, and inserted quite round the compass. Thus, north, north by east, north east; north east by north; north east, &c. but instead of the words, the initial only of every word is placed (see Fig. 1, in the plate to this System). Also each point is divided into quarter points. The needle is a straight piece of steel, made magnetic, by being properly touched with a loadstone. Its property is to point with one end towards the North pole. This needle is fixed to the under side of the card, and in the centre is placed a conical socket, which is put upon an upright pointed pin fixed in the bottom of the box; so that the card hanging on the pin, turns with the needle, & follows its centre; that point which is over the north end of the needle (marked with a

flout-de-lis) always pointing as an index to the magnetic north. The top of the box is covered with a glass pane, that the motion of the card may not be disturbed by the wind. The compass box is to be so placed in the ship, that the middle section of the box, parallel to its sides, may be parallel to the middle section of the ship, along its keel. There are sea compasses somewhat differently constructed; but this before described, is according to the most common or usual form. Also, besides the common sea compass, there is another called the azimuth compass, which differs from the other only in this, that the circumference of the card or box is divided into degrees, and there is fitted to the box an index with two sights, which are upright pieces of brass placed diametrically opposite to each other, through which the sun, star, &c. is viewed at the time of observation. This compass is to take the bearing of any celestial object. Fig. 2 is a representation of an improved compass as fitted up in the box for use, which answers both the purposes of a common compass, and also of an azimuth compass. The card in this figure, from the point of view in which it is taken, not being clearly seen, we have introduced a more perfect representation thereof in Fig. 3.

7. *Variation of the Compass*, is an arch of the horizon, contained between the meridian of the place, and the magnetic meridian, or direction of the needle. If the needle point to the eastward of the true meridian, it is called *east variation*; if to the westward thereof, *west variation*. After the discovery of this property of the magnet, mariners and others many years used the compass without knowing that it in any degree deviated in its direction from the true north; and about the middle of the 16th century, so positive were some of this, that they treated with contempt the notion of its variation, which at that time began to be suspected. But careful observations soon discovered that in England and its neighbourhood the needle pointed to the eastward of the true north; and the quantity of this deviation being known, mariners became as well satisfied as if the compass had none, because, by making a constant allowance for the variation, the true course could be obtained. However, it was found from successive observations, that the variation was not a constant quantity, but that it gradually diminished, and at last, namely, about 1657, it was found at London, that the needle pointed due north; since which time it has been getting to the westward; and now the variation is about $22\frac{1}{2}$ deg. to the westward of the north. So that in any one place it may be suspected, that the variation has a kind of libratory motion traversing through the north to certain limits eastward and westward. But the settling of this point must be left to time.

8. *Log-board*. In the steerage or some convenient place in the ship, there generally hangs a black-table, called the log-board, divided into seven columns; in the first is written, with chalk, the hours of the day; in the second, the knots that the ship runs during half a minute, for determining the ship's rate; in the third, the fathoms; in the fourth, the courses steered by the compass; in the fifth, the winds; in the sixth the lee-way, or how far the ship is drove to the leeward of the course steered by the compass; and in the seventh, the transactions of the day.

9. *Log-book* is the book ruled like a log-board, in order to contain the daily copies of the remarks written on the log-board, which book is esteemed the only authentic record of a ship's transactions.

10. *A Sea Journal*, is a book in which are entered the most remarkable daily occurrences relating to the ship during her voyage outward and homeward. Some make one book serve both for Journal and Log-book.

11. *Ship's reckoning*, is that account by which it can be known at any time where the ship is, and on what course, or courses, she must steer to gain her port.

12. *Dead-reckoning*, is that account deduced from occurrences written on the log-board.

13. *Charts*, are maps of the sea, and sea coasts. When the degrees of latitude and longitude are made every where equal, such a chart is called a *plain chart*. If the meridians are drawn parallel, and the degrees thereon be made to increase towards the poles in proportion to the sines of the latitudes, that sort of chart is called a *Mercator's chart*. The former is on the supposition that the earth is a perfectly flat surface, and answers well enough for short distances, or the description of particular places. In the latter, though the meridians are also drawn parallel to one another, yet by lengthening the degrees of latitude in the above proportion, it gives the bearings of places, the same as they have upon the globe; by which also the longitude is truly determined, for the degrees of longitude on the globe decrease as the cosine of the latitude; and the degrees of latitude being here increased in that proportion, it causes the result of the calculations for the difference of longitude from plain triangles only, to be the same as would be deduced from spherical triangles. Hence the principles of those charts agree with those of the globe; and they are the best adapted for the purpose of mariners. *Gerrard Mercator*, a Fleming, was the first who published a chart somewhat similar, and from thence they are called *Mercator's charts*; but his chart was not in true proportion. Mr. Edward Wright, an Englishman, was the first who discovered the true principles of those charts; and the proper methods of calculation depending thereon. In justice therefore to his memory,

NAVIGATION.

the theory and art of calculation at least ought to be ascribed to him, as being the real inventor, even though the charts be called Mercator's, on account of his first making a chart in some degree similar, though erroneous, and without advancing any fixed principles.

14. *Meridional Distance*, is the distance in miles of any given place from the meridian of another place. This is counted in the parallel of latitude of the given place.

15. *Difference of Longitude*, is an arch of the equator, or the degrees contained, between the meridians of two given places.

16. *Meridional Parts*, are the several lengths on the meridian line reckoned from the equator to all latitudes, agreeably to the principles of the Mercator's chart, and digested in a table for use.

17. *Meridional Difference of Latitude* of two places, is the difference of the meridional parts answering to the latitudes of the places, when the latitudes are both north or both south. But if the latitudes are of contrary names, such difference is equal to the sum of those parts.

18. *Dip of the Horizon*, in taking observations of the sun, stars, &c. the observer's eye being raised above the level of the sea, he sees an horizon below the level of the true one, and consequently the instrument gives an altitude too great, when a fore observation is used, and too small when a back observation is used. This error is called the dip of the horizon: as it depends on the height of the eye above the water, corrections for different heights may be computed and put in order in manner of a table for use.

For definitions of other terms that occur in Navigation, see System of Astronomy.

SECT. II.

THE REQUISITES FOR A NAVIGATOR.

A navigator should be furnished with correct charts of all those parts that lie between the port sailed from, and the place the ship is bound to, so that by inspection thereof it may be discovered in any part of the voyage what course the ship ought to steer to gain the desired port; and in those charts, or in an index to them, there should also be inserted an account of the various rocks, shoals, and other obstructions that navigators have met with; as also of the soundings in different places, to the end that the mariner by those helps may be the better enabled to steer clear of danger. He should also have proper instruments for the taking of observations, such as the cross-staff, Davis's quadrant, but above all, that new improved quadrant, invented by Mr. John Hadley; and he should also be supplied with the Nautical Ephemerides, published under the direction of the board of longitude, and with the requisite tables to the Nautical Ephemeris; both of which are sold at Heather's in Leadenhall-street; moreover he should be provided with a good scale and case of instruments for the purpose of laying down the ship's course, and drawing the plans of coasts, harbours, &c. and with a good time-piece; adding to which, he should have a suitable knowledge of the theory of navigation, viz. the method of keeping a dead reckoning and of taking and managing observations, making all proper allowances; and these matters, it is presumed, he will find sufficiently handled in this brief Treatise, without purchasing any other book on the subject, and in the most clear and satisfactory manner.

SECT. III.

RULES AT SEA, FOR MAKING ALLOWANCES FOR LEE-WAY.

It seldom happens but a ship makes either more or less lee-way, and as the ship's *real course* differs from the course steered by so much as the lee-way amounts to, even were there no other irregularity, it is therefore necessary, in the first place, that the quantity of lee-way should be ascertained, in order that by means thereof the course steered may be corrected so as to get the true or real course of the ship.

The common allowances for lee-way are as under:

- 1st. When a ship is close hauled, has all her sails set, the water smooth, and a moderate gale of wind, she is then supposed to make little or no lee-way.
- 2d. An allowance of one point is generally made when it blows so fresh that the small sails are taken in.
- 3d. An allowance of two points, when the top-sails are close reefed.
- 4th. Two points and a half are allowed, when one top-sail must be handed.
- 5th. Three points and a half are allowed when both top-sails are to be taken in.
- 6th. When the fore course is handed, the allowance is 4 points.
- 7th. When trying under the main-sail only, 5 points are allowed.
- 8th. An allowance of 6 points is made, when both main and fore courses are taken in.
- 9th. When the ship tries a hull, or all her sails handed, then an allowance of 7 points is made.

But notwithstanding those common adopted rules, a great deal will still depend upon the judgment and experience of the mariner; for in all these cases a rougher sea and harder wind will increase the lee-way. Also regard must be had to the setting of

the water, as will be more particularly shewn hereafter; for that will increase or decrease the lee-way, according as it opposes or conspires with the motion of the ship.

Also differently constructed ships will make different lee-ways; and the same ship, according as she is in or out of repair, will make different lee-ways. Ships that draw most water make the least lee-way, and a ship out of her trim makes the most lee-way. The method that is most to be depended on for finding the lee-way in any ship is as follows: set the ship's wake by the compass, through which you will discover the angle between it and the keel, which is the lee-way; or if you are within sight of land, take the angle between the ship's keel and that point of land which always bears on the same point of the compass, and it will be the quantity of lee-way.

SECT. IV.

OF FINDING THE VARIATION OF THE COMPASS.

I have already explained what the variation of the compass is; and in order to allow for it readily, the mariner should be furnished with correct variation charts, or with a table of the variation for all those places on the globe where it has been truly ascertained. In places where the variation has not been determined, it may be found by means of the sun's amplitude or azimuth, as follows:

1. For finding it by the Amplitude.

RULE. Add the log secant of the latitude (abating radius) to the log-sine of the sun's (or star's) declination; and the sum will be the log-sine of the true amplitude, which is ever of the same name with the declination, whether North or South. Then find the sun's magnetic amplitude, thus: Having an azimuth compass, move the box about till the four cardinal points of the card coincide with the four lines in the side of the compass-box; then keeping the box steady, turn the index till the centre of the sun, at rising or setting (when this lower edge just touches the horizon) is seen through both the sights; so will the degrees between the north point of the compass, and the end of the index pointing to the sun, be the sun's magnetic amplitude. Then if the sun's true and magnetic amplitudes agree, there is no variation: but if they disagree, and are both of the same name, that is, both north or both south, their difference is the variation.— If when they disagree, the true and observed amplitudes be of different names, viz. one north and the other south, their sum is the variation; and to determine whether the variation is easterly or westerly, observe this rule, viz. Let the observer's face be turned to the sun, then if the true amplitude be to the right hand of the magnetic, the variation is easterly, but if to the left westerly.

EXAMPLE. Let the sun's declination be 21° N. the latitude $49^{\circ} 27'$, and the sun's magnetic amplitude at setting $111^{\circ} 30'$ N. required the variation?

To Logarithm sine 20°	9.55433
Add Logarithm Sect. $49^{\circ} 27'$	0.18701
abating Radius	
Gives Logarithm sine $33^{\circ} 27'$	9.74134
the true Amplitude North	
Then from true Amplitude West $33^{\circ} 27'$ North	
Take the Magnetic Amplitude West $111^{\circ} 30'$ North	
Remains the variation	21 57

Here both the true and magnetic amplitudes lying both to the north of the west point of the horizon, their difference gives the variation; and as the true amplitude (when the observer's face is turned towards the sun) is to the right hand of the magnetic amplitude, it denotes that the variation of the compass is so much easterly.

2. To find the Variation by the Sun's Azimuth.

RULE. Find the sun's true azimuth thus. Add the complement of the altitude, the complement of the latitude, and the sun's (or star's) polar distance into one sum, from half that sum subtract the polar distance, and note the half sum and remainder. Then add together the arithmetical complement of the log cosine of the latitude, the arithmetical complement of the log cosine of the altitude, the sine of the said half sum, and the sine of the said remainder into one sum, then half the sum of these four logarithms will give the cosine of half the true azimuth, and the double thereof is the true azimuth. And the magnetic azimuth must also be taken by the compass thus: set the box so that the four cardinal points of the card stand opposite to the four lines in the compass box, and hold the box in that position; moving the index till the sights being directed to the sun's (or star's) centre, the shadow of the string joining the sights is observed to fall directly along the middle of the index, then the degrees in the arch intercepted between the end of the index next the sun and the north point of the card will give the magnetic azimuth required. If the sun does not shine bright enough to give a strong shadow, look through one of the sights, and move the index till one of the strings cut the sun's (or star's) azimuth. Then if the true and observed azimuths be both on the east; or both on the west-side of the meridian, their difference is the variation; but if one of them be on the east, and the other on the west of the meridian, their sum is the

NAVIGATION.

the variation, and to know whether the variation be easterly or westerly, observe the same directions here, with respect to the azimuth, as were laid down in the preceding article respecting the amplitude.

When the azimuth is observed, the altitude of the object must be taken at the same time.

N. B. The sun's polar distance, is his distance from the nearest, or the elevated pole. When the latitude and declination are both north or both south, then the complement of the declination is the polar distance, but if the latitude and declination be one north and the other south, the declination added to 90° gives the polar distance.

EXAMPLE, suppose in lat. $26^\circ 30'$ N. the sun's altitude in the forenoon be $24^\circ 28'$, his declination $22^\circ 40'$ N. and the observed magnetic azimuth $68\frac{1}{2}^\circ$ from the north, required, the variation of the compass?

11. Let there be found the sun's true azimuth as under:

Co-lat. $= 63^\circ 30'$	Arith. Comp. of log. Cos. of lat. $26^\circ 30'$	0.04821
Co-alt. $= 65^\circ 32'$	Arith. Comp. of log. Cos. of alt. $24^\circ 28'$	0.04086
Sun's polar dist. $67^\circ 20'$	Log. sine of half sum $98^\circ 11'$ for which (being above 90°) use the supplement	9.99555
Sum $196^\circ 22'$		
Half sum $98^\circ 11'$	Log. sine of half difference $30^\circ 51'$	9.70994
Polar dist. $67^\circ 20'$		Sum 19.79456
Remainder $30^\circ 51'$	Half sum = Cosine $37^\circ 52'. 10 =$	9.89928
The true azimuth $75^\circ 45' E$	The double of which is the true Azimuth from the North = $75^\circ 45'$ nearly.	
Magnetic azimuth $68\frac{1}{2}^\circ$		
Variation $7^\circ 15'$		

Hence the variation of the compass is found to be $7^\circ 15'$, which is east variation, because the sun's true azimuth is to the right hand of the magnetic azimuth, when the observer's face is towards the sun.

N. B. The variation may be readily found by taking the sun's altitude in the morning, and observing what point of the compass he bears upon; and also observing what point of the compass the sun bears upon again in the afternoon when the altitude is the same; then the middle point between the two will be the true meridian, and the difference between that and the magnetic meridian, shewn by the compass, is the variation. In correcting a ship's course for variation, if the variation is easterly, it must be allowed for to the right hand in all courses steered, and upon all bearings that are taken by the compass; but if the variation is westerly, it must be allowed for to the left hand thereof. Thus, if a ship is steered east, and I know there is half a point easterly variation, then the true course is E. by S. $\frac{1}{2}$ E. Again, if the magnetic course is S. W. and the variation be two points westerly, then the true course is S S W. and in like manner for any other.

SECT. V.

TO FIND THE SETTING OF A CURRENT AND ITS VELOCITY.

When there is a smooth sea and little wind, and you suspect there is a current, send out the boat to a small distance from the ship, with three or four men in her, who are to be supplied with a compass, log-line, half minute glass, and a large triangular board; to one side of this board, let there be fastened as much lead as will sink it; and to the three angles, tie three equal pieces of line, and knot the other three ends together, and thereto let there be fastened another line of 100 fathoms long, or more. Then being off from the ship, cast over the board letting it sink 60, 80, 100, or 120 fathoms, if your line will allow it, that being done, fasten the line to the stern of the boat, and it will bring her up, and make her ride as if she were at anchor. Then cast over the log, turn up the glass, and as you veer out the log-line, let the drift of the log by the compass, and it will shew how the current sets, and the length of the log line run out will be the current's motion; but you must add to the drift $\frac{1}{4}$ or $\frac{1}{2}$ part, according to the length of the line she rides at, for both the boat and the board will drive; the bigger and heavier however the board is, the less they will drive. Indeed, if the board be heaved out of the ship into the wake, and suffered to sink far enough, it will shew the apparent direction of the current, and the line run off, compared with the ship's way, will help to determine its velocity.

Also the direction of a current may be nearly conjectured from the position of the waves or furrows of the sea; for the direction of the current's motion is always perpendicular to these waves or furrows.

If a ship be at rest, or have no proper motion of her own in the sea, and if at the same time the sea has a current towards any point, then it is the same thing as if there was no current, and the ship was sailing towards such point with the same motion as that of the current. Hence, if a ship sails upon any course in a current, one may, instead of considering the current's motion, consider the ship as having a new course, the same in all respects as that of the current. This will be more fully exemplified further on.

Method of reducing points of the compass into degrees, &c. and the contrary.

RULE. Knowing the point of the compass on which the ship is steered, count how many points and quarter-points, the

course is from the meridian, then say, as 8 points is to 90° , so is the ship's course in points of the compass to the degrees and minutes answering to the ship's course, or if the degrees be given, and it be required to find the number of points answering thereto, say, as 90° is to 8 points, so is the given number of degrees to the points required. For practice it will be convenient to have a table of the degrees, &c. answering to every point and quarter-point of the compass ready calculated.

PART. II.

METHOD OF KEEPING AND MANAGING A SHIP'S ACCOUNT, OR RECKONING AT SEA. (USUALLY TERMED THE DEAD RECKONING.)

The method of estimating or calculating a ship's place at sea, depends on the knowledge of plain trigonometry; and there are commonly these two things given, namely the course steered, or the angle that the ship's way makes with the meridian, and the distance run, as measured by the log-line, from which to determine how much she has altered her latitude, and what meridian she is arrived at, or how much is her difference of longitude from the place sailed from.

Was the earth a flat surface, as was formerly supposed, the matter would be easy and self-evident, to any one the least acquainted with plain trigonometry; for the meridians being on that supposition every where parallel, it would be only finding the two legs of a plain right-angled triangle, by having the hypothenuse (or distance run) and one angle given; that leg opposite the given angle (or ship's course) being the ship's departure from the meridian (which in that case would be equal to the difference of longitude); and the other leg would be that part of the meridian sailed from, which is contained between the latitude sailed from, and the latitude arrived at, and therefore equal to the difference of latitude. But as the earth is globular, and all the meridians come to a point at the poles, such an hypothesis as that of supposing the earth a flat surface must be egregiously false, except in short distances near the equator.

However, notwithstanding the fallaciousness of the hypothesis, it so happens that this method (usually called plain sailing) will find the latitude true, though not the longitude; but since the method of sailing by the globe, supplies us with true rules for both latitude and longitude, I shall proceed to explain the nature of globular sailing, and justly explode the former, as serving only to encumber the mariner with needless forms and precedents, of no use to any but the school-master who gets paid for the time that he is employed in teaching them.

SECT. I.

GLOBULAR SAILING.

As all the meridians on the globe intersect each other at the poles, so all those parallel circles, named parallels of latitude, diminish, or are each less than the former in passing from the equator to the poles, till at the pole, the parallel circle vanishes, and becomes a mere point; and therefore as those circles do gradually decrease to nothing, the length of a degree of longitude, which is the 360th part thereof, must decrease in the same manner; and consequently the method of sailing by the plane chart, which considers all meridians every where parallel to each other, and a degree of longitude every where of the same length, must be exceedingly erroneous. Yet, as it has been always desirable to every practical navigator, that the art of computing a ship's reckoning at sea might be brought under as easy rules as possible; and as there arise the most simple ideas when the earth is supposed a flat surface, so navigators have strove to form their methods as conformable to that supposition as might be; but so as to make suitable allowances for the globular figure of the earth. Now, since by the plane chart, where the meridians are supposed parallel, a degree of longitude is every where taken as equal to a degree of latitude, or to a degree of longitude on the equator, and consequently every where greater than it ought to be, except on the equator, Mr. Gerrard Mercator, a Fleming, about the year 1555 or 1556, struck upon the idea of lengthening the degrees of latitude upon the plane chart, in approaching to the pole, in the like manner as the degrees of longitude on the globe are lessened or diminished towards the pole; in order that a chart on a plane surface might be made to exhibit the degrees of latitude and longitude in the like relation or proportion to each other as they have upon the globe; and in 1556 he published a chart (though not a correct one) according to that principle; but this idea of his appears to have been more a chance thought than the effects of good learning, as it is evident from the incorrectness of his chart, that he was a stranger to the due proportions; nor was he able to advance any rules for computation, so there is little room to doubt but he was totally ignorant whether any true methods of computation could be deduced from such a principle or not. However, about the year 1590, Mr. Edward Wright, an Englishman, discovered the true principles upon which such a chart should be constructed, and about the year 1599 he published a book entitled, 'The Errors in Navigation,' wherein he gave a true chart, and fully illustrated its nature and use, and laid down the methods of computation, suited to a table of meridional parts, calculated by him for that purpose, which was the first thing of the kind introduced into navigation;

NAVIGATION.

navigation; and therefore, in justice to his memory, that method should not be called Mercator's Sailing, but Mr. Wright's Sailing, for Mercator was never acquainted with the true principles, but barely caught the idea of lengthening in some measure the degrees of latitude towards the pole, that their proportion to the degrees of longitude on the plain chart might approach in some degree to the proportion which they have upon the globe.

But Mr. Wright shewed that when the lengths of the degrees of latitude on a plain chart, in advancing towards the pole are as the cosines of the latitudes to radius; or, which is the same, in the ratio to each other, as the secants of the latitudes, they will then precisely bear the same proportion to their corresponding degrees of longitude (the meridians being supposed every where equally distant) as the degrees of latitude on the globe itself do to the degrees of longitude on their corresponding parallels. And hence he very justly concluded, that in order to gain this proportion, the distance of any parallel of latitude from the equator, must be equal to the sum of the secants of all the intermediate latitudes. And upon this principle he constructed charts, and calculated a table of meridional parts to be used in computation. In this chart therefore, though the degrees of latitude and longitude bear the same proportion to each other as they do upon the globe, yet they every where exceed their due quantities on the globe, in proportion as the radius exceeds the cosines of the respective latitudes. Also from the parallelism of the meridians; it likewise follows, that in Mr. Wright's chart, every rhumb line (which on the globe is a spiral line) will be a right-line, seeing that every rhumb line on the globe cuts all the meridians at equal angles, which in a chart, where all the meridians are parallel, can only be when the line is a right-line. Hence by having a table of meridional parts, the rules of operation become similar to those that had before been used on the old plane chart, they being all derived from a plane right-angled triangle, only here a true allowance is made for the finding of the longitude, of which, by the old charts, navigators could scarcely form even any tolerable guess.

In order to illustrate this, let A (Fig. 4) be a port from which a ship sets sail, let AE be the meridian line, and let the ship sail upon a course between the north and the west, denoted by the line ABD, to a certain distance, as AB, then BC is the departure from the meridian; AC the difference of latitude, and the angle BAC the course steered. Now on the old plane chart the departure BC in miles is taken as the difference of longitudes in minutes, which would be true, did not the length of a degree of longitude diminish, as has before been observed; in passing from the equator to the pole, but since that is the case, the length of the line BC on the parallel of latitude will contain more degrees of longitude than a like distance would do on the equator: but if the degrees of latitude between A and C be severally lengthened in the proportion of the radius to the sine complements of the latitudes, or be made equal to the secant of the intermediate latitudes, reaching to E, then will the corresponding distance DE be equal to the difference of longitude, accounting a mile for a minute; for on the plane chart (reckoning a mile to a minute) BC contains less degrees of longitude than it would do on the globe, in proportion as the sine complement of latitude is less than radius, but AE is greater than AC in that proportion; and as AC is to BC as AE is to ED, therefore ED is greater than BC, in the same proportion; viz. as a degree of longitude on the equator is greater than a degree of longitude on the parallel BC, and consequently DE truly denotes the difference of longitude corresponding to the departure BC.

Hence by plane trigonometry (when the course and distance run are given, as is usually the case) we have these rules for finding the departure and difference of latitude.

RULE I. FOR THE DEPARTURE.—As Radius is to (AB) the distance run, so is the sine of the course (sine=angle BCA) to the departure (BC).

RULE II. FOR THE DIFFERENCE OF LATITUDE.—As radius is to the distance run (AB); so is the cosine of course (= cosine of angle BCA) to the difference of latitude (AC). Then the departure, and difference of latitude being thus found, the difference of longitude is found by similar triangles, as under.

RULE III. TO FIND THE DIFFERENCE OF LONGITUDE. As the proper difference of latitude (AC) is to the departure (BC) so is the meridional difference of latitude AE, according to the lengthened degrees of latitude, before described, to the difference of longitude. Or, the first case for the departure may be performed thus:

RULE IV. Having first found the difference of latitude, say as radius is to the difference of latitude, so is the tangent of the course to the departure. Also, if the departure be found first, the difference of latitude may be found thus:

RULE V. As radius is to the departure, so is the cotangent of the Course to the Difference of Latitude. And hence the difference of longitude may likewise be found thus:

RULE VI. As radius is to the tangent of the course, so is the meridional difference of latitude to the difference of longitude, all of which rules follow from the doctrine of right angled plane triangles; for which refer to our Treatise on TRIGONOMETRY.

The truth of these rules may also be deduced from the nature and properties of a spiral rhumb passing on the globe itself without regard to the chart before-mentioned, which therefore must

at once put an end to all cavils respecting the truth of Mr. Wright's method of sailing.

Thus let ABFQ (Fig. 5) be a rhumb line described by a ship; P being the pole. Divide the rhumb or distance AF into an infinite number of equal parts, as AB, BC, CD, &c. through A, B, C, &c. draw the meridians, PA, PB, PC, &c. and the parallels of latitude AL, Bk, Cp, Dg, &c. These will form an infinite number of small triangles ABk, BCp, CDg, &c. all equal and similar; for all the hypotenuses AB, BC, CD, &c. are equal by construction; and the angles kAB, pBC, gCD, &c. are equal (by Definition 3) whence all the sides Ak, Bp, Cg, &c. are equal; as also all the sides kB, pC, gD, &c. Now, since the triangles themselves are supposed infinitely small, the difference between supposing them plane triangles, or parts of a sphere, will be an infinitely small difference of the second order, or a difference which is infinitely less than one of these infinitely small triangles, and therefore there cannot arise even the least assignable error, by taking those infinitely small triangles as plane triangles, for when such a difference is infinitely multiplied, the result is only a quantity infinitely less than the least finite quantity. Wherefore, by plane trigonometry, as radius: sine kAB :: AB: kB :: BC: pC: CD: gD, &c. and by composition radius sine kAB :: AB+BC+CD, &c. :: kB+pC+gD, &c. But AB+BC+CD, &c. or AF, is the distance run; and kB+pC+gD, &c. is the departure by Definition 2. Therefore it is as radius: sine kAB :: distance run: departure, or alternately radius: distance :: sine of course (kAB): departure, which is the same as the first rule before given, and hence the second rule follows of course.

Also the 3d Rule for the longitude may be demonstrated much after the same manner. For let A, F, be two places, then since it has been proved that the infinitely small triangles upon the globe, ABk, BCp, &c. are all similar and equal, and by the nature of Mercator's chart these triangles are each of them projected into others, upon the chart likewise similar to these and one another, the angle of the course remaining the same in both. Now in any small triangles, as ABk, since its departure kB, by the construction of the chart, is so far enlarged as to be represented by its corresponding difference of longitude; therefore the difference of latitude Ak, will be increased in the same proportion, viz. as kB: diff. longitude of kB or of A and B :: proper diff. lat. Ak: its meridional difference of latitude. Therefore from the similitude of all these triangles, it will be as the meridional parts of Ak: diff. longitude of A and B :: Ak: kB: Bp: pC: Cg: gD, &c. :: (by composition) Ak+kB+Bp+pC+gD, &c. or AR: kB+pC+gD, &c. or the departure. And again as AR: departure :: meridional parts Ak: diff. longitude A, B, :: meridional parts of Bp: diff. longitude B, C, :: meridional parts Cg: diff. longitude C, D, &c. :: (by composition) sum of all the meridional parts of Ak, Bp, Cg, &c. that is of AR: sum of all the differences of longitude of AB, BC, CD, &c. or the difference of longitude of the two places A and F. And alternately as the proper diff. lat.: departure :: meridional parts of A R: diff. longitude of A and F, which is the same as the 3d Rule, and the other Rules follow from the nature of sines and tangents.

Thus are the foregoing rules demonstrated to be true in the strictest sense, being founded on real mathematical principles. There is however another useful rule to be observed, and that is for finding the longitude, when the ship makes either a direct sail or west course, usually called parallel sailing, which rule is this:

RULE VII. As the cosine of latitude is to radius, so is the distance of two places in one parallel, to the difference of longitude, or since the cosine is to radius as radius is to the secant of any arch, the rule may be rendered more commodious for working, thus: As radius is to the secant of the latitude, so is the distance along the parallel to the corresponding difference of longitude.

The reason of this rule is obvious, for the circumference of any parallel circle is to the circumference of the earth at the equator, as the cosine of the latitude or radius; and therefore as the cosine of the latitude is to radius, so is any part of the parallel circle to a corresponding part on the equator; and a geographical mile on the equator is a minute of longitude.

Having laid down the useful rules of sailing, it remains that I give an example or two to shew how they are applied in the actual practice at sea.

An EXAMPLE, illustrating the foregoing Rules.

Admit a ship in the latitude of 50° north, sails N. by E. 100 miles; required, her present latitude and difference of longitude, supposing her course to be truly corrected?

I. To find the Departure, say by RULE I.

As radius	- - - Log.	- - -	10,00000
Is to distance run (100)	- - -	- - -	2,00000
So is sine of course 11° 15'	- - -	- - -	0,29024
To departure 19,52 miles East	- - -	- - -	1,29024

II. For the Difference of Latitude by RULE II.

As radius	- - -	- - -	10,00000
Is to distance run (100)	- - -	- - -	2,00000
So is cosine of course (11° 15')	- - -	- - -	0,99157
To difference of lat. 98,08 miles or 1° 38'	- - -	- - -	1,99157
Hence the latitude arrived at is 51° 38' North.	- - -	- - -	

III. To

ship;
in a
B, C,
of la.
nber
iles;
rue.
Del.
also
axes
ting
tey
is to
ene-
king
dutch
ntiny
lane
CD:
CD,
F, is
e by
run:
AB)
and

much
ce it
lobe,
re of
into
ther,
w in
con-
d by
ence
z. as
At:
multi-
ts of
D,
C+
ridi-
Bp:
le C,
ts of
es of
itude
diff.
of A
Rules

trict-
here
find-
ll or
e d/f-
tude,
any
king,
dence
tude.
f any
ator,
ofine
cle to
ile on

hat I
n the

100
itude,

I. To

	7
fab-	
rith-	
coul-	
xo-	
l	
the	
fir-	
by	
cal-	
com-	
gu-	
the	
for	
s	
M	
to	
qu-	
a	
and	
are	
com-	
m	
An	
tam	
the	
pos-	
1	
1	
1	
1	
2	
2	
2	
2	
3	
3	
3	
3	
4	
1	
I	
ing	
tha	
out	
the	
take	
rat	
on	
feel	
dac	
hab	
1	
mu	
(the	



NAVIGATION.

III. To find the Difference of Longitude by RULE III.

The meridional parts answering to lat. $50^{\circ} = 3474$
 The meridional parts for lat. $51^{\circ} 38' = 3630$
 The meridional difference of lat. $= 156$
 Then, as proper difference of lat. $98.08 \log. 1.99157$
 Is to the departure (found above) $19.52 = 1.29024$
 So is the meridional difference of lat. $156 = 2.19312$
 3.48336

To the difference of long. 31.03 minutes east 1.49179

The method of performing these by logarithms, as above, is to subtract the logarithms of the 1st term from the sum of the logarithms of the 2d and 3d terms; and the remainder is the logarithm of the fourth term or answer, as has been shewn in our account of logarithms; for which see also our Treatise on TRIGONOMETRY.

But the difference of longitude is found more easily without the departure by the 6th Rule, as under:

As radius $= 10,00000$
 Is to tangent of course $(11^{\circ} 15') = 9.29866$
 So is meridional diff. latitude $(156) = 2.19312$
 To diff. longitude 31.03 as before 1.49178

This rule saves the trouble of finding the departure, and, the first being radius, the operation is performed as it were merely by addition. Indeed, were it not that in working days' reckonings, navigators have come into the method of adding together all the eastings and all the westings, and then making their difference a common departure, from which they find the difference of longitude for the whole at once, it would not be worth while finding the departures at all, since the departure only serves as a means for finding the difference of longitude, which, as I have observed, is easier found without it, as in the foregoing operation.

N.B. Tables of Difference of Latitude and Departure, and Meridional Parts, are inserted in the Book of requisite Tables mentioned in Section II. and in almost every common book of Navigation. We therefore thought it useless to give them a place in a work of this kind, which is more intended to point out improvements in the principles of science, than to abound in matters that are to be met with in common.

The Method by Natural Numbers.

In working the above cases it is hardly worth while to have recourse to logarithms, as they are as readily performed, or perhaps more so, by natural numbers: the operation being only short multiplication, without having any further reference to tables. And to this end, I have here annexed a short table of natural sines, tangents, and secants to every point, and $\frac{1}{4}$ point of the compass, the radius being supposed an unit.

A TABLE OF NATURAL SINES, TANGENTS, &c.

points	sine	cosine	tang.	cotang.	secant.	cosecant.	
$\frac{1}{4}$	.049	.999	.049	20.355	1.001	20.380	$7\frac{1}{4}$
$\frac{1}{2}$	.098	.995	.098	10.143	1.005	10.172	$7\frac{1}{2}$
$\frac{3}{4}$	.147	.989	.148	6.741	1.011	6.815	$7\frac{3}{4}$
1	.195	.981	.199	5.027	1.020	5.126	8
$1\frac{1}{4}$	.243	.970	.250	3.991	1.031	4.115	$8\frac{1}{4}$
$1\frac{1}{2}$	.290	.957	.303	3.296	1.045	3.445	$8\frac{1}{2}$
$1\frac{3}{4}$	.337	.941	.358	2.795	1.062	2.968	$8\frac{3}{4}$
2	.383	.924	.414	2.414	1.082	2.613	9
$2\frac{1}{4}$	.427	.904	.473	2.114	1.106	2.339	$9\frac{1}{4}$
$2\frac{1}{2}$	.471	.882	.534	1.871	1.134	2.121	$9\frac{1}{2}$
$2\frac{3}{4}$	.514	.858	.599	1.668	1.166	1.945	$9\frac{3}{4}$
3	.556	.831	.668	1.497	1.203	1.800	10
$3\frac{1}{4}$	.596	.803	.742	1.348	1.245	1.679	$10\frac{1}{4}$
$3\frac{1}{2}$	.634	.773	.821	1.218	1.294	1.570	$10\frac{1}{2}$
$3\frac{3}{4}$	.672	.741	.906	1.103	1.350	1.489	$10\frac{3}{4}$
4	.707	.707	1.	1.	1.414	1.414	11
	cosine	sine	cota.	tangent	coseca	secant	point

By the help of this short table, and a table of meridional parts, I am of opinion the latitude and longitude of a ship at sea, according to the dead reckoning, may be more expeditiously estimated than by having recourse to logarithms; for the trouble of taking out the logarithms and adding them together, &c. and of finding the required number answering to the logarithm at last, will always take up more time than is required for performing the short operation by natural sines; besides, by this method, there is less room to error, seeing that there are few tables which are printed perfectly correct, and consequently practical tables should be reduced to as narrow bounds as the case will admit of; as the probability of error will be proportionally the less.

In the foregoing example, the difference of latitude is found by multiplying the distance 100, by the natural cosine of the course, (that is the cosine of 1 point) which by the table is .981; and the product is 98.1 miles or minutes. Also, the difference of longitude is

found by multiplying the meridional parts (156) by the natural tangent of the course, viz. .199 and the product is 31.04 minutes; both of them agreeing nearly with the answers found by logarithms. If I had continued the table to four places of decimals, it would, speaking as a critic, have been something more exact; but this is near enough for any particular purposes of this nature, and expedition requires that one should not be incumbered with unnecessary figures.

The Method by the Traverse Table.

In a table of the difference of latitude and departure, and in the column of distance look for the distance; and opposite thereto, under the proper course, you have the difference of latitude and departure. Thus, opposite 100, in the column of distance, you have 98.1, and 19.5, for the difference of latitude, &c. departure respectively agreeing with the former method.

The Method by Gunter's Scale.

I. The extent from radius to 7 points (the complement of the course) on the line marked S. R. will reach from the distance 100 to the difference of latitude 98.08 on the line of numbers.

II. The extent from 7 points to 1 point on the sail line, marked S. R. will reach from the meridional difference of latitude 156 to the difference of longitude 31.03 on the line of numbers.

The Method of Construction.

Draw a meridian line ABD (Fig. 6) and with the radius of 60° taken from the line of chords, describe an arc de ; make $de = 11^{\circ} 15'$ the degrees in the given course, and draw the line ACE, on which, from a scale, set off from A to C 100, the distance sailed, and draw BC perpendicular to ABD; then AB, measured on the same scale of equal parts, is equal to the difference of latitude 98.08, and BC is equal to 19.5 the departure; then the latitude sailed to being known, the meridional difference of latitude, viz. 156 must be found as before, and set off from A to D, and DE must be drawn parallel to BC, so will DE = 31.03 the difference of longitude required.

The Method of calculating the Difference of Longitude by the Log-tangents, without a Table of Meridional Parts.

From a table of sines and tangents, find the difference of the log-tangents of half the complements of the latitudes of the two places, and multiply it by 10,000, and reserve the product; then say, as the tangent of the constant angle $51^{\circ} 38' 9''$ (the log-tangent of which is 10,015) is to the said reserved product, so is the tangent of the course to the difference of longitude. In the foregoing example, the latitude sailed from is $50^{\circ} N$; half its complement is 20° , and the log-tangent thereto is 9.56106. Also, the latitude sailed to is $51^{\circ} 38' N$; half its complement is $19^{\circ} 11'$, and the log-tangent therefore is 9.54146. The difference of these log-tangents is .01960, which multiplied by 10,000 makes 196, for the reserved number.

Then as log-tangent of constant angle $51^{\circ} 38' = 10.10151$

Is to the reserved product 196 log. $= 2.29225$

So is tangent of course $11^{\circ} 15' = 9.29866$

11.59091

To difference of longitude 31 minutes $= 1.48940$

N.B. The truth of this method is demonstrable by the doctrine of fluxions.

The Method of calculating the Difference of Longitude by taking a Mean Latitude, usually called Middle Latitude Sailing.

In calculating by this method, the departure is to be found as before, and then that departure is accounted as though it had been all made along that parallel of latitude, which lies in the middle, between the place sailed from and the place sailed to (during any one direct course): according to this principle the departure becomes the same as meridional distance in that parallel, and is to be turned into longitude, as has been taught in Rule VII.

In the foregoing example, the middle latitude is $50^{\circ} 49'$, and the operation will be as under.

As radius $= 10.00000$

Is to secant of middle lat. $50^{\circ} 49' = 10.19942$

So is departure 19.52 $= 1.29024$

To difference of longitude 31, $= 1.48966$

Agreeing with Wright's method by the meridional parts, and with the log-tangents. For short distances, such as occur in a day's reckoning, this method will be always sufficiently near the truth, except in very high latitudes indeed, and then it will not err much; and as it does not require a table of meridional parts, and is withal so exceedingly easy and simple, it deserves, in general, to be practised in preference to the other methods.

Other Rules useful to the Practical Mariner.

It has been observed that in particular navigation, there are generally given the ship's course and distance run, to find from thence the ship's latitude and longitude; and to determine this matter from the dead reckoning, the foregoing rules are amply sufficient, proper allowances being previously made for lee-way, variation of the compass, currents, &c. Yet the things that in practical navigation are generally a part of the data, or supposed to be known, may, in the theory, be supposed as unknown; while, on the contrary, matters that are generally to be determined as quantities

unknown

NAVIGATION.

unknown in the practical part, may in a theoretical consideration be supposed as given: which causes a great variety of cases; and, if it answers no other end, it contributes at least to the perfecting of pupils in the knowledge of this excellent art. And that this system may not be deficient herein, I subjoin the following cases, with the different methods of solution; and also remarks upon each, shewing in what possible occurrences the same may be of use.

CASE I. Given, both latitudes, and the distance; required, the course, departure, and difference of longitude?

I. *For the Course.* As the distance is to radius, so is the difference of latitude, to the cosine of the course.

II. *For the Departure.* Having found the course, proceed as in Rule I. in the last section.

III. *For the Difference of Longitude.* The departure and course being known, proceed for the difference of longitude, either by Rule III. or Rule IV. or according to the method of log-tangents, or middle latitude, contained in the foregoing section.

REMARK. When a ship is bound to any port, and the distance of the two ports and their difference of latitude are known, this case serves to determine the course the ship ought to steer, and the longitude of the place sailed to; also, when you have your latitudes true by observation, and can depend upon your log for the distance run, this serves to correct the course and find the longitude.

CASE II. Given, the course, and both latitudes; required, the distance, departure, and difference of longitude?

I. *For the Distance.* As the cosine of the course is to the radius, so is the difference of latitude to the distance.

II. *For the Departure.* As radius is to the tangent of the course, so is the difference of latitude to the departure.

III. *For the Difference of Longitude.* As radius is to the tangent of the course, so is the meridional difference of latitude to the difference of longitude. Or, by the method of log-tangents, say as the tangent, $51^{\circ} 38' 9''$ is to the tangent of the course, so is the difference of the log-tangents of half the complements of the latitudes, multiplied by 10,000, to the difference of longitude. Or, by middle latitude, say, as the cosine of the middle latitude is to the tangent of the course, so is the difference of latitude to the difference of longitude.

REMARK. When the bearing between two ports and their latitudes are known, this serves to determine their distance and difference of longitude; also, when by observation you have the latitudes true, and you are sensible there can be no material error in the course, this case serves to correct the distance, and find the longitude.

CASE III. Both latitudes and difference of longitude being given, to determine the course, and distance?

I. *For the Course.* As the meridional difference of latitude is to radius, so is the difference of longitude to the tangent of the course. Or, by the log-tangents, say, as the difference of the log-tangents, of half the complements of the latitudes, multiplied by 10,000 is to the tangent of $51^{\circ} 38' 9''$ so is the difference of longitude to the tangent of the course: or, by middle latitude, say, as the difference of latitude is to the difference of longitude, so is the cosine of the middle latitude to the tangent of the course.

II. *For the Distance.* As the cosine of the course is to radius (or as radius :: the secant of the course) :: the diff. of lat. to the distance.

REMARK. This case may serve to determine how much the real or true course of any ship differs from her course as steered by the compass, for the latitudes and longitudes of two distant places being had by observation, the true course may hence be determined, and that being compared with the course steered, will shew the difference, and from thence you may judge what allowances it is necessary to make for lee-way, currents, variation, &c. on future occasions. By this you may also find how much the true distance along any rhumb differs from the distance as measured by the log, which, if there is any error in the log, will be a means of correcting it. Also by knowing the latitude and longitude of the port the ship is bound to, and what latitude and longitude the ship is in, one may from hence determine what course the ship ought to steer to gain her destined port; so that this case is exceedingly useful at sea.

CASE IV. One latitude, the course, and difference of longitude, being given, to determine, the other latitude and the distance?

I. *For the other Latitude.* As tangent of the course is to radius, so is the difference of longitude to the meridional difference of latitude, which subtracted from or added to the meridional parts of the given latitude, as the case shall require, will give the meridional parts of the required latitude, which latitude may therefore be found by referring to the table of meridional parts; or as the tangent of the course is to the difference of longitude, so is the tangent of $51^{\circ} 38' 9''$ to 10,000 times the difference of the log-tangent of half the complements of the two latitudes; the 10,000 part of which therefore being added to or subtracted from the log-tangent of half the complement of the given latitude, according as the case shall require, will give the log-tangent of half the complement of the required latitude; then the half complement being had, the double will be the complement of the latitude, which subtracted from 90° leaves the latitude itself. Or, by middle latitude, thus, assume the given latitude, or some other as the middle latitude, and then say, as the tangent of the course is to such assumed middle latitude, so is the

difference of longitude to the difference of latitude, half of which being added to or subtracted from the given latitude, will give the middle latitude more exact; with which repeat the operation, and the difference of latitude will be had sufficiently correct.

II. *For the Distance.* The difference of latitude being found by one of the above methods, the distance may be determined by Case II. foregoing.

REMARK. When you are sure that you can depend upon the course as inserted on the log-board, and that by help of a good time-piece, or some other means, you have got your longitude correct, then this case will serve for the correcting of the difference of latitude, and the distance run, if they are found to be incorrect.

CASE V. Given, one latitude, the distance and difference of longitude, required the other latitude and the course? Assume a course as near the true course as you can, by means of which find the difference of latitude, the other latitude, and departure, till by the method of trial and error you obtain a difference of latitude that shall have the same proportion to the departure as the meridional difference of latitude has to the difference of longitude.

REMARK. When you can depend upon the log for the distance run, and on your time-piece or observations for the difference of longitude, you may by this method correct your course, so as to get the difference of latitude true, if it was wrong before.

CASE VI. Given, the course, distance, and difference of longitude, required, both the latitudes? Assume one latitude, and thence find the other, till, by the rule of false position, you find the difference of latitude has the same proportion to the departure as the meridional difference of latitude has to the difference of longitude.

REMARK. If this case can ever be of use at sea, it must be when the ship is in unknown latitudes, and the mariner has been deprived of his instruments for making observations, but by a good timepiece and the rising or setting of stars, &c. he has been able to determine the difference of longitude during a certain course; when that is the case, and a tolerable dead reckoning has been kept, he may by this method find his latitude.

CASE VII. Given, the latitude and the difference of longitude made along any parallel of that latitude, to find the distance? This is found by varying the proportion in Rule VII. of last section. The proportion varied to suit this case becomes, as radius is to the cosine of the latitude, so is the difference of longitude to the distance.

REMARK. This serves to correct the log or distance run, when by observation or a timepiece, you have got your longitude true, and you can depend upon the course.

CASE VIII. Given, the distance run along any parallel of latitude, and the difference of longitude, answering thereto, to find the latitude. As the diff. long. : dist. :: radius : cosine of latitude.

REMARK. This may serve to find the latitude when the mariner's situation is as has been described in the Remarks to Case VI.

SECT. II.

CURRENT SAILING.

Currents are certain streams of the ocean which set or move forward in particular directions, by means of which a ship's course is either altered, or else her motion is accelerated or retarded, according as the current's motion either conspires with, or opposes, the motion of the ship as driven by the wind. If the motion of the ship and current be the same way, then the ship's motion will be increased by a quantity equal to the motion of the current. If their motions are in a contrary direction, the ship's motion will be retarded by a quantity equal to the current's motion. And when the direction of the ship's motion crosses the direction of the current's motion, then the direction of the ship's motion will be altered, and she will be driven in a course that lies between the direction of the current's motion and the direction of the ship's motion, as shewn by the compass. Under the article MOTION, in this Work, it has been shewn that if a body is acted on by two forces, and lines are drawn denoting the direction of each, and the quantities of motion by them produced in a given time; and if two other lines be drawn parallel to those lines, forming a parallelogram, then the motion of the body so acted on will be along the diagonal of the parallelogram, and the length of the diagonal will denote the quantity of motion in the like given time. Hence, as was observed before, when a ship is acted on by a current, it is the same thing as if she made two courses during a given time; one of which is in the direction shewn by the compass, and according to the rate given by the log; and the other according to the setting of the current, and at the rate of the current.

EXAMPLE. A ship running south, at the rate of 5 miles per hour, in ten hours crosses a certain current, which all that time was setting east, at the rate of 3 miles per hour; required, the ship's true course and the distance sailed? (See Fig. 7.)

Here the ship is first supposed to be at A, her imaginary course is along the line AB; but her real course is along the line AC, the diagonal of the parallelogram, the known sides of which are AB = 50 miles (= 10 x 5) and BC = 30 (= 10 x 3).

Hence there are given the two legs of a right-angled triangle to find the hypotenuse or distance; wherefore, by trigonometry, half the sum of the logarithm of AB and BC = the logarithm of 31 miles the distance. Then by trigonometry, as the distance AC is to radius, so is BC to the sine of the angle A = $30^{\circ} 38'$

NAVIGATION.

the angle of the ship's course, answering nearly to S. E. by S. & S'. So by the resolution of plane triangles, may any ship's course be determined. And the course being thus corrected, where there are currents, are to be entered in the log-book. Or, the ship's rate and course may be set down, as shewn by the log and the compass; and afterwards the course and rate of the current, and the difference of latitude and departure being put down for each, will give the same result, as to the ship's place at sea, as if you had used the corrected course. In the above example, according to the latter method, the case will be as under:

Courses	Distance	N	S	E	W
S	50	—	50	—	—
E	30	—	—	30	—
		—	50	30	—

The annexed table is according to the method practised for computing a ship's place at the end of each day's sailing, or after

a number of courses run. The first column contains the corrected courses of the ship; the second the distance run on each course, the next two columns contain the differences of latitude, according as the same shall be north or south, and the two latter columns contain the departure to each course; that characterised E, being the column for East Departure, and that titled with W, being the column for West Departure. Then the difference of the total of the North and South differences of latitude gives the first difference of latitude between the latitude the ship is in, and the ports sailed from, which is N. or S. according as she has made more North or South difference of latitude. Also, the difference of the east and west departures is usually reckoned as a common departure for the whole of a ship's run in one day, and is named east departure, or west departure, according as the east departure or west departure is the greatest. In this example the course of the ship is south 50 miles, which makes 50 miles difference of latitude without any departure, then the current is taken as a course, which as it has set east at the rate of 3 miles an hour for 10 hours, makes 30 miles for the difference in that direction; and hence the departure is 30 miles east, without any difference of longitude; therefore the ship in the whole has made a difference of latitude 50 miles south, and a departure 30 miles east, which latitude and departure are answerable to the same course and distance, as was determined by the former method.

SECTION III.

SAILING TO WINDWARD.

Suppose WA (Fig. 8) to be the direction of the wind, and the angle WAD or WAF, the nearest a ship can lie to the wind. And suppose a ship to sail from the port A, to the port B, and it is required to find the point C in the course AC, where she must turn to windward. Having made the angles WAD and WAF the nearest the ship can lie to the wind; through B, draw BC, parallel to FA intersecting AD, in C; then C is the place required. Now in a trigonometrical calculation, there is given the distance of the ports AB, and the angle WAB, and WAF, or WAC, and from thence the angle BAC is had, being = to angle WAC—WAB, and the angle FAB is also known, or its equal ABC, and from thence is known the angle ACB. Hence the proportion is as the sine of angle ACB : AB :: sine of angle ABC : AC, the distance from the port A along the course AC, where the ship must turn to windward along the course BC to gain the port B.

EXAMPLE. Supposing the wind at due North, denoted by the line AW, and a port at B, distant 80 miles, bears N. N. E. from E, and I find that I can make my way along AC within 6 points of the wind; required, how far I must sail along that course before I can make a direct course to the port B? Here the angle BAC is 4 points, the angle ACB is 8 points, and the angle ABC is 4 points.

Then as sine of ABC=4 points or 45° = 9.84948
Is to sine AB 80 = 1.903009
So is sine ABC 8 points or radius = 10.00000
To AC=113.1 the distance required 205361

To find the Place of turning to Windward in a current.—Suppose a ship sails from A to B (Fig. 9) in a current that sets in the direction AI, from A to I; and if WA be the point of the wind, to find the place where to turn to windward? Make the angle WAE and WAF the nearest the ship can lie to the wind. And make AE to EH, and AF to FG as the motion of the ship to the motion of the current, and draw FG and EH parallel to AI; then through G, and H, draw the lines AG and AH. From B draw BC parallel to AG, and from C draw CD, parallel to AF, and from B draw BD parallel to AI; then C is the point of turning to windward, and the ship is to steer the course and distance AC, and by the motion of the current she will be brought to C, when she must steer the course and distance CD, and by the motion of the current she will be driven to B, as required. Note, if the direction of the current be from I to A, the points G and H must be taken on the other side of the lines AF, and AE; but the rest of the business will be the same. From the nature of the construction, the trigonometrical calculation is easily deduced; other cases of this nature might be proposed, but as they would have little use in practical navigation, I shall pass on to other matters; at

the same time, if, the reader has made himself well acquainted with trigonometry, he cannot be at a loss how to resolve any question of this sort.

SECTION IV.

HOW TO FIND THE DISTANCE OF A CAPE, OR HEADLAND, &c. AT SEA.

Suppose a ship to be sailing on some known course, as from A towards B (Fig. 10) and a cape is discovered at C. Then, to find its distance, take the bearing of the cape C by the compass, from A. Also, after you have sailed a known distance, AB, on the same course, take the bearing of the cape again at B; so there will be given the distance BA, and the angles A and B, and subtracting their sum from 180° , the remainder is the angle C at the cape; and to find the distance, the proportion is as follows, viz. As the sine of the angle C is to the distance AB, so is the sine of the angle B to AC, the distance of the cape at the first observation.

N.B. The distance may be determined pretty near, by the report of a gun fired from a cape, &c. For count how many seconds of time there are between seeing the flash of firing, and hearing the report, and multiply the same by .185, will give you the distance in sea miles. Various problems might be introduced under this head, which however would have very little use in navigation, except so far as they might tend to perfect a pupil in trigonometry,

SECTION V.

RULES FOR CORRECTING A SHIP'S RECKONING.

I. Always, when opportunity offers, take the meridian altitude of the sun or a known star, and from thence proceed to find the latitude, as shewn in our System of Astronomy; then, if the latitude observed, agree with the latitude by account, your reckoning requires no correction.

II. If the observed and computed latitudes differ, examine whether you have committed any mistake in allowing for variation or leeway, or in the calling up of your reckoning. If not, see if you have rightly allowed for currents. If a strong wind has flood a good while one way, assure yourself a current sets more or less that way.

III. At all opportunities get the variation, by the sun's amplitude or otherwise. And if the variation had been taken wrong, you may find a correction in the latitude and departure, thus, judge as near as you can how long the variation has been wrong accounted; probably, it has altered gradually ever since the last observation, and therefore you may safely take half the time since that was, then find the difference of latitude and departure for that time, and say, as radius: sine of the error of variation:: departure: correction in latitude:: and so is the diff. latitude to the correction in departure. Then lay a thread over the compass, to represent the true meridian, and to shew the error of variation. If the ship's course lie farther from this thread than it did before (from the supposed meridian) the correction of departure is to be added to the departure; but if nearer, the correction of latitude must be added to the difference of latitude. And these corrections in latitude and departure are always of a contrary kind, viz. if one be added, the other must be subtracted.

VI. If a current is the cause of the error, and you have found out its direction and course, you may correct the departure thus: say as radius: correction in latitude:: tangent of current's course: correction in departure, which is to be reckoned the same way (east or west) as is the current's motion. By this the departure will be corrected to agree with the observed latitude.

V. When none of these appear to be the cause of the error, it must lie either in the course or distance run. In which case observe whether the ship has outrun the reckoning, or the reckoning is ahead of the ship, for the reckoning must be brought to the ship. Also, consider your course since the time of the last observation, whether it has laid nearer to the meridian, or to the east and west; viz. whether the difference of latitude or the departure be greater; if the former, it is probable the error is in the distance sailed; therefore take the difference of latitude and the departure from the time of the last observation, and say, as diff. latitude: departure:: error in latitude: correction in departure, which is to be added to the departure when the ship is foremost, but subtracted when the reckoning is foremost. In this case the correction of difference of latitude and departure are of like kind, viz. if one be added the other is added, and vice versa.

VI. But if the course has been nearer the east and west than the north and south, since the last observation, then the error is most likely in the course, wherefore say, as departure: diff. latitude:: error in latitude to correction in departure, which is to be added to the departure, if the reckoning is before the ship; but subtracted when the ship is foremost. In this case, the correction in latitude and departure are of a contrary kind, viz. when one is added, the other must be subtracted. When you sail near the east or west, the above correction will not be worth notice, it will be so small.

VII. When the difference of latitude and departure are nearly equal, and you suspect either course or distance, correct where you think the error lies. If you are doubtful whether of them is wrong, correct only the latitude, leaving the departure as it was; for if both the course and distance be faulty, their corrections will be contrary, and destroy each others' effects.

VIII. To

NAVIGATION.

VIII. To correct the longitude: having got the correction in departure, take the meridional difference between the computed and observed latitude, and say, *as error in latitude : correction in departure :: meridional diff. latitude : correction in longitude* which must be applied the same way (east or west) as the correction of departure is applied.

IX. The error in the distance may arise from the log, or half minute glass. When the fault is in the glass, say, as the seconds run by the glass are to 30 seconds, so is the distance run by the log to the true distance. When the fault is in the log, say, as 50 feet is to the distance between each knot, so is the distance run by the log to the true distance. When both log and glass are faulty, multiply thrice the measured length of a knot by the distance run per log, the product divided by 5 times the measured time of the glass will give the true distance.

SECT. VI.

THE METHOD OF CONSTRUCTING A MERCATOR'S CHART.

When a chart is to commence from the equator.—Having a scale of convenient length, draw a line to represent the equator; and, crossing that at right angles, another to represent the meridian of some known place, such as London, Paris, &c. the upper end of which will represent the north, and the lower the south. From the scale take 60 in your compasses, and with one foot on the meridian, and at the point of intersection with the equator, set off that distance both ways on the equator, if the chart is to contain both east and west longitude: but if it is only to contain either east or west longitude, lay it off on that side of the meridian the case requires; which gives the point where the meridian cuts the equator at one degree difference of longitude; the same distance turned over again, will give the point where the meridian cuts the equator, at the next degree of longitude; and thus the places of all the meridians, as far as the chart is to extend in longitude, may be determined. Having found the places of all the meridians, draw a line perpendicular to the equator at each extremity, and on each line set off from the equator, a distance equal to the meridional parts of the highest latitude, which the chart is intended to include; join these points by a line parallel to the equator, and the chart will be bounded, then through every degree of longitude on the equator, draw meridians, parallel to one another; and on both the extreme meridians set off the meridional parts, answering to every degree of latitude; join each by lines parallel to the equator, and so the chart will be truly divided to every degree of latitude and longitude; then on the extreme meridians, insert the degrees of latitude in figures at least to every 5 or 10 degrees, which will serve as an index for finding the degrees of latitude, the latitude being every where the same in the same parallel: also from the first meridian, number the degrees of longitude both ways on the equator, and the chart will be drawn, except the planning thereon coasts, &c. as may be thought necessary and useful. This is done by making a fine point on that place in the chart, where the latitude and longitude is the same as the latitude and longitude of the place you would have described; and doing this with many bounding points, head-lands, &c. a line may be drawn through those points which will represent the out-lines of any coast, the boundaries of any island, place, &c. to which may be annexed the depths of water, setting of currents, variation of the compass, and whatever else may be thought convenient for the chart to contain.

When a chart is not to commence from the equator, an east and west, or longitude line, may be drawn through any known latitude parallel to the meridian, and divided into equal parts or degrees, in like manner as was the equator; then the parts of meridional difference of latitude between the given latitude and the latitude or latitudes to which the chart is proposed to reach, must be applied on the meridians from such longitude line, both ways, if the chart is to contain places situate on both sides of such longitude line; and then through the several points draw lines intersecting one another, and the chart will be completed, as before. In order that our readers may have a full and clear comprehension of the nature and construction of this useful chart, we shall not confine ourselves, as others have done, to giving a bare sketch of one in narrow and confined limits, but shall, exclusive of the navigation plate, present them with a whole sheet chart of all the known world, including all the late discoveries of Captain Cook and others, which cannot fail of proving useful to those who learn navigation, as well as highly instructive to such as wish to be well informed in geography, the globe of the earth being in this chart represented in a plane, from which a knowledge of the true bearings and latitude and longitude of places is more readily acquired than from any globular maps, though it must be confessed that in those kinds of maps, the true distances are not preserved, which towards the pole causes the places to appear somewhat distorted.

PART III.

DESCRIPTION AND USE OF SEA INSTRUMENTS.

SECTION I.

OF THE SEA QUADRANT, CALLED DAVIS'S QUADRANT.
(See Fig. 11.) This instrument is used for taking the sun's altitude, and consists of three vanes, A, B, C; and two arcs, *ed*, and

G, F: A is the horizon vane; B the shadow vane; C, the sight vane; *de*, is the 60 arc, containing 60 or 65 degrees. FG, the 30 arc, containing 30 or 25 degrees. In using this instrument, the vane B must be put to an even degree, less by 15° or 20° than the zenith distance; then turning the back to the sun, and looking through the vanes C and A, raise or settle the instrument, till the shadow of the upper edge of the vane B fall on the slit A; then raise or settle the vane C, till you see the horizon appear through C and A. Thus you have the altitude of the sun; and adding the degrees on the arc *ed* to the degrees on the arc FG, gives the zenith distance. But this must be corrected by allowing for refraction, and parallax.

SECT. II.

OF THE CROSS-STAFF, OR FORE-STAFF.

This is used for taking the altitude of a star (Fig. 12) it consists of a staff, AD, and three or four crosses BC; to suit different altitudes. The staff AD is graduated on each side in a different manner, for the different crosses. In using it, put on the proper cross CB; and place the end A as near the eye as possible; and turning the face to the star, move the cross CB, back or forward, till the star appears in the upper end C; and the horizon at the lower end B; then you have the altitude number on the inner edge of the cross; and on that side of the staff belonging to the cross you observe with.

SECT. III.

OF THE NOCTURNAL.

The nocturnal (Fig. 13) is an instrument, chiefly used at sea to take the altitude or depression of some of the stars about the pole, in order to find the latitude, and the hour of the night. There are nocturnals of various contrivances, some of them projections of the sphere; such as the hemispheres, or planispheres, or the plane of the equinoctial; those ordinarily used by the seamen are two; the one adapted to the polar star, and the first of the guards of the Little Bear; the other to the pole-star, and the pointers of the Great-Bear.

The nocturnal consists of two circular plates (Fig. 13) applied on each other. The greater, which has a handle to hold the instrument, is about 2½ inches diameter, and is divided into twelve parts, agreeing to the twelve months; and each month subdivided into every fifth day: and so as that the middle of the handle corresponds to that day of the year, wherein the star here regarded has the same right ascension with the sun. If the instrument be fitted for two stars, the handle is made moveable. The upper left circle is divided into twenty-four equal parts, for the twenty-four hours of the day, and each hour subdivided into quarters, as in the figure. These twenty-four hours are noted by twenty-four teeth, to be told in the night. Those at the hours twelve are distinguished by their length. In the centre of the two circular plates is adjusted a long index, A, moveable upon the upper plate. And the three pieces, viz. the two circles and index, are joined by a rivet, which is pierced through the centre, with a hole two inches in diameter for the star to be observed through.

When the nocturnal is used, turn the upper plate till the longest tooth, marked 12, be against the day of the month on the under plate; then, bringing the instrument near the eye, suspend it by the handle, with the plane nearly parallel to the equinoctial; and viewing the pole-star through the hole of the centre, turn the index about, till, by the edge coming from the centre, you see the bright star or guard of the Little Bear (if the instrument be fitted to that star:) then that tooth of the upper circle, under the edge of the index, is at the hour of the night, on the edge of the hour-circle; which may be known without a light, by counting the teeth from the longest, which is for the hour 12.

SECT. IV.

DESCRIPTION OF HADLEY'S QUADRANT (Fig. 14) AS CONSTRUCTED IN THE BEST MANNER BY MR. ADAMS, OPTICIAN IN FLEET-STREET.

This instrument consists of the following parts:

1. The arc BC, which is generally an octant or eighth part of a circle, but is more useful when a sextant or sixth part of a circle.
2. The index D; *ab*, the nonius scale.
3. E, the index glass, or speculum.
4. F, the fore horizon glass; and G. the back horizon glass.
5. K, the dark glasses, or screens.
6. H, I, two sight vanes.

The arc BC is firmly attached to two radii or bars, AB, BC, which are strengthened and bound together by two braces L, M.

The index D is a flat bar of brass, that turns on the centre of the octant; at the lower end of the index there is an oblong opening; to one side of this opening the nonius scale is fixed, to subdivide the divisions of the arc; at the bottom or end of the index, there is a piece of brass, which bends under the arc, carrying a spring which makes the nonius scale lie close to the divisions; it is furnished with a screw to fix the index in any desired position; and the best instruments have an adjusting screw fitted to the index, that it may move more slowly, and with greater regularity and accuracy than by the hand.

The

NAVIGATION.

The *Index Glass* is designed to receive the image of the sun, or any other object, and reflect it upon the horizon glasses.

The brass frame with this glass is fixed to the index by the screw C, the other screws serve to replace it in a perpendicular position, if by any accident it should be deranged.

The *Horizon Glasses* are mirrors which receive the reflected rays from the object, and transmit them to the observer. They are not entirely quick-silvered; for the upper one, F, is only silvered on its lower part, or that half next the quadrant; the other half is transparent, and the back part of the frame is cut away, that nothing may impede the sight through the unsilvered part of the glass. The other *horizon glass* is silvered at both ends, but leaving in the middle a transparent slit, through which the horizon may be seen. Both of these glasses are so mounted as to have their positions set truly by their adjusters at the back, should the frame of the instrument be warped.

The shades or dark glasses, K, are two red or dark glasses, and one green one, for preventing the bright rays of the sun or the glare of the moon from hurting the eye of the observer. They may be used separately or together, as the brightness of the object may require. The green glass also may be used alone if the sun be very faint; it is also used for taking the altitude of the moon, and in ascertaining her distance from a fixed star.

When the glasses are used in the fore observation, they are fixed as represented in the figure. When used in the back observation, they are removed to N.

The two sight vanes H, I, are perforated pieces of brass designed to direct the sight parallel to the plane of the quadrant. That which is fixed at I, is used for the fore observation, the other for the back observation.

The *Divisions of the Arc, &c.* The limb is divided from right to left into 90 divisions, which are to be considered as degrees, each of which is sub-divided into three equal parts, which are therefore twenty minutes each. The odd minutes are obtained by means of the small divisions, which are placed on the small arc of the index.

The nonius, or subdividing scale, depends on this simple circumstance, that if any line be divided into equal parts, the length of each part will be greater the fewer divisions there are in the original line, and on the contrary, the length of each division will be less, in proportion as the divisions are more numerous.

Thus it may be observed that the two extreme strokes on the nonius contain 7 degrees, or 21 of the aforementioned small divisions, but that it is divided only into 20 parts, each of these parts will be longer than those of the arc, by $\frac{1}{20}$ th part or (1 minute) than the divisions of the arc; consequently if the first or index division of the nonius be set precisely opposite to any degree, the relative position of the nonius and the arc must be altered one minute before the next division on the nonius will coincide with the next division of the arc; the second division will require a change of 2 minutes, the third of 3 minutes, and so on till the 20th stroke on the nonius arrive at the next 20 minutes on the arc, the index division will then have moved exactly 20 minutes from the division whence it set out, and the intermediate divisions of each minute have been regularly pointed out by the divisions of the nonius. If therefore in taking an observation, the index division stands at 40° , then 40° is the measure of the required angle. If it coincides with the next division beyond 40° it is $40^\circ 20'$: if with the second division beyond 40° , the angle is $40^\circ 40'$, &c. But if the index does not coincide with 40° , but that the next division to it is the first coincident division, then is the required angle $40^\circ 1'$. If it had been the second division the angle would have been $40^\circ 2'$, and so on to $20'$, when the index division coincides with the first 20 minutes from 40° .

Again, suppose the index division to stand between 30° and $30^\circ 20'$, and that the 16th division on the nonius coincides with a division on the limb, then the angle is $30^\circ 16'$.

Also suppose the index division to stand between $35^\circ 20'$ and $35^\circ 40'$: and at the same time the 12th division on the nonius stands directly opposite to a division on the arc, then will the angle be $35^\circ 32'$.

To adjust the Instrument for a fore Observation.

Set the fore horizon glass parallel to the index glass, by the following method: Set the index line of the nonius exactly against O of the limb, and fix it there by the screw at the under-side; then look through the sight, I, at the edge of the sea, or some very distant object. The edge of the sea will be seen directly through the unsilvered part of the glass; but by reflection, in the silvered part. If the horizon in the silvered part exactly meets and forms one continued line with that seen through the unsilvered part, then is the instrument laid to be adjusted, and the horizon glass is parallel to the index glass. But if the horizons do not coincide, then loosen the milled nut on the under-side of the quadrant, and turn the horizon glass on its axis, by means of the adjusting lever, till you have made them perfectly coincide; then fix the lever firmly in the situation thus obtained, by tightening the middle nut. This adjustment ought to be repeated before and after every astronomical observation.

To find the Index Error, if any.

The instrument being adjusted as near as possible as above, move the index forward and afterwards bring it back, so that the edge of the No 117. VOL. III.

sea seen in the silvered part of the mirror may join exactly to, and form one continued line with the edge of the sea seen through the transparent part of the glass: this done, observe whether the index division on the nonius agrees with the 0 line on the arc; if it do not, the number by which they differ is a quantity to be added to the observation, if the index line is beyond the 0 on the limb; but if the index line of the nonius stands between 0 and 90 degrees, then this error is to be subtracted from the observation. That part of the arc beyond 0 towards the right hand is called the arc of excess; the nonius must be read the contrary way; or which is the same thing, you may read them off in the usual way, and take their complement to $20'$, and you will have the real number of degrees and minutes to be added to the observation.

Adjust the index glass, thus: Being provided with the two adjusting tools represented at fig. 15 and 16, (which are two wooden frames with two lines on each, exactly at the same distance from the bottom) place the quadrant in an horizontal position on a table, put the index about the middle of the arc, turn back the dark glasses, place one of the above mentioned tools near one end of the arc, the other at the opposite end, the side with the lines towards the index glass; then look down the index glass, directing the sight parallel to the plane of the instrument, you will see one of the tools by direct vision, the other by reflection in the mirror. By moving the index a little they may be brought exactly together. If the lines coincide, the mirror is rightly fixed, if not, it must be restored to its proper situation by loosening the screw and tightening the screw, or *vice versa*.

The fore-horizon glass must be placed perpendicular to the plane of the instrument, by the following means: having adjusted the index and horizon glasses, set the index division of the nonius exactly against 0 on the limb; hold the plane of the quadrant parallel to the horizon, and observe the image of any distant object at land, or of the horizon itself at sea. If the image seen by reflection be higher than the object seen directly, release the fore screw, and tighten the back screw; and *vice versa*, if the image seen by reflection be lowest. Thus proceed till both are of an equal height; and by moving the index you can make both objects appear as one. Care must be taken to loosen one screw before the other is screwed up, and to leave the adjusting screws tight.

THE USE OF THIS INSTRUMENT.

To take the Altitude of the Sun by the fore Observation.

The instrument, being previously adjusted, one or two of the dark glasses should be placed before the horizon glass, that the image may be viewed without injury to the eye. Hold the quadrant (in a vertical position, the arc downwards) either by the braces or the radii, as may be most convenient. Let the eye be at the upper hole in the sight vane, and the lower part of the limb against the breast. Turn towards the sun, and direct the sight to that part of the horizon that lies directly under it, keeping the quadrant as near as you can judge in a plane passing through the sun's centre, and the nearest part of the horizon, moving at the same time the index with the left hand, so as to bring the image of the sun down towards the horizon, then swing the quadrant round in a line parallel to the line of sight, by this means the image of the sun may be made to describe the arc of a circle, with the convex side downwards. Now, if that edge of the sun, which is observed, just touches the horizon, as a circle touches its tangent, the observation is rightly made. And the degrees and minutes pointed out by the nonius on the arc, shew the apparent altitude of the sun's lower limb, to which add the sun's apparent semidiameter, and you have the apparent altitude of the sun's centre.

This however is to be corrected by allowing for refraction and parallax, as will be shewn hereafter. Note, also the altitude must be corrected by allowing for the dip of the horizon, occasioned by the observer's eye being above the plane of the horizon.

To take the Altitude of a Star.

Set the index of the nonius to the 0 line of the limb; and hold the quadrant in a verticle position as before directed: look through the sight vane and the transparent part of the horizon glass straight up to the stars; which will coincide with the image seen in the silvered part, and form one star; but as soon as you move the index forwards, the reflected image will descend below the real star; you must follow this image by moving the whole body of the quadrant downwards, so as to keep it in the silvered part of the horizon glass, as the motion of the index depresses it until it comes down exactly to the edge of the horizon. The altitude of a star must be corrected by allowing for refraction and parallax.

SECT. V.

OF HADLEY'S SEXTANT, AS CONSTRUCTED AND SOLD BY THE LATE MR. GEORGE ADAMS.

The sextant is an instrument of the same kind as the former, only in this the arc consists of the sixth part of a circle instead of an eighth part, which renders it more useful in taking the angular distances of the sun and moon; or of the moon and a star, &c. for the purpose of finding the longitude.

Fig. 4. Plate V. of Astronomy, represents an instrument of this sort. The arc AA is divided into 120 degrees, each divided into

*

K

3 parts

NAVIGATION.

3 parts of 20 minutes each, as in the former instrument, which are again subdivided by the nonius into every half minute.

In order to observe correctly, an adjusting screw B is added to the index, through which it can be moved with greater accuracy than by the hand, but this screw does not act till the index is fixed by the finger screw C.

There are four tinged glasses at D, each of which is set in a separate frame that turns on a centre. They are used to screen and save the eye from the brightness of the solar image and the glare of the moon, and may be used separately or together as occasion requires. There are three more such glasses placed behind the horizon glass at E, to weaken the rays of the sun or moon when they are viewed directly through the horizon glass.

The frame of the index glass I, is firmly fixed by a strong cock to the centre plate of the index. The horizon glass F is fixed in a frame that turns on the axes or pivots, which move in an exterior frame; the holes in which the pivots move may be tightened by four screws in the exterior frame; G is a screw by which the horizon glass may be set perpendicular to the plane of the instrument; should this screw become loose it may be easily tightened by turning the capstan-head screw, H.

The sextant is furnished with a plane tube (fig. 7, in said Plate) without any glasses; and to render the object still more distinct, it has also two telescopes; one of which (fig. 5,) representing the objects erect, or in their natural position, and the other (fig. 6,) shews them inverted. The telescopes are to be screwed into a circular ring at K; this ring rests on two points against an exterior ring, and is held thereto by two screws; by means of which the axis of the telescope may be set parallel to the plane of the sextant. Fig. 8. is a circular head with tinged glasses to screw on the eye end of either of the telescopes. The glasses are contained in a circular plate, which has four holes; three of which are fitted with tinged glasses, the fourth is open. Fig. 9. is a small screw-driver; and fig. 10, a magnifying glass.

As to the adjusting of this instrument, those who know how to adjust the octant already described, cannot be at a loss how to adjust the sextant. The principal points are to set the horizon glass perpendicular to the plane of the sextant, and the axis of the telescope parallel thereto. Altitudes are taken by the sextant in like manner as by the octant; the sextant is also used in taking angular distances; I shall therefore say a few words on that head, referring however the reader for a more full description of the nature and use of both these instruments to a little pamphlet, by Mr. Adams, optician, designed for the instruction of those who purchase his octants, or sextants, and which therefore every one that uses such instruments ought to have.

To take the Angular Distance between the Moon and the Sun.

The moon should be viewed directly through the unfiltered part of the horizon glass, but the sun by reflection. If the sun be to the left hand of the moon, the sextant must be held with its face downwards, but with the face upwards if the sun be to the right of the moon; set the index to the distance of the nearest limbs of the sun and moon, computed in a rough manner from the Nautical Ephemeris; direct the telescope to the moon, putting the sextant into such a position, that if you look edge-ways against it, it may seem to form a line passing through the sun and moon. Then give the sextant a sweep, or swing round a line parallel to the axis of the telescope, and the reflected image of the sun will pass by the moon to and fro, so near that you cannot fail of seeing it. The nearest edges or limbs may now be brought into exact contact, by moving the index, and then using the adjusting screw. The index will then shew the apparent distance of the nearest edges of the sun and moon. And the true distance of their centres may be thence determined, as will be shewn when we treat of the method of working observations. In a similar manner the angular distance between the moon and a star, &c. may be observed. Only here the star must be viewed direct, and the moon by reflection.

PART IV.

METHODS OF FINDING THE LONGITUDE.

SECT. I.

BY HELP OF A PERFECT TIME-KEEPER.

If a time-keeper was so contrived as to go uniformly in all seasons, and in all places, and regulated to the true time at London, or Greenwich; then the time of the day under any other meridian being known, the difference between that time and the London or Greenwich time, would give the difference of longitude. Hence a good time-piece is of the utmost importance at sea; and many artists have endeavoured to construct such as should in all situations keep true time; and that excellent artist Mr. John Harrison, succeeded so well in his attempt, that the commissioners of longitude ordered him a reward of 10,000*l*.

SECT. II.

BY THE SUN'S DECLINATION.

Let such observations of the sun be made, as are sufficient for determining its declination, by some of the methods given in the

System of Astronomy. Take the difference between this computed declination, and that for the noon of the day at London, as shewn by the Ephemeris; from which also take the daily difference of declination at that time, and say, as the daily difference of declination is to the above found difference, so is 360° to the difference of longitude.

SECT. III.

BY THE ECLIPSES OF JUPITER'S SATELLITES.

Knowing (from the dead reckoning) within a small quantity, the difference of longitude between the meridian of the place, and that of London, turn the same into time, by allowing 15 degrees to an hour, then from the Nautical Ephemeris take the time of the eclipse's happening at London, and to that time add the time answering to the difference of longitude, if the place is east from London; or subtract it, if west, and you will have the time nearly when to look for the eclipse at that place; therefore begin to observe a quarter, or half an hour before, and note the precise time when you see the beginning or end of the eclipse, and the difference between that time and the time at London turned into degrees, is the difference of longitude required, which is east, if the time observed be after the time at London; but west, if before.

N.B. The same may be performed by an eclipse of the moon.

SECT. IV.

BY A LUNAR OBSERVATION, HAVING GIVEN THE ALTITUDES OF THE MOON AND SUN, OR A FIXED STAR, AND THEIR ANGULAR DISTANCES, WITH THE TIME OF OBSERVATION.

In order to the solution of this problem, the true angular distance must be first found as follows:

I. From the sun's refraction, take his parallax in altitude, and the remainder will be the correction of the sun's altitude. The correction of a star's altitude is its refraction only. The refraction and sun's parallax to all altitudes, are contained in page 1, of the requisite tables to be used with the Nautical Ephemeris, as is also the dip of the horizon for the different heights of the observer's eye, above the surface of the water.

II. Take the proportional logarithm of the moon's horizontal parallax, out of the Nautical Ephemeris; increase its index by 10, and subtract the log-cotangent of the moon's apparent altitude from the sun's, and the remainder will be the proportional logarithm of her parallax in altitude; then from her parallax in altitude, take the refraction answering to her apparent altitude, and the remainder will be the correction of her altitude.

III. Add the sun's apparent altitude to the moon's, and take half the sum; subtract the less from the greater, and take half the difference; add together the co-tangent of the half sum, the tangent of the half difference, and the co-tangent of half the observed distance, the sum, rejecting 20 from the index, is the log-tangent of an arc A.

IV. When the sun's altitude is greater than the moon's, take the difference between A, and half the apparent distance; but if the moon's altitude be greatest, take their sum; and to the co-tangent of this sum or difference, add the co-tangent of the sun's apparent altitude, and the proportional logarithm of the correction of the sun's altitude; their sum, when 20 is rejected from the index, is the proportional logarithm of the first correction of the apparent distance.

V. If the difference of the arc A, and half the apparent distance was taken in the preceding article, take now their sum; but if their sum was then taken, now take their difference; and to the log-cotangent of this sum or difference, add the log-cotangent of the moon's apparent altitude; and the proportional logarithm of the correction of the moon's altitude; the sum, rejecting 20 from the index, is the proportional logarithm of the second correction.

VI. If the arc A be less than half the apparent distance, the first correction must always be added to, and the second subtracted from the apparent distance; but when the arc A is greater than half the apparent distance, both the first and second corrections must be added, if the sun's altitude be less than the moon's; but if the moon's be the least, both must be subtracted to give the corrected distance of the sun and moon.

VII. Add together the proportional logarithms of the sum and differences of the moon's altitude; and the second correction of the observed distance, the log-tangent of the corrected distance, and the constant log 1.5820, the sum rejecting 10 from the index is the proportional log of the third correction, to be added to the corrected distance when it is less than 90, but subtracted when it is above, and this gives the true distance required. Then for the longitude find the time at Greenwich, when this true distance happened, which is readily done from the Nautical Ephemeris. The difference between the Greenwich time and the time at the ship, turned into degrees, by allowing 15° to an hour, is the difference of longitude.

It being requisite, in order to the finding the longitude by the foregoing method, to know the true time at the ship, the following methods of regulating the time-piece may be practised as often as circumstances will admit of them.

I. *By equal Altitudes.* The ship lying by, let the sun's altitude be taken in the forenoon, at three or four hours distant from noon; set down that time and altitude. In the afternoon, wait till the sun has exactly the same altitude, (the index of the quadrant

NAVIGATION.

rant being already set to the morning altitude) and note down that time, then the half sum of these two times is the apparent time shown by the clock or watch, when the sun was on the meridian of that place. When in any case it is wanted to reduce the apparent to mean time, seek in the nautical almanack the equation of time, answering to the given day, and apply it as the title directs to the apparent time, will give the mean time.

II. *By an Observation of the Sun's Altitude.* At a convenient time take the altitude of the sun's upper or lower limb, then subtract or add, as the case shall be, the sun's apparent semidiameter, and from the sum or difference take the dip of the horizon and the refraction, and you will have the sun's altitude at the centre corrected for dip and refraction. The parallax in altitude should be added to this, but in general it will not sensibly affect the altitude, for this purpose, it being at the horizon only about 9". At the time of the observation, find the ship's latitude and longitude by account, and correct the sun's declination for the day (obtained from the Nautical Ephemeris) by the difference of longitude and time from noon; then having the latitude, declination, and zenith distance, find the hour angle, as has been shewn in the System of Astronomy, which, turned into time, shews the apparent time when the observation was made. The like may be had from a star's altitude, &c. with this addition, that when the hour angle is found it must be applied to the star's right ascension, and it will give the right ascension of the mid-heaven. Then the difference between the right ascension of the mid-heaven, and the sun's right ascension, (found for the place and time) is the apparent time of the observation. Wherefore, regulate the watch by the apparent time thus found.

N. B. In altitudes, taken by the fore observation, the dip of the horizon and refraction are always to be subtracted from the sun's or moon's apparent central altitudes, and the parallax is to be added in order to get the true altitudes at the centre. In the fixed stars, the dip and refraction must be subtracted, the parallax as to them is insensible; and in common cases it is so small, even in the sun, that it need not be regarded, except near the horizon. The Nautical Ephemeris shews the apparent semidiameters of the sun or moon, which must be added to altitudes made on the lower limb, but subtracted from those of the higher limb, in order to obtain the apparent central altitudes.

There being a sufficient number of Examples in the Nautical Ephemeris and requisite table, which no mariner should be without, I thought it unnecessary to introduce any here.

PART V.

THE METHOD OF KEEPING A SEA JOURNAL.

I have before observed, that a sea journal is a book in which are entered the most remarkable daily occurrences at sea during a ship's voyage; and that this book is frequently so ordered, as to serve for a log-book also.

There is seldom, however, any log account kept till a ship is near losing sight of land; and then the bearing of some known cape, head-land, point, &c. is observed and its distance computed; a regular account of the ship's way is then kept, and the ship is said to make her departure from that place. The log in merchant's ships is usually heaved every two hours, but in some king's ships it is heaved every hour. The following is a specimen of such remarks as are usually made at first setting out at sea, and before the ship makes her departure.

I. THE TITLE OF THE JOURNAL.

A Journal of a Voyage from London to Madeira, in the Nancy of London, R. T. Commander, kept by T. W. Mate.

Departure from the Lizard in Lat. 49° 57' N. Long. 5° 14' W. bound for Funchal in Madeira, in Lat. 32° 38' N. Long. 17° 6' W. bearing from Lizard point S. 27° 1' W. distance 1156 miles.

II. THE JOURNAL REMARKS PREVIOUS TO THE DEPARTURE FROM THE LIZARD.

JOURNAL OF A VOYAGE, &c.

Wednesday April 23	At 5 A.M. the pilot came on board; then weighed and failed from Tower Wharf. At 11 came to with the Best Bower at Blackwall. Wind S. S. W.
Thursday 24	Fresh gales and cloudy weather with rain. At 5 A.M. weighed and failed; at 9 came to anchor at Gravesend and cleared ship. Wind from S. S. W. to N. N. W.
Friday 25	At 4 P.M. weighed and failed, moderate weather; at 9 came to with the Best Bower at Nore in 9½ fathoms; fresh gales; at 4 A. M. weighed and failed; at 11 came to anchor in the Downs in 7 fathoms, Deal Castle bearing W. ½ S. distant 3 miles. Wind W. by S.
Saturday 26	At 1 P.M. sent the pilot on shore. The first and middle parts of these 24 hours moderate and fair. The latter part strong gales and cloudy.
Sunday 27	Strong gales and cloudy. At 2 P. M. veered out the long serve of the Best Bower, top-gallant-yards down. At 4 P. M. struck yards and top-masts. These 24 hours very hard gales of wind. Wind W. by S.

JOURNAL OF A VOYAGE, &c.

Monday 28.	These 24 hours fresh gales. At 4 A.M. hove up the Best Bower, and let go the small Bower. At 9 hove up the small Bower, and let go the Best Bower again.
Tuesday 29.	At 6 P. M. strong gales and heavy rain. At 8 veered out the long serve, and let go the sheet anchor under foot. At 9 A. M. hove up the sheet anchor. Wind variable from S. by W. to W.
Wednesday April 30.	These 24 hours moderate and fair. Wind W. by S.
Thursday May 1.	These 24 hours fair with fresh gales. At 3 P.M. got top-gallant-mast-down. At 10 A.M. got yards and top-mast up. Wind S. W.
Friday 2.	At 2 P.M. hove short, at 4 weighed and failed. At 6 S. fore-land bore N. N. W. distant 4 miles. At 2 A. M. Fair-lee bore N. distant 6 miles; at 6 Beachy bore N. E. by E. 9 miles. Fresh gales and clear; several ships standing up channel; close reefed both top-fails; at 12 Bembridge Point bore W. N. W. 27 miles.
Saturday 3.	Fresh gales and clear. At 5 P.M. let out one reef of each top-fail. At 7 A. M. Portland light bore W. N. W. 9 miles. At 10 A. M. it bore N. E. 12 miles. Fifteen sail of merchantmen in sight.

Afterwards the ship approaching to the Lizard, the mate begins to keep account of the ship's way from the log-book as follows:

JOURNAL from LONDON to MADEIRA.

H	K	F	Courses	Winds	LW	Rem. on board Sun. May 11.
2						These 24 hours moderate gales, and fair weather.
4						At 6 P. M. the Lizard bore N. by E. distance 6 leagues, from which I take my departure, it being in the lat. of 49° 57' N. and Long. 5° 14' W. of London, unbent the cables, and stowed the anchor, 14 fail in sight standing to westward.
6			S. W. by S. N. W.			Variation 1½ point westerly.
8	4	5				
10	4	5				
12	5		S. W.			
2	5					
4	5	5				
6	5	5				
8	5	5				
10	5	5				
12	6					

Course	Dist.	S.	W.	lat. by D. R.	lat. by Ob.	M. dist.	diff. lon.	long. in	Bear. & Dist.
S. 26° 30' W.	107	98	48	48° 21' N.		0° 48'	1° 14'	5° 28' W.	Ullant N 80° 30' 54' miles

In the above day's account, the Lizard bearing N. by E. distance 6 leagues, is the same as if the ship had failed that distance from the Lizard upon the opposite, or S. by W. point of the compass, and allowing for the variation of the compass at that place makes it S. half E. distance 18 miles, which is to be set down as the first course, and distance in the following traverse table, which table for the day is generally put down at the bottom of each journal page, together with the calculations deduced therefrom, &c.

The first course steered by the compass is S. W. by W. which allowing for the variation (1½ point) makes S. W. by S. half W. and the sum of all the distances failed on that course till 2 o'clock, (when it alters) is 18½ miles, which being doubled, because the log is only heaved every 2 hours, gives 37 miles; which corrected course and distance I set down in the traverse table under the former. In like manner the second course (variation allowed, and distance doubled) is S. S. W. ½ W. 56 miles. Then from the table of difference of latitude and departure, I find the difference of latitude and departure to each course, and put them down in the table, and add them up; and I find the whole difference of latitude the ship has made is 95.9 miles south, and that she has made 1.8 departure east, and 49.9 departure west; taking the difference of the departures, the total departure is 48.1 west; therefore with this difference of latitude and departure, I find the difference of longitude either by the table of meridian parts or middle latitude, as has been before taught, I find the difference of longitude, which is 74 miles, or 1° 14' which write down in the 8th column under the day's account; and therefore the longitude the ship is in is 6° 28' W. which I enter in the 9th column.

Also with the said diff. latitude and departure I find the ship's course from the Lizard, as though she had failed from one point of the compass the whole time, and it comes out S. 26°, 30' W. and the distance in a direct course is 107 miles, both of which I put down in their proper columns: (namely, the first and second columns) also the difference of latitude being 95.9 (or 96) S. I put that down in the third column at the bottom, with an S. above it, and the difference of longitude I put down in the fourth column with W. above it

TRAVERSE TABLE.					
Course.	Dist.	N.	S.	E.	W.
S. ½ E.	18		17.9	1.8	
S. W. by S. ½ W.	37		38.6		23.5
S. S. W. ½ W.	56		49.4		26.4
			95.9	1.8	49.9
					48.1

NAVIGATION.

it. The latitude the ship is in, is $48^{\circ} 21' N.$ which I write in the fifth column. The meridional difference of latitude I place in the seventh column: Also Uthant being situated in latitude $48^{\circ} 30' N.$ and $5^{\circ} 5' W.$ I proceed to calculate by the rules before laid down, its bearing and distance, and I find it bears $N. 80^{\circ} 26' E.$ distant 54 miles, which I put down in the tenth column, and as no observations of the sun, &c. have been made, that day's account is computed. *N. B.* The difference of latitude and departure may be found by trigonometrical calculation for each course, but it is sooner done by the table of difference of latitude and departure.

In this manner the navigator is to proceed from day to day, making proper allowances for lee-way and currents when there are any, as well as for the variation; but the currents may be inserted in the traverse table (their setting and velocity being known) as a distinct course, by doing which a true allowance will be had. Also altitudes of the sun, stars, &c. for finding the latitude should be taken, and inserted in the journal at all opportunities; and the operations performed as shewn in the System of Astronomy. Then the latitude being had true, dead reckoning must be corrected by the rules, before laid down in order to get the longitude right; for which purpose, however, the lunar observation should be taken as often as possible. Then the latitude and longitude being determined right by observation, the dead reckoning account should begin a-new, unless there was reason to suspect that the observations were not well made.

The foregoing method of casting up a ship's reckoning (though constantly practised) is not strictly true, as it supposes equal departures to be uniformly made in sailing on each course; which if not true, though upon an average in one day's run, it may not materially err. The true method is to find the difference of longitude made along each course, and to insert the same in columns titled East and West, in like manner as for the departure; then the difference of their sums is the true difference of longitude the ship has made that day, if the course and distance were truly ascertained; and is east or west, according as the east or west longitudes were the greatest.

A ship's difference of latitude and departure during a day's sailing, may be determined by drawing from a good scale on paper; for measuring how far she is then from the meridian failed from will be the departure; and the distance measured on the meridian between where the line of departure cuts it, and the place failed from, in the difference of latitude. *Fig. 17.* is a representation of the ship's courses, during the above day's sailing after she took her departure.

The following is a question in navigation proposed and answered in the following manner.

Suppose two ports, one in latitude of $30^{\circ} N.$ the other in lat. $40^{\circ} N.$ and their difference of longitude 50° , required the bearing and distance of each of them from an island equally distant from both, in 18° of South Latitude.

First say as the meridional difference of latitude of the two Ports (735) : difference of longitude (3000) :: proper difference of latitude (600) : departure (2449) Then the course is had by this proportion, as meridional difference of latitude is to radius, so is difference of longitude to tangent of the course, which comes out $76^{\circ} 14'.$

This being done, proceed to describe the situation of the two ports and island, thus. Draw AB (*fig. 18.*) = to the departure of the two ports, and make BC perpendicular thereto, and equal to the difference of latitude. So will A and B represent the two ports. Draw AE perpendicular to AB and equal to the difference of latitude between the port A and the island (= 2880 miles) and draw EF parallel to AB . Also from the middle of the line AB erect a perpendicular HD , cutting AF in D , then D is the place of the island. Also let fall the perpendicular HG ; then the angle GHD is equal to the complement of the course = $13^{\circ} 46'$; also $HG = 48^{\circ} + 5^{\circ} = 53^{\circ} = 3180$ miles, and therefore as $\text{rad.} : HD (3180)$ so is tangent of $\angle GHD (13^{\circ} 46')$ to $GD = 779$. Also $EG = \frac{1}{2} AB = 1224.5$; and $GD + EG = 1224.5 + 779 = ED = 2003.5$ miles = the departure that a ship would make in sailing from the port A to the island at D . Also $2449 - 2003.5 = 445$ miles, the departure that a ship would make in sailing from the port C to the said island. Then AE being = 2880 miles, AD is = $2880^2 + 2003.5^2)^{\frac{1}{2}} = 3508.2$ miles nearly = the distance between the island and each port.

Then as the distance $AD (3508.2)$: $\text{rad.} :: ED (2003\frac{1}{2})$: sine $34^{\circ} 50\frac{1}{2}'$, a ship's course in sailing from the port A to the island, so that if the port in the latitude of $30^{\circ} N.$ be to the West of that in the latitude of $40^{\circ} N.$ its bearing from the island is $N. W.$ by $N. 1^{\circ} 10' W.$ but if it is situate to the east of the other latitude, then its bearing from the island is $N. E.$ by $N. 1^{\circ} 10' E.$ Also as the distance $CD (= AD = 3508.2)$: $\text{rad.} :: DI (= IE - ED = 445\frac{1}{2} \text{ miles})$: sine $7^{\circ} 17\frac{1}{2}'$, a ship's course in sailing from the port C to the island B ; so that if the port C is to the East of the port A , it will bear $N.$ by $E. 3^{\circ} 57\frac{1}{2}' N.$ from the island: or if it is to the west of the port A , the bearing will be $N.$ by $W. 3^{\circ} 57\frac{1}{2}' N.$

N. B. The distance here given is not on the arc of a great circle, but on the rhumb-lines which pass between the island and the ports, it being apprehended that such is the true sense of the question.

PART VI.

A SELECTION OF OTHER ARTICLES OF USE TO THE PRACTICAL NAVIGATOR.

SECT. II.

TO DETERMINE THE POSITION OF THE SAILS OF A SHIP, IN RESPECT TO THE WIND, THE POSITION OF THE RUDDER, AND WAY OF WORKING A SHIP.

The sails of a ship have more or less force to move the ship, according to the different position they have in respect of the ship's keel, as well as in respect to the wind; concerning which, observe these general Rules.

RULE I. Head sails serve to keep a vessel steady, and to make her wear. Main sails tend only to move the centre of gravity of the ship. Mizzen sails keep a ship from sheering backwards and forwards, and serve to force a ship's stern to leeward. Sails have more force the tighter they are hoisted; and a sail that bags has less power. The higher a sail is placed, the more wind it will receive to move the ship. Wet sails draw more than dry ones.

II. Any one sail gives the greatest motion to the ship when it stands at right angles to the keel, and the ship goes directly before the wind. But in all the sails together, (because one sail keeps the wind from another;) if the wind come at an angle of about 60 degrees, they will have the most power to move the ship. Likewise the nearer a right angle any sail makes with the keel, or ship's way, the less lee-way she makes, and the further from a right angle, the more lee-way.

Again, the nearer the way of the wind is with the way of the ship, the less lee-way; and the more distant or across, the more lee-way she makes.

III. As to the most advantageous placing of the sails: If S be a ship (*fig. 19*) SD her way, SA the sail, WS the direction of the wind, or the point it blows from. Then if the ship lie near the wind, the angle WSA must be almost twice the angle ASD , that is, the angle between the wind and the sail, should be nearly double the angle between the sail and the keel. If the wind come near at right angles to the way of the ship, the angle WSA must be once and a half the angle ASD . And if she go almost before the wind, the sail must almost bisect the angle between the point of the wind and the keel. And such positions will give the greatest motion to the ship. And to cause her to gain the most to windward, the angle WSD must be 55° , WSA 35° , and ASD 20° , or thereabouts, if any ship can lie so nigh the wind; if not, then they must be in that proportion.

IV. If the wind come almost across the way of the ship, then the sharper the head sails are set, the more power they have to turn the ship's head about. Again, if the way of the wind be nearly the same as the way of the ship, the sail ought to make an angle with the keel of 54° . If the wind make an angle of 40° or 50° deg. with the ship's way, the angle between the sail and the keel may be about 30° degrees, and these positions will turn her fastest about.

V. The most advantageous position of the rudder, so as to have the greatest force possible in turning the ship about, is, when it makes an angle with the keel of $54\frac{1}{2}^{\circ}$. The faster a ship sails, the better she will answer her helm; if the sail very slow, she will scarce steer at all. If the heel much, she will not answer the helm so well.

SECT. II.

TO FIND THE TIME OF HIGH WATER AT ANY GIVEN PLACE.

RULE. By the tide-table, in the Book of requisite Tables, find the time of full sea on the full or change day, for the place proposed; add to this the time of the moon's southing.

Otherwise, by the Nocturnal. Set 12 o'clock on the middle piece; to the time of high water at the new or full moon, on the great piece: then bring the long index to the moon's southing or age on the middle piece; this cuts the inner circle (the circle of hours) of the great piece, as required.

Example. At the Lizard, it is full sea at 7 : 30 at the full, by the table. And suppose the moon to be south, at 16 $\frac{1}{2}$, the sum is 24 $\frac{1}{2}$: that is, a quarter past 12 next day, the time of high water.

In this System, I have cautiously endeavoured to explain the whole Art of Navigation, in a concise, clear, and practical way; and have exploded those useless methods with which books on this subject have been generally incumbered. I have therefore been silent on great Circle Sailing; for ships being steered by the compass, can never sail on the arc of a great circle, except on a direct north or south course, or along the Equator, which cases require not the application of Spherics. Therefore I trust it will appear, that while I have been expunging extraneous matter, I have not rejected any article that could prove of essential service at sea.

ROBERT MOODY.

Excise-Office, Broad-Street.

NAUTILUS, a genus belonging to the order of vermes testacea. The shell consists of one spiral valve, divided into several apartments by partitions. For a more particular account, see the System of CONCHOLOGY, Genus XIX.

There are seventeen species, chiefly distinguished by particularities in their shells. Bonani observes, that this genus of shell-fish is very well named from the Greek ναυτιλος, which signifies both "a ship" and "a sailor;" for that the shells of all the nautili carry the appearance of a ship with a very high poop. It is by some imagined that men first learned the art of navigation from this animal.

The most remarkable divisions of the nautili is into the thin and thick-shelled kinds. The first is called *nautilus papyraceus*; and its shell is indeed no thicker than a piece of paper when out of the water. When this species is to sail, it expands two of its arms on high, and between these supports a membrane, which it throws out on this occasion: this serves for its sail, and the two other arms it hangs out of its shell, to serve occasionally either as oars or as a steering; but this last office is generally served by the tail. When the sea is calm, it is frequent to see numbers of these creatures diverting themselves in this manner: but as soon as a storm rises, or any thing gives them disturbance, they draw in their legs, and take in as much water as makes them specifically heavier than that in which they float; and then they sink to the bottom. When they rise again, they void this water by a number of holes, of which their legs are full. The other nautilus, whose shell is thick, never quits that habitation.

NAVY, the fleet or shipping of a prince or state. For an account of the laws, discipline, management, &c. of the navy of Great Britain, naval tactics, naval engagements, with the construction of ships, &c. see the Treatise on Naval Affairs.

NAVY, or *Vitallising Bills*, are bills or orders for the payment of money, issued by the commissioners of the navy, and other boards in that department, on the treasurer of the navy, for stores purchased, &c. These bills are not payable at any fixed time, but bear interest at the rate of 4 per cent. after six months, from the date of their being registered at the respective offices; and they have generally been paid off within eighteen months, or two years, from the time of their being issued.

NAYRES, the nobility of the Malabar coast. We may with truth affirm that they are the oldest nobility in the world; for the most ancient writers mention them, and quote the law that permits the Nayre ladies to have many husbands; every one being allowed four. Their houses, which stand single, have as many doors as the lady has husbands. When one of them visits her, he walks round the house, striking with his sabre on his buckler: he then opens his door, and leaves a domestic with his arms in a kind of porch, who serves to inform others that the lady is engaged. It is said, that one day in the week the four doors are all opened, and all her husbands visit her, and dine together with her. Each husband gives a sum of money, or portion, at the time of marriage; and the wife has only the charge of the children. The Nayres, even the Samorin, and the other princes, have no other heirs than the children of their sisters. This law was established, that the Nayres, having no family, might be always ready to march against the enemy. When the nephews are of age to bear arms, they follow their uncles. The name of *father* is unknown to a Nayre child. He speaks of the husbands of his mother and of his uncles, but never of his father.

NAZARITE, or **NAZAREAN**, or *Nazarines*, a term which may signify. 1. One that is of Nazareth, or any native of this city. 2. It was given to Jesus Christ and his disciples, and is commonly taken in a sense of derision and contempt, in such authors as have written against Christianity. 3. It has been taken for a sect of heretics called Nazareans. 4. For a Nazarite, a man that has laid himself under the obligation of a vow to observe the rules of Nazaritethip, whether it be for his whole life, as Sampson and John the Baptist, or only for a time, as those mentioned in Numbers vi. 18, 19, 20. Amos ii. 11, 12. Lastly, the name Nazarite in some passages of scripture denotes a man of particular distinction and great dignity in the court of some prince.

The Nazareate was a state of separation from the rest of mankind; particularly in three things. 1. In that the person devoted hereto drank no wine. 2. In that they did not shave their heads, but let the hair grow. 3. In avoiding the touch of dead people, which they held a defilement.

NEBULOUS, *Cloudy*, in astronomy, a term applied to certain of the fixed stars, which shews a dim, hazy light; being less than those of the sixth magnitude, and therefore scarce visible to the naked eye, to which at best they only appear like little dusty specks or clouds. Through a moderate telescope, these nebulous stars plainly appear to be congeries or clusters of several little stars.

NECESSARY, in a philosophical sense, that which cannot but be, or cannot be otherwise. The learned make a great many kinds or divisions hereof: as, *necessary in causing*; when there is a cause from which an effect must necessarily follow: *necessary in predicating*; *necessary in being*, &c. There is also a *logical necessity*; *physical necessity*; and there are *metaphysical* and *moral necessities*.

NECESSITY, what is done by a necessary cause, or a power that is irresistible. In this sense necessity stands opposed to liberty.

Whether man is a necessary or a free agent, is a question which

has been debated with much ingenuity by writers of the first eminence, from Hobbes and Clarke, to Priestley and Gregory. See PREDESTINATION.

Necessity is usually confounded with constraint; yet, in effect, necessity, according to Rochefoucault, differs from constraint in this, that the former is joined with the pleasure and inclination of the will, to which constraint is contrary. Simplicius, after Plato and Epictetus, distinguishes two kinds of necessity; the one *violent or coercive*, which is opposite to liberty; the other *spontaneous or voluntary*, very consistent with it; this latter, adds he, is that which necessitates all things consistent with their nature, as being connatural to them; since *αὐτονομία*, a thing that is self-moved, must of necessity be removed according to its own nature, i. e. spontaneously. This distinction is admitted by many of the divines, particularly by St. Augustine, who urges it against the Pelagians, as is shewn by Janfenius. The learned distinguish a *physical necessity* and a *moral necessity*; and a *simple absolute necessity*, and a *relative one*.

Physical NECESSITY, is the want of a principle, or of a natural means necessary to act; which is otherwise called a *physical* or *natural impotence*.

Moral NECESSITY, is only a great difficulty; such as that arising from a long habit, a strong inclination, or violent passion.

Simple or absolute NECESSITY, is that which has no dependence on any state or conjuncture, or any particular situation of things, but is found every where, and in all the circumstances in which the agent can be supposed. Such is in a blind man the necessity he is under of not distinguishing colours.

Relative NECESSITY, is that which places a man in a real incapacity of acting, or not acting in those circumstances, and that situation he is found in; though in other circumstances, and another state of things, he might act, or not act. All these kinds of necessity are opposite to liberty; since, even in the last, it is as impossible for a man to act, or not act, as if he were in a state of *absolute, simple, and physical necessity*. The learned admit other species of necessity; antecedent, concomitant, consequent, &c.

Antecedent NECESSITY, is that arising from an antecedent cause, necessarily operating. Such is the necessity of the sun's rising to-morrow morning.

Concomitant NECESSITY, arises from an antecedent cause, but depends on the circumstances of the effect; the effect all the while being free. Thus it is necessary Peter sit, supposing he is sitting.

Metaphysical or Philosophical NECESSITY, is a term used much by modern writers; and which some have defined to be, that by which a thing cannot but be, or whereby it cannot be otherwise. But a much approved author on this subject objects against this definition, and observes that *philosophical necessity* is really nothing else than the full and fixed connection between the things signified by the subject and predicate of a proposition, which affirms something to be true; so that it is in no respect different from their certainty. When there is such a connection, then the thing affirmed in the proposition is necessary in a philosophical sense; whether any opposition or contrary effort be supposed or supposable in the case, or no. When the subject and predicate of the proposition, which affirms the existence of any thing, either substance, quality, act, or circumstance, have a full and certain connection, then the existence of that thing is said to be necessary in a metaphysical sense.

Those that are commonly called *Necessarians* allow no other liberty to man, that is not restrained by this kind of necessity: and when they consider intelligent beings as the subjects of it, some of them distinguish it into *moral* and *natural necessity*. *Moral necessity* is used in a variety of senses; sometimes for a necessity of moral obligation; and often for great obligation in point of interest: sometimes by *moral necessity* is meant that apparent connection of things, which is the ground of moral evidence; and so it is distinguished from *absolute necessity*, or that sure connection of things, that is a foundation for infallible certainty: and sometimes by *moral necessity* is meant that necessity of connection and consequence, which arises from such moral causes as the strength of inclination or motives, and the connection, subsisting in many cases, between these and certain volitions and actions. By *natural necessity*, as applied to men, they understand such necessity as men are under, through the force of natural causes; in contradistinction to those that are called moral causes; such as habits and dispositions of the heart, and moral inducements and motives.

Mr. Hobbes, who is said to have been the first that understood and maintained the proper doctrine of *philosophical necessity*, gives the following account of it, in his Leviathan, p. 108. Liberty and necessity are consistent; as in the water that hath not the liberty, but a necessity of descending in the channel; so likewise in the actions which men voluntarily do, which, because they proceed from their will, proceed from liberty; and yet, because every act of man's will, and every desire and inclination, proceedeth from some cause, and that from another cause, in a continual chain, (whose first link is in the hand of God, the first of all causes), proceed from necessity: so that to him, who could see the connections of those causes, the necessity of all men's voluntary actions would appear manifest; and, therefore, God, that seeth and disposes all things, seeth also that the liberty of man, in doing what he will, is accompanied with the necessity of doing that which God will, and no more or less; for though men may do many things, which God does not command, nor is,

therefore, the author of them, yet they can have no passion, will, or appetite to any thing, of which appetite God's will is not the cause; and did not his will assure the necessity of man's will, and consequently of all that on man's will dependeth, the liberty of men would be a contradiction and impediment to the omnipotence and liberty of God.

Mr. Collins, one of the most admired writers on the subject of necessity, has stated the question concerning human liberty in the following manner: man, he says, is a necessary agent, if all his actions are so determined by the causes preceding each action, that not one past action could possibly not have come to pass, or have been otherwise than it hath been; nor one future action can possibly not come to pass, or be otherwise than it shall be. But he is a free agent, if he is able, at any time, under the circumstances and causes he then is, to do different things; or, in other words, if he is not unavoidably determined, in every point of time, by the circumstances he is in, and causes he is under, to do that one thing he does, and not possibly to do any other. According to this state of the question, he undertakes to prove, that a man is a necessary agent; and that there neither is nor can be such a thing as liberty. 1. He appeals to experience; alledging, that, though the vulgar urge this in proof of liberty, it is not a proof of it; that many celebrated philosophers and theologians, both ancient and modern, have given definitions of liberty, that are consistent with fate or necessity: that some great patrons of liberty do, by their concessions in this matter, destroy all arguments from experience; that all the actions of men may be ranked under the four heads of perception, judging, willing, and doing as we will; and that experience does not prove any of these to be free; and that experience not only does not prove liberty, but, on the contrary, men may see by experience, that they are necessary agents. It is, says he, matter of experience, that man is ever determined in his willing; we experience perfect necessity; and they, who think liberty a matter of experience, yet allow that the will follows the judgment of the understanding, and that when two objects are presented to a man's choice, one whereof appears better than the other, he cannot chuse the worst. 2. Man is a necessary agent, because all his actions have a beginning; for whatever has a beginning, must have a cause, and every cause is a necessary cause: and if any action whatsoever can be done without a cause, then effects and causes have no necessary relation; and, consequently we should not be necessarily determined in any case at all. 3. Liberty would not be a perfection, but an imperfection; whereas, on the contrary, necessity is an advantage and a perfection. 4. Liberty is consistent with the Divine prescience; for if God foreknows the existence of any thing, as it depends on its own causes, that existence is no less necessary than if it were the effect of his decree; for it no less implies a contradiction, that causes should not produce their effects, than that an event should not come to pass that is decreed by God.

This argument for necessity has been urged by a variety of writers; and the advocates for liberty have felt its force, and endeavoured to obviate it. Some have actually given up the Divine prescience: some have allowed the seeming contradiction, implied in the fore-knowledge of a contingent event, and have acknowledged themselves incapable of removing it; others have endeavoured to reconcile the foreknowledge of God and the liberty of man, by alledging that there is a great difference between God's foreknowledge and his decrees, with regard to the necessity of future events; for God's prescience has no influence at all on our actions; his infallible judgment, concerning contingent truths, does no more alter the nature of the things, and cause them to be necessary, than our judging right, at any time concerning a contingent truth, makes it cease to be contingent; or, than our sense of a present truth is any cause of its being true or present.

In the argument, says Dr. Clark, drawn against liberty from the divine prescience, it must not first be supposed that things are in their own nature necessary; but from the divine prescience or power of judging infallibly (which power is as much more extensive and infallible than in man, as the divine nature and understanding are superior to ours), concerning free events, it must be proved, that things otherwise supposed free, will, therefore, unavoidably become necessary, which can no more be proved, than it can be proved that an action, supposed at this present time to be free, is yet (contrary to the supposition) at the same time necessary; because, in all past time, whether foreknown or not foreknown, it could not, upon that very supposition of its being now freely done, but be future.

It cannot reasonably be disputed, that there is an essential difference between the foreknowledge and permission of events, and the preordination and production of them; and the scheme of necessity seems directly to charge God with being the efficient cause or author of those vices and evils, which arise from circumstances and connections of his previous and absolute appointment. Indeed, many of the advocates of this scheme will not admit the consequence that seems to be fairly deducible from their opinion: however, Dr. Priestley very candidly allows it. It certainly (says he) sounds harsh to vulgar ears to say, that in all those crimes that men charge themselves with, and reproach themselves for, God is the agent: and that, in such cases, they are in reality no more agents than a sword is an agent, when employed to commit a murder. It does require strength of mind not to startle at such a conclusion;

but then it requires nothing but strength of mind; i. e. such a view of things as shall carry us beyond false and fallacious appearances.

5. Another argument in favour of necessity is the following: if a man was not a necessary agent, determined by pleasure and pain, there would be no foundation of rewards and punishments, which are the essential supports of society. These would be useless, because if men were free and indifferent to pleasure or pain, they could be no motives to a man to do or forbear any action.

6. Another argument of the same kind is deduced from the nature of morality: for if a man is not a necessary agent, determined by pleasure and pain, he would have no notion of morality, or motive to practise it; and if he were indifferent to pleasure and pain, he would have no rule to go by, and might never judge, will, and practise right. Every act of the will, it is said, is excited by some motive, which motive is the cause of that act; and if volitions are properly the effect of motives, then they are necessarily connected with their motives; whence it is inferred, that volition is necessary, and doth not proceed from any self-determining power in the will. This argument has been illustrated and urged in all its force by many modern writers, from M. Leibnitz to Dr. Priestley, the last and most zealous advocate for necessity: and it has often been answered by Dr. Clarke and others, who have strenuously maintained, that liberty is perfectly consistent with men's acting from a regard to motives.

Supposing, says Dr. Price, a power of self-determination to exist, it is by no means necessary that it should be exerted without a regard to any end or rule: on the contrary, it can never be exerted without some view or design. Whoever acts, means to do something. The power determining ourselves by the very nature of it, wants an end to rule or guide it; and no probability or certainty of its being exerted agreeably to a rule, can have the least tendency to infringe or diminish it. All that should be avoided here, is the intolerable absurdity of making our reasons and ends, in acting, the physical causes or efficient of action. This is the same with ascribing the action of walking, not to the feet, or the power which moves the feet, but to the eye, which only sees the way. The perception of a reason for acting, or the judgment of the understanding, is no more than seeing the way: it is the eye of the mind, which informs and directs; and whatever certainty there may be, that a particular determination will follow, such determination will be the self-determination of the mind; and not any change of its state stamped upon it, over which it has no power, and in receiving which, instead of being an agent, it is merely a passive subject of agency. Although the views and ideas of beings may be the occasion of their acting; yet it is a contradiction to make them the mechanical efficient of their actions; so necessary and important is the distinction insisted upon by Dr. Clarke, between the operation of physical causes and the influence of moral reasons.

Upon the whole, the question concerning liberty is not, whether the views or ideas of beings influence their actions, but what is the nature of that influence. If we say, that it is some kind of mechanical or physical efficiency; or, with Dr. Priestley, after Hobbes and Leibnitz, that man has no other liberty, in following motives, than water has in running down hill, or that the arms of a scale pressed by weights, have in rising and falling; then it must follow, that man never acts; and it must be folly to applaud or reproach ourselves for our conduct; and there is an end of all moral obligation and accountableness. See LEIBNITZIAN PHILOSOPHY.

However the Necessarians do not allow these consequences; but, on the contrary, maintain that the doctrine of the necessary influence of motives upon the mind of man, makes him the proper subject of discipline, reward and punishment, praise and blame, both in the common and philosophical use of the words; and that the doctrine of self-determination, independently of the influence of motives, entirely disqualifies a man from being the proper subject of them.

Mr. Edwards, an acute writer on this subject, has endeavoured to prove, that liberty of indifference is not only not necessary to virtue, but utterly inconsistent with it; and that all habits of inclination, whether virtuous or vicious, are inconsistent with the Armenian notions of liberty and moral agency. And Dr. Priestley observes, that the sense of self-reproach and shame is excited by our finding that we have a disposition of mind leading to vice, and on which motives to virtue, in particular cases, have had no influence. If we ask, whence proceeds that disposition, and how it comes to pass, that motives to virtue had not a greater influence, we must ultimately ascribe the inefficiency of the one, and the evil tendency of the other, to God, who made us what we are, and placed us in the situation which we occupy. Dr. Priestley overcomes this difficulty, by alledging that the distinction between things natural and moral entirely ceases in the scheme of necessity; that the vices of men come under the class of common evils, producing misery for a time, but, like all other evils, in the same great system, ultimately subservient to greater good. In this light, he says, every thing without distinction may be ascribed to God. However, he acknowledges, that this is a view of moral evil, which, though innocent and even useful in speculation, no wise man can or would chuse to act upon himself, because our understandings are too limited for the application of such a means of good; though a being of infinite knowledge may introduce it with the greatest advantage. If there be

be any foundation for the doctrine of necessity, i. e. if all events arise from preceding situations, and the original situations of all things, together with the laws by which all changes of situation take place, were fixed by the Divine Being, there can be no difference whatever, with respect to his causation of one thing more than another, and even whatever takes place in consequence of his withholding his special and extraordinary influence, is as much agreeable to his will as what comes to pass in consequence of the general laws of nature. But our supposing that God is the author of sin (as by the scheme of necessity he must in fact be the author of all things), by no means implies, that he is a sinful being; for it is the disposition of mind, and the design, which constitutes the sinfulness of an action. If, therefore, this disposition and design be good, what he does is morally good. To the same purpose he observes, that the proper foundation, or rather the ultimate object of virtue is general utility; since it consists of such conduct as tends to make intelligent creatures the most truly happy in the whole of their existence; though, with respect to the agent, no action is denominated virtuous, that is not voluntary, or that does not proceed from some good motive. And this reasoning he applies to the Deity, who pursues the happiness of his creatures by such means as are best calculated to secure that end, and which are sanctified by it. And he farther adds, that the Deity may adopt some things, which he would not have chosen on their account, but for the sake of other things, with which they were necessarily connected.

The scriptures, according to this last writer, are favourable to the doctrine of necessity; though he does not think that the sacred writers were, strictly speaking, Necessarians, for they were not philosophers: but their habitual devotion led them to refer all things to God, without reflecting to the rigorous meaning of their language; and very probably, had they been interrogated on the subject, they would have appeared not to be apprized of the proper extent of the Necessarian scheme, and would have answered in a manner unfavourable to it.

The reader who is desirous of being farther acquainted with the reasoning of different writers on this subject, may consult the Collection of Papers between Leibnitz and Clarke, 1717. Collins's Philosophical Enquiry concerning Human Liberty, 1735, 3d ed. with Clarke's Answer. Edwards on the Freedom of the Will, 8vo. 1775, 4th ed. Priestley's Doctrine of Philosophical Necessity, 8vo. 1777. Correspondence between Dr. Price and Dr. Priestley, 8vo. 1778. Hartley's Observations on Man, 8vo. 1749.

NECESSITY, in mythology, a power superior to all other powers, and equally irresistible by gods and by men. Herodotus, as he is quoted by Cudworth, mentions an oracle which declared that "God himself could not shun his destined fate." And among the fragments of Philemon, collected by Le Clerc, is the following sentence:

Δουλοὶ βασιλεῶν ἐσμεν, οἱ βασιλεῖς θεῶν, ὁ θεὸς ἀναγκη.

"We are subject to kings, kings to the gods, and God to necessity." Hence it is, that, in the Iliad, we find Jove himself, the fire of gods and men, regretting that he was restrained by necessity from rescuing his favourite son from the sword of Patroclus. Nay, to such a height was this impiety carried in the earliest ages of Greece, that we find Hesiod and Homer teaching that the gods themselves were generated by necessity, of night and chaos.

This power, though always represented as blind and unintelligent, was however worshipped as a goddess, bearing in her hand large iron-nails, wedges, anchors, and melted lead, as emblems of the inflexible severity of her nature. "In the city of Corinth she had a temple, in which the goddess Violence likewise resided, and into which no person was ever permitted to enter but the priest who officiated in *sacris*."

Learned men have exercised their ingenuity in vain attempts to trace this portentous notion to its origin. Some, who wished to interpret it in a pious sense, have supposed that the gods who were subject to necessity were only those who were the ministers of the supreme numen; and that by necessity itself was meant nothing more than divine providence. But this is not consistent with Hesiod and Homer's generation of the gods, or with the epithets *severa necessitas*, by which this power was perpetually distinguished. Others, and among them Mosheim, have supposed that this monstrous fable was invented by the pagan priests, and diligently inculcated upon the minds of the people, in order to excuse the villainies of the objects of their worship. For, says he, who could be indignant at Jupiter's numberless adulteries, after it was known that in all his actions he was the servant of blind necessity? In the thefts of Mercury, the whoredoms of Venus, and the frequent squabbles of the other gods, there could be no moral turpitude, if they were under the influence of a superior power.

Numina cum videas turis obnoxia satis,
Invidia possis exonerare deos.

This account of the matter is at least as plausible as any other which is usually given. See PARCÆ.

NECESSITY, in law, as it implies a defect of will, excuses from the guilt of crimes. See CRIME.

Compulsion and inevitable necessity are a constraint upon the will, whereby a man is urged to do that which his judgment disapproves;

and which, it is to be presumed, his will (if left to itself) would reject. As punishments are therefore only inflicted for the abuse of that free will which God has given to man, it is highly just and equitable that a man should be excused for those acts which are done through unavoidable force and compulsion.

1. Of this nature, in the first place, is the obligation of *civil subjection*, whereby the inferior is constrained by the superior to act contrary to what his own reason and inclination would suggest: as when a legislator establishes iniquity by a law, and commands the subject to do an act contrary to religion or sound morality. How far this excuse will be admitted *in foro conscientie*, or whether the inferior in this case is not bound to obey the divine rather than the human law, is not our business to decide; though, among the casuists, it is believed the question will hardly bear a doubt. But, however that may be, obedience to the laws in being is undoubtedly a sufficient extenuation of civil guilt before the municipal tribunal. The sheriff who burned Latimer and Ridley, in the bigotted days of Queen Mary, was not liable to punishment from Elizabeth for executing so horrid an office; being justified by the commands of that magistracy which endeavoured to restore Superstition, under the holy auspices of its mercilefs sister, Persecution.

As to persons in private relations, the principal case where constraint of a superior is allowed as an excuse for criminal misconduct, is with regard to the matrimonial subjection of the wife to her husband: for neither a son nor a servant are excused for the commission of any crime, whether capital or otherwise, by the command or coercion of the parent or master; though in some cases the command or authority of the husband, either express or implied, will privilege the wife from punishment, even for capital offences. And therefore, if a woman commit theft, burglary, or other civil offences against the laws of society, by the coercion of her husband, or even in his company, which the law construes a coercion, she is not guilty of any crime; being considered as acting by compulsion, and not of her own will. Which doctrine is at least 1000 years old in this kingdom, being to be found among the laws of King Ina the West-Saxon. In treason also (the highest crime which a member of society can, as such, be guilty of), no plea in coverture shall excuse the wife; no presumption of the husband's coercion shall extenuate her guilt: as well because of the odiousness and dangerous consequence of the crime itself, as because the husband, having broken through the most sacred tie of social community by rebellion against the state, has no right to that obedience from a wife, which he himself as a subject has forgotten to pay. In inferior misdemeanors also, we may remark another exception, that a wife may be indicted and set in the pillory with her husband, for keeping a brothel: for this is an offence touching the domestic economy or government of the house, in which the wife has a principal share; and is also such an offence as the law presumes to be generally conducted by the intrigues of the female sex. And in all cases where the wife offends alone, without the company or coercion of her husband, she is responsible for her offence as much as any feme-sole.

2. Another species of compulsion or necessity is what our law calls *duress per minas*; or threats and menaces, which induce a fear of death or other bodily harm, and which take away for that reason the guilt of many crimes and misdemeanors, at least before the human tribunal. But then that fear which compels a man to do an unwarrantable action ought to be just and well-grounded; such, "qui cadere possit in virum constantem; non timidum et meticulosum," as Bracton expresses it, in the words of the civil law. Therefore, in time of war or rebellion, a man may be justified in doing many treasonable acts by compulsion of the enemy or rebels, which would admit of no excuse in the time of peace. This, however, seems only, or at least principally, to hold as to positive crimes, so created by the laws of society, and which therefore society may excuse; but not as to natural offences, so declared by the law of God, wherein human magistrates are only the executioners of divine punishment. And therefore though a man be violently assaulted, and hath no other possible means of escaping death but by killing an innocent person, this fear and force shall not acquit him of murder; for he ought rather to die himself than escape by the murder of an innocent. But in such a case he is permitted to kill the assailant; for there the law of nature, and self-defence its primary canon, have made him his own protector.

NECROMANCY, the art of revealing future events by a pretended communication with the dead.

This superstitious and impious imposture appears to have had its origin at a very early period in Egypt, and to have been thence propagated in every nation with the manners of which history has made us acquainted. The conquests of Sesostris might introduce it into India; the Israelites would naturally borrow it from the people among whom they sojourned 400 years; and it would easily find its way into Phœnicia, from the vicinity of that country to the land of its nativity. From the Egyptians and Phœnicians it was adopted, with the other rites of paganism, by the Greeks; and it was imported into Rome with Grecian literature and Grecian manners. It was not however confined to the Pagan nations of antiquity; it spread itself through all the modern nations of Europe, and took such deep root as to be long retained even after those nations were converted to the Christian faith.

Of its early antiquity we have complete evidence in the writings of Moses, where it is severely condemned as an abomination to the Lord; and though it appears to have even then spread into Phœnicia, we might yet conclude its birth-place to have been Egypt, because at their *exodus*, the Israelites were corrupted only by Egyptian superstitions, and because necromancy seems to be one of those whoredoms which the prophet Ezekiel represents his countrymen as having brought with them from Egypt, and continued to practise till they were carried captives into Babylon.

If from sacred we proceed to consult profane authors, we shall find them not only affirming Egypt to have been the birth-place of necromancy, but in some degree accounting for the origin of so impious a delusion. From Diodorus the Sicilian we learn, that the Grecian fable of *Charon*, the ferry-man of hell, of *Styx*, *Cocytus*, the *Elysian Fields*, *Tartarus*, the judgment of *Minos*, and *Radamanthus*, &c. with the whole scenery of the infernal regions, were imported from Egypt into Greece. The ancient Egyptians, and indeed all the people of the east, made use of caves for burying places, which were well suited to the solemn sadness of the surviving friends, and proper receptacles for those who were never more to behold the light. In Egypt, many of those subterranean cavities being dug out of the natural rock, still remain and command the admiration of travellers; and near to the pyramids in particular there are some apartments of a wonderful fabric, which though they extend in length 4400 feet, and are about 30 feet in depth, appear to have been, if not entirely dug, at least reduced to form by the chizel or pick-axe of the artist.

From the practice of burying in some caverns sprung the opinion that the infernal mansions were situated somewhere near the centre of the earth, which by the Egyptians was believed to be not very distant from its surface. In these dreary mansions, it was very easy for such adepts as the priests of Egypt to fabricate *Erebus*, *Tartarus*, the *Elysian Fields*, and all those scenes which were displayed before the initiated (see MYSTERIES), and by them described to the million of the people. As it was in those dark abodes that necromancy was practised, it would be no difficult matter for such magicians, as withstood Moses, to impose so far upon the credulous vulgar, as to make them believe, that in consequence of their evocations they actually saw the ghosts of their friends ascend out of the earth. It appears, from the book of Exodus, that the Israelitish women were, even in the wilderness, well acquainted with the use of the mirror, which was therefore undoubtedly known to the Egyptians. But a mirror of a particular form and properly illuminated at the instant required, might easily be made to reflect in a cavern from which all other light was carefully excluded, the image of the deceased, who was called upon by the necromancer; and we can readily conceive, that with respect to the question to be proposed, a person might be concealed, prepared to give such ambiguous answers, as would satisfy the enquirer, and at the same time save the credit of the oracle. The terrified imaginations of the spectators would aid the delusion, and make a very slight resemblance pass for the ghost or *eidolon* of their departed friends; or the necromancer might assign plausible reasons why a spectre, after having dwelt for some time in the infernal regions, should lose something of its resemblance to the body which it animated. Such juggling tricks, though performed by artists less accomplished than Jannes and Jambres, have gained credit among people much more enlightened than the Egyptians can possibly have been when the science of necromancy was invented by their priests.

That the Israelites, notwithstanding the prohibition of their legislator, continued to practise the rites of necromancy, is apparent from Saul's transaction with the witch of Endor (see MAGIC). From the same transaction, it is likewise apparent that the witches of Israel, and therefore, in all probability, the necromancers of Egypt, pretended to evocate the ghosts of the dead by a *demon* or *familiar spirit*, which they had at their command to employ upon every emergency. This demon was called *ob*, and therefore Saul desires his servants to find him a woman who was mistress of an *ob*. It is probable that those wretched impostors had in their pay some persons who occasionally acted the part of a demon, and when the execution of the plot required their agency, emitted, by means of a cavity dug for that purpose, a low hollow voice from below the ground. Hence we find Isaiah, in his denunciations against Ariel, saying, "Thou shalt be brought down, and shalt speak out of the ground; and thy speech shall be low out of the dust, and thy voice shall be as one that hath a familiar spirit (an *ob*) out of the ground, and thy speech shall whisper out of the dust."

But though the Egyptian priests were undoubtedly the inventors of the whole mystery of necromancy, and though it was from them imported into Greece by the *SELLI* or priests of Dodona, it does not appear that the Grecian necromancers pretended to be masters of *obs* or familiar spirits. Mopsus, Orpheus, Linus, Eumolpus, &c. who either travelled into Egypt in quest of knowledge, or were actually natives of that country, instructed the early Greeks in this occult science: but whatever might be the practice of these apostles themselves, their disciples professed to do all the feats of magic by performing certain rites, by offering certain sacrifices, by muttering a certain form of words, by charms, spells, and exorcisms. By these they pretended to evocate the dead as certainly as the Egyp-

tians and Jews did by their *familiar spirits*. By a small display of critical learning this might be easily proved from the popular story of Orpheus and Eurydice, which certainly was founded on one of these necromantic deceptions exhibited in a cave near Dodona, where the priests had a *hades*, or infernal mansion, in humble imitation of those with which the first of them were well acquainted in Egypt. It is indeed evident, without the aid of criticism: no man of any letters is ignorant, that whatever superstitions of this kind prevailed among the Romans were borrowed from the Greeks. But we all know that Virgil makes one of his shepherds, by means of certain herbs, poisons, and senseless charms, raise up ghosts from the bottoms of their graves; and Lucan has fabricated a story of this kind, which may be considered as an exact parallel to the witch of Endor. Just before the battle of Pharfalla he makes young Pompey travel by night to a Thessalian sorcerer, and anxiously inquire of her the issue of the war. This female necromancer, by a tedious process of charms and incantations, conjures up the ghost of a soldier who had been lately slain. The phantom, after a long preamble, denounces a prediction much of the same kind with that which the king of Israel received from Samuel at Endor; and though we have elsewhere shown, that nothing but the spirit of God could have foreseen the inevitable destruction of Saul, his sons, and his army (see MAGIC), it was very easy for any man of tolerable sagacity to foresee the defeat of Pompey's raw and undisciplined troops by the hardy veterans of the victorious Cæsar.

It would be endless to enumerate all the fallacious evocations of ghosts, and the ambiguous responses returned by those pretended spirits, of which we have accounts from the poets and historians of the celebrated nations of antiquity.

That all these pretences, whether ancient or modern, to the power of divination by means of familiar spirits, or by the art of necromancy, were groundless as well as impious, it would be affronting the understandings of our readers to offer any proof. Under the article MAGIC we have said enough on the subject, and perhaps more than enough, to those who know that demons, if they have any existence, and the departed spirits of good and bad men, are all under the controul of Him who governs the intellectual as well as material world by fixed and equal laws.—These details of superstition, however, will not be useless, if, by showing how poor and wretched a creature man becomes when left to his own inventions, they shall make any one grateful for the benefits of good government, and the blessings of revealed religion.

NECTAR, *νεκταρ*, among the ancient poets, the drink of the fabulous deities of the heathens. See AMBROSIA.

NECTARINE, the English name of species of the genus *persica*, a fruit greatly esteemed for its delicious flavour, and supposed to have its name from the nectar of the gods, in heathen stories. It differs in nothing from the peach, but in having a smoother skin and firmer pulp. We have ten kinds of *nectarine* cultivated by the curious in gardening; viz. Fairchild's early *nectarine*, ripening in the end of July: the Ebruge, Newington, scarlet, Brugnion or Stalian, and Roman, which ripen in August; the murrey, golden, and Temple's, which ripen in September; and the Peterborough, or late green *nectarine*, which ripens about the middle of October.

For particular directions for the planting, pruning, preservation, and whole culture of this plant; see Treatise on Gardening, Article FRUIT GARDEN.

NECTARIUM, in botany, from *nectar*, the fabled "drink of the gods;" defined by Linnæus to be a part of the corolla, or appendage to the petals, appropriated for containing the honey, a species of vegetable salt under a fluid form, that oozes from the plant, and is the principal food of bees and other insects.

Notwithstanding this definition, which seems to consider the nectarium as necessary a part of the corolla as the petals; it is certain that all flowers are not provided with this appendage, neither indeed is it essential to fructification.

In discriminating the genera, the nectarium often furnishes an essential character.

Plants which have the nectarium distinct from the petals, that is, not lodged within their substance, are affirmed by Linnæus to be generally poisonous. The following are adduced as examples: monk's hood, hellebore, columbine, fennel-flower, grass of Parnassus, barren-wort, oleander, marvel of Peru, bean-caper, succulent swallow-wort, fraxinella, and honey flower.

NEEDLE, a very common little instrument or utensil made of steel.

Dipping NEEDLE, or *Inclinator Needle*, a magnetical needle, so hung, as that, instead of playing horizontally and pointing out north and south, one end dips, or inclines to the horizon, and the other points to a certain degree of elevation above it. For the phenomena, uses, &c. of this instrument, see the article DIPPING NEEDLE.

NE EXEAT REGNO, in law, is a writ to restrain a person from going out of the kingdom without the king's licence. F.N.B. 85. It may be directed to the sheriff, to make the party find surety that he will not depart the realm, and on refusal to commit him to prison: or it may be directed to the party himself; and if he then goes, he may be fined. And this writ is granted on a suit being commenced against a man in chancery, when the plaintiff fears the defendant will fly to some other country; and thereby avoid the justice

justice and equity of the court; which hath been sometimes practiced: and when thus granted, the party must give bonds to the master of the rolls, in the penalty of 1000l. or some other large sum, for yielding obedience to it; or satisfy the court, by answer, affidavit, or otherwise, that he hath no design of leaving the kingdom, and give security.

NEGATIVE, a term that denies, or implies a denial of any thing. Logicians, &c. say a *negative* cannot be proved but by converting them into an affirmative. See *System of Logic*, Part II. Sect. II.

NEGATIVE Electricity. For a clear and accurate description of the properties and effects of this branch of the science of electricity, see the *System*, Sect. III.

NEGRO, *Homo pelle nigrâ*, a name given to a variety of the human species, who are entirely black, and are found in the Torrid zone, especially in that part of Africa which lies within the tropics. In the complexion of negroes we meet with many various shades; but they likewise differ far from other men in all the features of their face. Round cheeks, high cheek-bones, a forehead somewhat elevated, a short, broad, flat nose, thick lips, small ears, ugliness, and irregularity of shape, characterise their external appearance. The negro women have the loins greatly depressed, and very large buttocks, which give the back the shape of a saddle. Vices the most notorious seem to be the portion of this unhappy race: idleness, treachery, revenge, cruelty, impudence, stealing, lying, profanity, debauchery, nastiness, and intemperance, are said to have extinguished the principles of natural law, and to have silenced the reproofs of conscience. They are strangers to every sentiment of compassion, and are an awful example of the corruption of man when left to himself.

The origin of the negroes, and the cause of their remarkable difference from the rest of the human species, have much perplexed the naturalists. Mr. Boyle has observed, that it cannot be produced by the heat of the climate: for though the heat of the sun may darken the colour of the skin, yet experience does not shew that it is sufficient to produce a new blackness like that of the negroes.

In Africa itself, many nations of Ethiopia are not black; nor were there any blacks originally in the West Indies. In many parts of Asia, under the same parallel with the African region inhabited with the blacks, the people are but tawny. He adds, that there are negroes in Africa beyond the southern tropic; and that a river sometimes parts nations, one of which is black, and the other only tawny. Dr. Barriere alledges, that the gall of negroes is black, and being mixed with their blood is deposited between the skin and scarf-skin. Their arguments have been examined with much acuteness and ingenuity by Dr. Stanhope Smith of New Jersey, Dr. Hunter, and professor Zimmerman, who have made it in a degree probable, that the action of the sun is the original and chief cause of the black colour, as well as distorted features of the negro. See *COMPLEXION*.

However, Dr. Mitchel of Virginia, in the *Philosophical Transactions*, No. 476, has endeavoured by many learned arguments to prove, that the influence of the sun in hot countries, and the manner of life of their inhabitants, are the remote causes of the colour of the Negroes, Indians, &c. The propositions adduced by the Dr. are the following.

1. The colour of white people proceeds from the colour which the epidermis transmits; that is, from the colour of the parts under the epidermis, rather than from any colour of its own.
2. The skins of *Negroes* are of a thicker substance, and denser texture, than those of white people, and transmit no colour through them.
3. The part of the skin which appears black in *Negroes*, is the *corpus reticulare cutis*, and external lamella of the epidermis: all other parts are the same colour in them with those of other people, except the fibres which pass between those two parts.
4. The colour of *Negroes* does not proceed from any black humour, or fluid parts contained in their skins; there being none such in any part of their bodies, more than in white people.
5. The epidermis, especially its external lamella, is divided into two parts by its pores and scales, two hundred times less than the particles of bodies on which their colours depend.

This is founded on Leeuwenhoek's observations, that a portion of the epidermis no bigger than what can be discerned by the naked eye, is divided into 125000 pores, and these pores must divide such a portion of the skin into as many particles. But the particles of bodies on which their colours depend, are, by Sir Isaac Newton's *Optics*, lib. ii. p. 3. prop. 7. 600 times less than those which can be discerned by the naked eye. Therefore, the particles of the skin must be about 200 times less than these. It may also be observed, that such a small portion of the epidermis is divisible into 250 scales, which must increase the number of its parts.

6. From these propositions and from Sir Isaac Newton's theory of light and colours, the doctor thinks he may conclude, that the proximate cause of *Negroes* is threefold; viz. the opacity of their skin, proceeding from the thickness and density of its texture, which obstructs the transmission of the rays of light, from the white and red parts under the skin, together with its greater refractive power, which absorbs these rays; and the smallness of the particles of this skin, which hinders it from reflecting any light.

7. The influence of the sun in hot countries, and the manner of life of their inhabitants, are the remote causes of the colour of *Negroes*, Indians, &c. And the ways of living in use amongst most nations of white people, make their colours whiter than they were originally, or would be naturally.

In support of this proposition, the doctor observes, that the skin is deprived of its white colour, by the force and influence of the sun, four ways. 1st. by being rendered opaque, from a dissipation of its more aqueous, and pellucid juices. 2dly. By a concretion of its vessels and glandules, from this dissipation of its more aqueous contents, which renders the skin both thicker and denser, or more callous and rigid. 3dly. By a new accretion of many new membranes, which render it thick and opaque. 4thly. By increasing those parts or principles, in the composition of the epidermis, which have the greatest refractive power; as the terrestrial and fixed saline; but especially the tenacious and sulphureous, which refract and absorb light more strongly than any other substances; while the more transparent and pellucid principles, as the aqueous, spirituous, and volatile saline, are evaporated by the heat, which causes the other more fixed principles to be accumulated; and these particles being likewise more comminuted by the sun, will, on this account, be black; as happens to oil when well boiled. These causes, with those first mentioned, may, the doctor thinks, by conspiring, make the skin quite black; especially if we add another effect of the sun's power, a peculiar necrosis of the epidermis, occasioned by the forcible vibrations, contractions, and exiccations of its fibres by the sun beams, which cause it to turn black, as these, or other parts do, by the heat of an inflammation, or a fever, in gangrenes, black tongues, &c.

We cannot pretend to follow the author in all the details of his observations on this subject, nor of his answer to a material objection already mentioned from Mr. Boyle, that the sun cannot be the cause of the colour of *Negroes*, because several nations, in the same latitude with those *Negroes*, are not made black by it. He seems to think the heat of Africa greater than that of other parts of the world. Whether it be so, or not, is, we apprehend, not easy to determine; but it would be a strong confirmation of his doctrine, if we could see any people, originally white, become black and woolly by transplantation, or *vice versa*, which cannot be the case.

Lord Kaimes, on the other hand, and such philosophers as he, whose genius and imagination are too lively to submit to a dry and painful investigation of facts, have contended, that no physical cause is sufficient to change the colour, and what we call the regular features of white men, to the dark hue and deformity of the woolly-headed negro. And it is to be observed, that naturalists who are constantly examining the numerous links which connect the chain of nature, refute the position that the heat of the sun is the cause of the colour of the Negroes, Indians, &c. and affirm, on the contrary, that the African is as much a distinct species from the European, in the Genus *Homo*, as the bull-dog is to the grey-hound, or the lap dog to the mastiff in the Genus *Canis*. They contend that the anatomical structure can be no more affected by the alteration of the climate in the species of the Genus *Homo*, than in those of the Genus *Canis*. It is surprising that this powerful argument adduced by naturalists should never have been adverted to, or answered by their opponents; for certainly, if we attend to the characteristic distinctions of the animal structure of the five species of the Genus *Homo*, enumerated by Linneus, we shall find a wonderful difference. This evidently demonstrates the separate links in the chain of the system of nature, which many naturalists have considered as evident marks of distinguished separation; they therefore maintain that the African and European do not descend from the same stock, but are of a distinct creation. But this is carrying the argument too far.

Negroes are brought from Guinea and other coasts of Africa, and sent to America and the colonies in the West Indies, to cultivate tobacco, sugar, indigo, &c. and in Mexico and Peru to dig in the mines; and this commerce, incompatible with the principles either of religion or humanity, is now carried on by all the nations of Europe that have settlements in the West Indies. Mahometan nations, too, import negroes from the pagan parts of Africa, for the purpose of making them eunuchs, and guards of their harems. The best slaves for West India purposes are the negroes who are brought from Angola, Senegal, Cape Verd, the river Gambia, the kingdoms of the Jalloffes, &c.

There are various ways of procuring these *Negroes*: some, to avoid famine, sell themselves, their wives, and children to their princes, and great men, who have wherewithal to subsist them. Others are made prisoners in war; and great numbers seized in excursions made for that very purpose by the petty princes upon one another's territories; in which it is usual to sweep away all both old and young, male and female.

The *Negroes* make a frequent practice of surprising one another while the European vessels are at anchor, and dragging those they have caught for sale, and it is no extraordinary thing to see the son sell, after this manner, his father or mother, and the father his own children, for a few bottles of brandy, or a bar of iron. As soon as the ship has its complement, it immediately makes off; the poor wretches, while yet in sight of their country, falling into such deep grief and despair in the passage, that a great part of them languish, fall into sickness, and die. It has been calculated that upwards of

N E G

one hundred thousand slaves have for many years been exported by the Europeans from the coast of Africa.

Through the whole of the peninsula of Africa with which we are acquainted, slavery has been prevalent from time immemorial. In the interior parts, one class of the people are born slaves to another; and on the gold coast, a freeman is reduced to that state for crimes real or imaginary. Prisoners of war are all considered as slaves, and, together with criminals, are sold, either by one negro chief to another, or by slave-brokers, to European merchants. Slaves which are born such are not permitted to be sold out of the country, unless they have been guilty of some offence which would have subjected them either to that state or to death, though they had been born freemen.

The crimes for which freemen are made slaves, are theft, debt, adultery, and witchcraft; and it is not uncommon for persons to game themselves away. All savages have an itch for games of hazard; and a negro will stake his freedom on a throw of the dice. If he lose, no trial is necessary; he immediately surrenders himself to his successful antagonist. Persons accused of crimes are tried by certain judges called *Pynims*, who wear a peculiar straw hat as a badge of their office; and the trial is fairly conducted, according to the laws of the country, either in the market-place or in an open court of justice. Witchcraft proved against a man involves in his punishment the whole family, which is always extirpated, if there be not a European merchant to buy them; and adultery committed with the wife of a great man is considered as a crime of too deep a dye to be punished with slavery either to a black or a white master: such offenders are instantly doomed to death.

Human sacrifices have at all times been practised in Africa; and such is the depravity of the Negro princes, that there is reason to believe that prisoners of war are either all sacrificed or sold to foreign merchants. That insolvent debtors should be reduced to slavery, among a people so very barbarous, can excite no wonder, when we consider that the same thing took place among the Romans, in the earlier periods of the commonwealth. It likewise took place among the Jews, and all other ancient nations; and it is apparent from the poems of Homer, that the early Greeks treated their captives, whether male or female, as part of their property. Of the slaves imported into the British colonies, great part are brought from a great distance to the coast; and as these exhibit little or no symptoms of uneasiness at their being sold into a foreign country, and doomed to serve masters whom they never saw before, the probability is, that they have been born slaves to tyrants so cruel, that no change of masters can, in their apprehension, increase their wretchedness. Negroes born on the coast are often extremely miserable on the thoughts of being sold to a foreign master; because these men were originally free, and expect such treatment as they have seen their own chiefs inflict on prisoners of war, or persons who, among them, have been reduced from freedom to a state of slavery.

These facts are mentioned, not with a view to defend or condemn the British slave-trade; but merely because they account for that ferocity and brutality by which Negroes in many respects resemble the most savage beasts of prey. Some of them have been known to feed on their brothers, and to devour their own children. But what indeed can be expected of men in their unhappy situation? Almost all blacks, but especially those of Loanga, treat their women as vile slaves, created solely to amuse and obey them. The wife often dares not look at her lord; she speaks to him on her knees; and yet this painful and humiliating situation is not distressing to them. Some Negroes, however, are sufficiently attached to their wives, and exceedingly fond of their mistresses: these yield in no respect to the men, but obey without reserve the natural impulse of their constitution. We likewise find Negroes of Congo, who, in order to please, become great jesters and buffoons. A single Congo slave is sufficient to diffuse cheerfulness and good humour through a whole plantation. But how comes it about that female Negroes, who are so prolific in Africa, are not equally so in America?

To discover the cause of such sterility, is an object worthy of the attention of government. According to some, these slaves are often instigated by the bitterness of their lot to rid themselves of a burden which other mothers support with pleasure. This, however, can not be the fact. Without in any degree pleading the cause of the West India planters, we may venture to suppose, that, in this case, interest will supply the place of that principle of humanity which their opponents affirm them to want. To rear a negro is less expensive than to purchase one from Africa; and by the confession of all parties, a creole slave is double the value of one just imported. That selfishness, therefore, of which the sugar planters have been so often and so vehemently accused, would make them, one should think, encourage, by every means in their power, the propagation of negroes, since by the laws of the colonies the child of a female slave is the property of her master. We doubt not that in the West Indies, as every where else, there are men who in sudden bursts of passion forget their interest as well as their duty; and we are not inclined to deny, that there may be many instances of cruelty practised on the slaves both male and female; but in Africa, cruelty is reduced to a system, and yet the mothers nurse and rear their children.

One cause certainly of the barrenness of colonial negroes, is the

N E P

small number of females in proportion to the males, and the dissolute and licentious lives which the males lead. It is a fact, for which physiologists must account, that when a woman, whether white or black, has a promiscuous intercourse with a number of men, she very seldom conceives children; and as our negroes in the West Indies are instructed in no principles of religion, and have appetites as keen as their masters and their mistresses, it is not surprising that many of the females abandon themselves to licentious amours, and become in consequence incapable of conception. The popish clergy in the French and Spanish islands, and the Moravian and Methodist pastors in their own, are at the utmost pains to instruct the negroes in what they conceive to be the truths of Christianity; whilst the missionaries of the English church too generally neglect every duty of their sacred function. The bishop of London has been expected, as diocesan of the West Indies, to take upon himself the forming of some plan for the religious instruction of the negroes in the colonies suited to their temporal condition; but in justice to that prelate, as well as to the memory of his immediate predecessors, it is proper to acquaint the public, that since the death of Dr. Gibson in 1748, the bishop of London has had no ecclesiastical authority whatever in the colonies, nor any other episcopal connection with them, than that of conferring orders upon their candidates for livings. That the colonies would gladly adopt any proper plan for improving the morals and meliorating the condition of the negroes, has been lately proved by the most respectable evidence given at the bar of the house of lords; and were such a plan put in execution, there cannot be a doubt, but that the slaves would be more diligent and faithful, the masters have less occasion to exercise cruelty, and the females, if imported in a sufficient number, be as prolific as other women in the same latitudes.

Both in France and in England laws have been lately enacted, to preserve the lives of negroes on what is called the *middle passage*, and to regulate the administration of justice to the negro-slaves in the West Indies. An edict to this purpose was, so far back as March 1724, published at Versailles, called the *black code*; and laws have been lately made by the parliament of Great Britain, to insure better accommodation to the negroes on board of ship from Africa to the sugar islands. The colonial assemblies have likewise themselves enacted laws to protect the persons of the negroes while in their state of servitude; and in some estates, these laws have been so well observed, that we have been informed by gentlemen of undoubted veracity, that they have known negro-slaves possessed of one, two, and 3000l. So horrible, however, to a British ear is the very sound of the word slavery, that a society was some years ago instituted at London, for the purpose of procuring an abolition of the slave trade; and petitions to parliament for the same purpose were obtained from almost every county and town in the kingdom. The success of these petitions, as well as their consequences, remain still to be determined.

NEHEMIAH, a canonical Book of the Old Testament, so called from the name of its author. Nehemiah was born at Babylon, during the captivity, and succeeded Ezra in the government of Judah and Jerusalem. He was a Jew, and was promoted to the office of cup-bearer to Artaxerxes Longimanus, king of Persia; when the opportunities he had of being daily in the king's presence, together with the favour of Esther, the queen, procured him liberty to repair and fortify the city of Jerusalem, in the same manner as it was before its destruction by the Babylonians. On his going to Jerusalem, he finished the rebuilding of the walls in fifty-two days, and dedicated the gates of the city with great solemnity. He then reformed some abuses which had crept in among his countrymen. The history of these transactions is the subject of this book.

NEPHRITICS, in pharmacy, medicines proper for diseases of the kidneys, especially the stone.—Such particularly are the roots of althæa, dog's grass, asparagus, fago, pellitory of the wall, mallows, pimpinella, red chick-pease, peach-kernels, turpentine, &c.

NEPHRITIS, in medicine, a disease of the reins, kidneys, &c. For a description of the symptoms, causes, and cure, see the System, Genus 18.

NEPTUNE, in mythology, the son of Saturn and Rhea, and brother of Jupiter and Pluto. He is commonly represented standing with his trident in his right hand, which was his peculiar sceptre, as lord of the Mediterranean seas, and seems to have been used by him chiefly to rouse up the waters; for we find sometimes that he lays it aside, when he is to appease them; but he resumes it, when there is any occasion for violence. Virgil, *Æn.* ii. v. 612, makes him shake Troy from its foundations with it; and in Ovid, *Met.* i. v. 284, it is with the stroke of this that the waters are let loose from the general deluge. The dolphin is in his left hand, and he treads on the beak of a ship; to shew that he presided over the seas, or more particularly over the Mediterranean sea; which was the great and almost the only scene for navigation among the old Greeks and Romans. The poets have described this god, as passing over the calm surface of the waters, in his chariot drawn by sea-horses. The fine original description of this is in Homer; from whom Virgil, *Æn.* i. v. 155, and Statius *Achil.* i. v. 60, have copied it. A triton is sometimes represented on each side, as guiding those that draw the chariot of Neptune. His aspect in all the best figures of him is majestic and serene. The lower sort of artists exhibit him

him sometimes with an angry disturbed air; and one may observe the same difference in this particular, between the great and inferior poets, as there is between the good and bad artists. Thus Ovid, *Met.* ii. v. 271, describes *Neptune* with a fullen look; whereas Virgil, *Æn.* i. v. 127, expressly tells, that he has a mild face, even when he is representing him in a passion. *Neptune* had a great number of temples erected to his honour, as well as feasts and games established in token of respect, both in Greece and Italy. Spence's *Polymetis*, p. 65. p. 215, &c.

NEREIS, in vermology, a genus of animals belonging to the order of vermes mollusca. The body is oblong, linear, and fitted for creeping; it is furnished with lateral pencilled tentacula. There are 11 species; of which the most remarkable is, the *Noctiluca*, or noctilucous nereis, which inhabits almost every sea, and is one of the causes of the luminousness of the water. These creatures shine like glow-worms, but with a brighter splendour, so as at night to make the element appear as if on fire all around. Their bodies are so minute as to elude examination by the naked eye.

It is sometimes called *nereis phosphorans*; and is thus described by Griseelin: the head is roundish and flat, and the mouth acuminate. The two horns or feelers are short and subulated. The eyes are prominent, and placed on each side the head. The body is composed of about 23 segments or joints, which are much less nearer the tail than at the head. These segments on both sides the animal all end in a short conical apex, out of which proceeds a little bundle of hairs: from under these bundles the feet grow in the form of small flexile subulated figments destitute of any thing like claws. It is scarcely two lines long, and is quite pellucid, and its colour is that of water green. They are found upon all kinds of marine plants; but they often leave them and are found upon the surface of the water: they are frequent at all seasons, but especially in summer before stormy weather, when they are more agitated and more luminous. Their numbers, and wonderful agility, added to their pellucid and shining quality, do not a little contribute to their illuminating the sea, for myriads of those animalculæ may be contained in the portion of a small cup of sea-water. Innumerable quantities of them lodge in the cavities of the scales of fishes, and to them probably do the fishes owe their noctilucous quality. "I have observed with great attention (says Barbut), a fish just caught out of the sea, whose body was almost covered with them; and have examined them in the dark: they twist and curl themselves with amazing agility, but soon retire out of our contracted sight; probably their glittering numbers dazzling the eye, and their extreme minuteness eluding our researches. It is to be observed, that when the unctuous moisture which covers the scales of fishes is exhausted by the air, these animals are not to be seen; nor are the fishes then noctilucous, that matter being perhaps their nourishment when living, as they themselves afford food to many marine animals. They do not shine in the day time, because the solar rays are too powerful for their light; however aggregate or immense their number." Their appearance is particularly brilliant when the wind is in the east and south-east points, and in winter-nights preceded by a warm day. If water containing these animalcules be kept warm, they retain their light two whole days after they are dead; but in cold water lose it in eight hours; motion and warmth, which increase their vivacity and strength, increase their light also.

NERVE, **NERVUS**, in anatomy, a round, white long body, like a cord, composed of several threads, or fibres, deriving its origin from the brain, or the spinal marrow, and distributed throughout all parts of the body; serving for the conveyance of a particular juice, by some called *animal spirits*, for the performance of sensation, and motion. For the origin, uses, and description of the nerves, see the *System*, Part VI. Sect. II throughout. For a representation of the posterior view of the spinal marrow, with the origin of its nerves, see Plate XI. fig. 4. For the distribution of the nerves from the brain, and spine, see fig. 5. for the origin of the nerves as they proceed from the skull, see fig. 3, for the nerves of vision, see fig. 10. For a representation of the nerves as they pass off to the thorax, abdomen, see Plate XII. For a representation of the nerves of the liver, gall-bladder, pancreas, stomach, with the ganglions, &c. see Plate XIII.

NERVES microscopically examined. Mr. Leeuwenhoek endeavoured by his microscope to discover the structure of the *nerves* in the spinal marrow of an ox; he saw there with great delight minute hollow vessels of an inconceivable firmness, invested with their proper membrane, and running out in length parallel to one another, and making up their composition; and though some hundreds of their vessels go to the formation of the least *nerve* that can be examined, he not only discerned the cavities in them, which he computed to be three times less than their diameters, but in some perceived the orifices as plainly as the holes in a pricked paper are to be seen when looked at against the sun. It requires, however, great dexterity and expedition to make this examination with success; for after a thin slice of the spinal marrow is placed before the microscope, in less than a minute's time it becomes dry, and the whole appearance vanishes. Baker's *Microscope*, p. 145.

Nervous Disorders compose a very numerous class of the diseases incident to mankind. These, whilst under various forms and modes of attack, they exhaust the strength of the body, impair the

vigour of the mind, and its power of self-enjoyment. Disorders of this kind proceed from any cause that contributes to relax the body, or depress the spirits; such are excess of study, and want of proper exercise, drinking weak watery liquors, frequent bleeding, purging, vomiting, immoderate venery, great fatigue, want of sleep, anxiety and grief, unwholesome air, &c. For a copious description of the symptoms, causes, and cure of the several disorders incident to the nervous system; see the *System of MEDICINE*, Genus 46 and Genus 51.

NET, a device for catching fish and fowl. See the articles *FISHERY* and *FOWL*.

NEURITICS, in pharmacy, medicines useful in disorders of the nerves.

NEUROGRAPHY, signifies a description of the nerves. See the *System of ANATOMY*, Part VI. Sect. 2. throughout.

NEUROPTERA, in entomology, the name by which Linnaeus calls an order of four-winged insects, from their wings being membranaceous with nerves, and being disposed in a reticulated form. In the Linnæan system, there are seven genera comprehended under this order. For classification, see the *System*, Order IV.

NEUTER, a person indifferent, who has espoused neither party and is neither friend nor foe. In grammar it denotes a sort of GENDER in nouns, which are neither masculine nor feminine. **NEUTER Verb.** For definition and explanation of these articles, see the *System*, Part I. Chap. I. Sect. I. and Part II. Art. V.

NEUTRAL Salts, among chymists, are a sort of intermediate salts between acids and alkalis; partaking of the nature of both. Formerly those only were called *neutral salts*, which were composed of acids and alkalis united together to the point of saturation, so that they had no acid nor alkaline property, and thence they were called *neutral*. But now this name is commonly extended to combinations of acids with all substances, with which they can so unite that they lose entirely or mostly their acid qualities; as, for instance, when they are united with earthy or metallic substances. Mr. Boyle also gives the appellation *neutral* to a sort of spirits, differing, in divers qualities, both from vinous, acid, and urinous spirits. These he also calls *anonymous* and *adiaphorous* spirits. See the *System of CHYMISTRY*, Part I. Chap. V.

NEWTONIAN Philosophy, the doctrine of the universe, and, particularly of the heavenly bodies; their laws, affections, &c. as delivered by Sir Isaac Newton.

The term *Newtonian philosophy* is applied very differently; whence have sprung divers confused notions relating to it. Some authors, under this philosophy, include all the corpuscular philosophy considered as it now stands corrected and reformed by the discoveries and improvements made in several parts thereof by Sir Isaac Newton, in which sense it is that Gravesande calls his *Elements of Physics*, *Introductio ad Philosophiam Newtonianam*. And in this sense the Newtonian is the same with the new philosophy, and stands contradistinguished to the Cartesian, the Peripatetic, and the ancient corpuscular.

Others, by *Newtonian philosophy*, mean the method or order which Sir Isaac Newton observes in philosophizing, viz. the reasoning and drawing of conclusions directly from phenomena, exclusive of all previous hypotheses; the beginning from simple principles; deducing the first powers and laws of nature from a few select phenomena, and then applying those laws, &c. to account for other things. See *Law of NATURE*. And in this sense the *Newtonian Philosophy* is the same with the experimental philosophy; and stands opposed to the ancient corpuscular.

Others, by *Newtonian philosophy*, mean that wherein physical bodies are considered mathematically; and where geometry and mechanics are applied to the solution of phenomena. In which sense the *Newtonian* is the same with the mechanical and mathematical philosophy.

Others again, by *Newtonian philosophy*, understand that part of physical knowledge which Sir Isaac Newton has handled, improved, and demonstrated in his *Principia*.

Others lastly, by *Newtonian philosophy*, mean the new principles which Sir Isaac Newton has brought into philosophy; the new system founded thereon; and the new solutions of phenomena thence deduced; or that which characterises and distinguishes his philosophy from all others; which is the sense wherein we shall chiefly consider it.

As to the history of this philosophy, we have but little to say: it was first made public in the year 1686, by the author, then a fellow of Trinity college, Cambridge; and in the year 1713, republished, with considerable improvements. Several other authors have since attempted to make it plainer; by setting aside many of the more sublime mathematical researches, and substituting either more obvious reasoning, or experiments, in lieu thereof; particularly Whiston, in his *Prælect. Phys. Mathemat.* Gravesande in *Element. & Inslit.* and Dr. Pemberton in his *View*; and Maclaurin, in his excellent work, intitled, *An Account of Sir Isaac Newton's Philosophical Discoveries*.

Notwithstanding the great merit of this philosophy, and the universal reception it has met with at home, it gained ground, at its first publication, but slowly abroad; *Newtonianism* had scarce two or three adherents in a nation; but Cartesianism, Huygenianism, and Leibnitzianism,

N I G

of these patients complained of vertigo. In 52 of the number it excited nausea; in the two last cases he directs the medicine to be suspended, and the doses lessened. Dr. Fowler tried it in 30 cases of dropsy, viz. four of anasarca, or general dropsy; two of ascites; and 12 of dropsical swellings of the legs, were all cured. In ten other cases it afforded considerable relief; and in three cases only it was of no use. In ten instances of dysury, the infusion was anodyne and diuretic, thereby abating pain, relaxing the urinary passages, and promoting urine.—In dysurias from gravel, it facilitates the expulsion of calcareous or gritty matter.

Dr. Fowler speaks of the use of tobacco in injections; an ounce of the infusion in a pint of water gruel at a time, and repeated in cases of obdurate constipation, as the case may require. In the *dry belly-ach*, in the West Indies, injections of the smoke of tobacco have long been employed with the happiest effects.

After all, the internal use of tobacco should be very limited, and can only be safe in the hands of a skilful and attentive practitioner. Tobacco is sometimes used externally in unguents for deflexion.

Tobacco is sometimes used externally in unguents for destroying cutaneous insects, cleaning old ulcers, &c. Beaten into a mass with vinegar or brandy, it has sometimes proved serviceable for removing hard tumours of the hypochondres: an account is given in the Edinburgh essays of two cases of this kind cured by it. The most common uses of this plant, however, are either as a stercutatory when taken by way of snuff, as a masticatory by chewing it in the mouth, or as effluvia by smoking it; and when taken in moderation, it is not an unhealthful amusement. Before pipes were invented it was usually smoked in segars, and they are still in use among some of the southern nations. The method of preparing these is at once simple and expeditious. A leaf of tobacco being

There is at once simple and expeditious. A leaf of tobacco being formed into a small twisted roll, somewhat larger than the stem of a pipe, and about eight inches long, the smoke is conveyed through the winding folds which prevent it from expanding, as through a tube; so that one end of it being lighted, and the other applied to the mouth, it is in this form used without much inconvenience. But, in process of time, pipes being invented, they were found more commodious vehicles for the smoke, and are now in general use.

Among all the productions of foreign climes introduced into these kingdoms, scarce any has been held in higher estimation by persons of every rank than tobacco. In the countries of which it is a native, it is considered by the Indians as the most valuable offering that can be made to the beings they worship. They use it in all their civil and religious ceremonies. When once the spiral wreaths of its smoke ascend from the feathered pipe of peace, the compact that has just been made is considered as sacred and inviolable. Likewise when they address their great Father, or his guardian spirits, residing as they believe in every extraordinary production of nature, they make liberal offerings to them of this valuable plant, not doubting but that they are thus secured of protection.

Tobacco is made up into rolls by the inhabitants of the interior parts of America, by means of a machine called a *tobacco wheel*.

With this machine they spin the leaves, after they are cured, into a twist of any size they think fit ; and having folded it into rolls of about 20 pounds each, they lay it by for use. In this state it will keep for several years, and be continually improving, as it always grows milder. The Illinois usually form it into carrots : which is done by laying a number of leaves, when cured, on each other, after the ribs have been taken out, and rolling them round with pack-thread till they become cemented together. These rolls commonly measure about 18 or 20 inches long, and nine round in the middle part. Tobacco forms a very considerable article in commerce.

NICTITATING Membrane, in anatomy, a thin membrane, which covers the eyes of several creatures, and shelters them from dust; or too much light; yet is so thin, that they can see indifferently well through it. This *nictitating membrane* is chiefly found in the bird and fish kind. See *System of COMPARATIVE ANATOMY*. Chap. II. Sect. II. and Chap. III. Sect. II.

This membrane, in the eagle's eye, is remarkably close and firm, infomuch as to be accounted as a second eyelid; and hence that remarkable firmness of the eagle's sight in viewing the sun.

NIGHT, that part of the natural day, during which the sun is underneath the horizon : or, *night* is that space of time, wherein the sun is out of our hemisphere. Under the equator, the nights are always equal to the days. Under the poles, the *night* continues

always equal to the days. Hence the poets, and the
half a year. The ancient Gauls and Germans divided their time
not by days, but *nights*; as appears from Tacitus and Cæsar; and
the Arabs do the same at this day. See DAY, HOUR, &c. The
same is also observed of our Saxon ancestors.

NIGHTINGALE, in ornithology; a species of the Genus **MOTACILLA**, in ornithology. For description of the Genus, see **MOTACILLA**. The nightingale takes its name from night and the Saxon word *galan*, "to sing;" expressive of the time of its melody. In size it is equal to the redstart; but longer-bodied, and more elegantly made. The colours are very plain. Mr. Hunter found by dissection, that the muscles of the larynx are stronger in the nightingale than in any bird of the same size.

This bird, the most famous of the feathered tribe, for the variety, length, and sweetness of its notes, visits England the beginning of April.

April, and leaves us in August. In England they frequent thick hedges, and low coppices; and generally keep in the middle of the bush, so that they are very rarely seen. They form their nest of oak-leaves, a few bents and reeds. The eggs are of a deep brown. When the young ones first come abroad, and are helpless, the old birds make a plaintive and jarring noise with a sort of snapping, as if in menace, pursuing along the hedge the passengers.

They begin their song in the evening, and continue it the whole night. These their vigils did not pass unnoticed by the ancients: the humbers of these birds were proverbial; and not to rest as much as the nightingale, expressed a very bad sleeper. This was the favourite bird of the British poet Milton, who omits no opportunity of introducing it, and almost constantly noting its love of solitude and night. How finely does it serve to compose part of the solemn scenery of his *Penferoso*: when he describes it:

In her faintest sweetest plight,
Smoother the rugged brow of night;
While Cynthia checks her dragon yoke
Gently o'er th' accusom'd oak.
Sweet bird, that shunn'st the noise of folly;
Most musical, most melancholy!
Thee, chauncer'st, oft the woods among,
I woo to hear thy evening song.

The reader will excuse a few more quotations from the same poet, on the same subject; the first describes the approach of evening and the retiring of all animals to their repose:

Silence accompanied; for beast and bird,
They to their grassy couch, these to their nests
Were flunk; all but the wakeful nightingale,
She all night long her amorous descant sung.

When Eve passed the irksome night preceding her fall, she, in a dream, imagines herself thus reproached with losing the beauties of the night by indulging too long a repose:

Why sleep'st thou, Eve? now is the pleasant time,
The cool, the silent, save where silence yields
To the night-warbling bird, that now awake
Tunes sweetest: his love-labour'd song.

The same birds sing their nuptial song, and lull them to rest. How rapturous are the following lines! how expressive of the delicate sensibility in our Milton's tender ideas:

The earth
Gave sign of gratulation, and each hill;
Joyous the birds; fresh gales and gentle airs
Whisper'd it to the woods, and from their wings
Flung rose, flung odours from the spicy shrub,
Disporting, till the amorous bird of night
Sung spousal, and bid haste the evening star
On his hill-top to light the bridal lamp.
These, lull'd by nightingales, embracing slept;
And on their naked limbs the flowery roof
Shower'd roses, which the moon repair'd.

These quotations from the best judges of melody, we thought due to the sweetest of our feathered choristers; and we believe no reader of taste will think them tedious.

Virgil seems to be the only poet among the ancients who hath attended to the circumstance of this bird's singing in the night-time:

*Qualem populei moerens Philomela, sub umbrâ
Amplexu pariter factus, quâ duras arator
Oscorans nido implacens detrahit: at illa
Flet noctem, ramque sedens miserabile cernit
Integrit, et magis late loco quiesibus implet.*

Geo. IV. l. 511.

As Philomel in popular shades, alone,
For her lost offspring pours a mother's moan,
Which some rough ploughman marking for his prey,
From the warm nest, unslept'st hath dragg'd away;
Perch'd on a bough, the all night long complains,
And fills the grove with sad repeated strains.

F. Warton.

NIPPLE, Papilla, in anatomy, a prominence arising from the middle of the breast or mamma: see the *System*, Part IV. Sect. I.

NITRE, or *Saltpetre*, is a neutral salt, composed of nitrous acid, saturated with fixed vegetable alkali. It is found immersed in imperceptible particles, in earthy substances, as the particles of metals in their ores, and is discoverable in these bodies by an acrid and pungent taste, and a sensation of coldness with which it affects the tongue; sometimes also it is found native and pure, in form of an efflorescence, or shapeless salt, either in its ore, or on old walls, and yields after solution hexædral prismatic crystals. See the *System* of *CHYMISTRY*, Part I. Chap. V. Sect. III. Art. I.

Nitre is found naturally crystallized in India, and as it is swept from earths or stones with brooms, it is called the sweepings of nitre, or of saltpetre. A nitre may also be obtained from several plants; and these are the two kinds of natural nitre. All other nitre is begun by nature, but art is required to extract and purify it.

NITROUS Acid. For a particular account of the nature and qualities of this branch of chymistry, see the *System*, Part I. Chap. V. Sect. III.

NOBILITY, in general, signifies dignity, grandeur, or greatness; more particularly, it signifies antiquity of family, joined with riches; in the common acceptation of the word, it means

No. 118.

that quality or dignity which raises a man above the rank of a peasant or a commoner.

At a time when the public mind is so much agitated on this subject, or subjects nearly allied to it, perhaps the less that is said on it the better. We should therefore (as far as concerns the question about its expediency in civil life, or the contrary) most cheerfully pass it over in silence, did we not esteem it our duty to give our readers at least some idea of it, and were it not our business to lay before them a few of those arguments which of late have been so copiously retailed, both for and against this illustrious order of civil society; leaving them, however, that liberty which every man unquestionably ought to be allowed, of judging for themselves as they shall see most proper.

Whether that equality of rank and condition, which has of late been so loudly contended for, would be more agreeable to the order of nature, or more conducive to the happiness and prosperity of mankind? may indeed be made a question; but it is a question, we apprehend, which cannot receive different answers from men capable of reflecting without prejudice and partiality. A state of perfect equity can subsist only among beings possessing equal talents and equal virtues: but such beings are not men. Were all mankind under the constant influence of the laws of virtue, a distinction of ranks would be unnecessary; but in that case civil government itself would likewise be unnecessary, because men would have attained all that perfection to which it is the object of civil government, as well as of religion, to guide them; every man then would be a law unto himself. But whilst, in so many breasts, the selfish passions predominate over those who are social, violence must be restrained by authority; and there can be no authority without a distinction of ranks, such as may influence the public opinion.

It is well observed by Hume, that government is founded only on opinion; and that this opinion is of two kinds: opinion of interest, and opinion of right. When a people are persuaded that it is their interest to support the government under which they live, that government must be very stable. But among the worthless and unthinking part of the community, this persuasion has seldom place. All men, however, have a notion of rights: of a right to property and a right to power; and when the majority of a nation considers a certain order of men as having a right to that eminence in which they are placed, this opinion, call it prejudice or what we will, contributes much to the peace and happiness of civil society. There are many, however, who think otherwise, and imagine that "the society in which the greatest equality prevails must always be the most secure. These men conceive it to be the business of a good government to distribute as equally as possible those blessings which bounteous nature offers to all." It may readily be allowed that this reasoning is conclusive; but the great question returns, "How far can equality prevail in a society which is secure? and what is possible to be done in the equal distribution of the blessings of nature?" Till these questions be answered, we gain nothing by declaiming on the rights and equality of men; and the answers which have sometimes been given to them suppose a degree of perfection in human nature, which, if it were real, would make all civil institutions useless, as well as the reveries of those reformers. The conduct of the democratic states of Pagan antiquity, together with the oppressive anarchy and shameful violences which we have seen and still see in a neighbouring kingdom, will be considered by many as a full and satisfactory answer, deduced from experience, to all the schemes of the visionary theorist: such facts at least render the abolition of the order of nobility a matter of more importance, and of infinitely greater difficulty, than those who plead for it are disposed to allow.

It is an opinion not uncommon, and at least plausible, that the nobility of a well regulated state is the best security against monarchical despotism or lawless usurpation on the one hand, and the confusion of democratic infolence on the other. Self-interest is the most powerful principle in the human breast; and it is obviously the interest of such men to preserve that balance of power in society upon which the very existence of their order depends. As it is our business, however, to exhibit all opinions of any celebrity, we shall lay before our readers a short extract from Dulaure's *Critical History of the French nobility*, which contains, in few but forcible words, some of the common arguments against this distinction of ranks.

"Nobility (says he) a distinction equally impolitic and immoral, and worthy of the times of ignorance and of rapine, which gave it birth, is a violation of the rights of that part of the nation that is deprived of it; and as equality becomes a *stimulus* towards distinction, so on the other hand this is the radical vice of a government, and the source of a variety of evils. It is almost impossible that there should be any uncommon instances of virtue in a state, when recompences belong exclusively to a certain class of society, and when it costs them no more to obtain these than the trouble of being born. Amongst the list of privileged persons, virtues, talents, and genius, must of course be much less frequent than in the other classes, since, without the possession of any of these qualities, they who belong to it are still honoured and rewarded. Those who profit by this absurd subversion of principles, and those who

N

lose

lose by this unjust distribution of favours, which seem to have grown into a right, cannot have any other than false, immoral, and pernicious ideas concerning merit.

A perfect equality, however, in rank and fortune has seldom been contended for, except by the most ignorant enthusiasts. It is indeed doubtful whether it could possibly exist. The more moderate and rational reformers have acknowledged that as these differences have always existed some way or other, so, from the infinite variety of talents and attainments in the world, we have reason to expect they will exist in every form of government, and among every people. The question, therefore, is reduced to this: Whether the present mode of distinction, or any other which could be instituted in its stead, be upon the whole the best? That the present is not perfect, or wholly without faults, few will be sanguine enough to contradict; and a wise man, in the sober hour of philosophical reflection, will scarce presume to assert that any other scheme which human ingenuity can plan would be wholly without imperfection, or altogether free from error. The case is, the errors of our own system are present, and on this account we see and feel them with peculiar force: the other plan we look forward to, perhaps in too sanguine a manner, and we probably forget, in the delusive heat of imagination, that if distinction depended entirely on merit, we should scarce find a society of men so honest, or so able, as always to reward it according to its deserts; or if this were possible, as perhaps in the nature of things it is not, such is the self-partiality of the generality of men, that few would think he were not dealt justly by if he were not promoted as well as his neighbour; and it is clearly impossible to promote every one. For such reasons then, and many more which our limits oblige us to omit, many think (and we are inclined to think with them) that it is safer to remain as we are, as we know the evils that attend our situation, and are still able to bear them, rather than to hazard a change, which, with some benefits, might also perhaps increase the troubles, and destroy many of the pleasures of social life.

Perhaps it may not be amiss to lay before our readers the following observations from that most judicious commentator on the laws of England, Mr. Justice Blackstone, on this important subject.

"The distinction of rank and honours (says he) is necessary in every well governed state, in order to reward such as are eminent for their services to the public, in a manner the more desirable to individuals, and yet without burden to the community; exciting thereby an ambitious, yet laudable ardour, and generous emulation, in others. And emulation, or virtuous ambition, is a spring of action which, however dangerous or invidious in a mere republic or under a despotic sway, will certainly be attended with good effects under a free monarchy; where, without destroying its existence, its excesses may be continually restrained by that superior power from which all honour is derived. Such a spirit, when nationally diffused, gives life and vigour to the community; it sets all the wheels of government in a motion, which, under a wise regulation, may be directed to any beneficial purpose; and thereby every individual may be made subservient to the public good, while he principally means to promote his own particular views. A body of nobility is also more peculiarly necessary in our mixed and compounded constitution, in order to support the rights of both the crown and the people, by forming a barrier to withstand the encroachments of both. It creates and preserves that gradual scale of dignity which proceeds from the peasant to the prince: rising like a pyramid from a broad foundation, and diminishing to a point as it rises. It is this ascending and contracting proportion that adds stability to any government; for when the departure is sudden from one extreme to another, we may pronounce that state to be precarious. The nobility, therefore, are the pillars, which are reared from among the people, more immediately to support the throne; and if that falls, they must also be buried under its ruins. Accordingly, when in the last century the commons had determined to extirpate monarchy, they also voted the house of lords to be useless and dangerous. And since titles of nobility are thus expedient in the state, it is also expedient that their owners should form an independent and separate branch of the legislature. If they were confounded with the mass of the people, and like them had only a vote in electing representatives, their privileges would soon be borne down and overwhelmed by the popular torrent, which would effectually level all distinctions. It is therefore highly necessary that the body of nobles should have a distinct assembly, distinct deliberations, and distinct powers from the commons."—These remarks, at a time like the present, deserve our serious attention.

The origin of nobility in Europe is by some referred to the Goths; who, after they had seized a part of Europe, rewarded their captains with titles of honour, to distinguish them from the common people. In this place we shall consider the manner in which they may be created, and the incidents attending them.

1. The right of peerage seems to have been originally territorial; that is, annexed to lands, honours, castles, manors, and the like, the proprietors and possessors of which were (in right of those estates) allowed to be peers of the realm, and were summoned to parliament to do suit and service to their sovereign, and, when the land was alienated, the dignity passed with it as appendant. Thus the bishops still sit in the house of lords in right of succession to certain

ancient baronies annexed, or supposed to be annexed, to their episcopal lands; and thus, in 11 Hen. VI. the possession of the castle of Arundel was adjudged to confer an earldom on its possessor. But afterwards when alienations grew to be frequent, the dignity of peerage was confined to the lineage of the party ennobled, and instead of territorial became personal. Actual proof of a tenure by barony became no longer necessary to constitute a lord of parliament; but the record of the writ of summons to him or his ancestors was admitted as a sufficient evidence of the tenure.

Peers are now created either by writ or by patent made to their ancestors; though by length of time it is lost. The creation by writ, or the king's letter, is a summons to attend the house of peers by the style and title of that barony which the king is pleased to confer; that by patent is a royal grant to a subject of any dignity and degree of peerage. The creation by writ is the more ancient way; but a man is not ennobled thereby, unless he actually takes his seat in the house of lords: and some are of opinion that there must be at least two writs of summons, and a sitting in two distinct parliaments, to evidence an hereditary barony: and therefore the most usual, because the surest, way is to grant the dignity by patent, which endures to a man and his heirs according to the limitations thereof, though he never himself makes use of it. Yet it is frequent to call up the eldest son of a peer to the house of lords by writ of summons, in the name of his father's barony: because in that case there is no danger of his children's losing the nobility in case he never takes his seat; for they will succeed to their grandfather. Creation by writ has also one advantage over that by patent: for a person created by writ holds the dignity to him and his heirs, without any words to that purport in the writ; but in letters patent there must be words to direct the inheritance, else the dignity endures only to the grantee for life. For a man or woman may be created noble for their own lives, and the dignity not descend to their heirs at all, or descend only to some particular heirs: as where a peerage is limited to a man and the heirs male of his body by Elizabeth his present lady, and not to such heirs by any former or future wife.

2. Let us next take a view of a few of the principal incidents attending the nobility, exclusive of their capacity as members of parliament, and hereditary counsellors of the crown, both of which we have considered under the articles LORDS and PARLIAMENT. And first we must observe, that in criminal cases a nobleman shall be tried by his peers. The great are always obnoxious to popular envy; were they to be judged by the people, they might be in danger from the prejudices of their judges; and would moreover be deprived of the privilege of the meanest subjects, that of being tried by their equals, which is secured to all the realm, by *magna charta*, c. 29. It is said, that this does not extend to bishops, who, though they are lords of parliament, and fit there by virtue of their baronies, which they hold, *jure ecclesiæ*, yet are not ennobled in blood, and consequently not peers with the nobility. As to peeresses, no provision was made for their trial, when accused of treason or felony, till after Eleanor duchess of Gloucester, wife to the lord protector, had been accused of treason, and found guilty of witchcraft, in an ecclesiastical synod, through the intrigues of cardinal Beaufort. This very extraordinary trial gave occasion to a special statute, 20 Hen. VI. c. 9, which enacts, that peeresses, either in their own right, or by marriage, shall be tried before the same judicature as peers of the realm. If a woman, noble in her own right, marries a commoner, she still remains noble, and shall be tried by her peers: but if she be only noble by marriage, then by a second marriage with a commoner she loses her dignity; for as by marriage it is gained, by marriage it is also lost. Yet if a duchess-dowager marries a baron, she continues a duchess still; for all the nobility are *pares*, and therefore it is no degradation. A peer or peeress (either in her own right or by marriage) cannot be arrested in civil cases: and they have also many peculiar privileges annexed to their peerage, in the course of judicial proceedings. A peer sitting in judgment, gives not his verdict upon oath, like an ordinary jurymen, but upon his honour; he answers also to bills in chancery upon his honour, and not upon his oath; but when he is examined as a witness, either in civil or criminal cases, he must be sworn; for the respect which the law shews to the honour of a peer does not extend so far as to overturn a settled maxim, that, in *judicio non creditur nisi juratis*. The honour of peers is however so highly tendered by the law, that it is much more penal to spread false reports of them, and certain other great officers of the realm, than of other men; scandal against them being called by the peculiar name of *scandalum magnatum*, and subjected to peculiar punishment, by divers ancient statutes.

A peer cannot lose his nobility but by death or attainder; though there was an instance, in the reign of Edward IV. of the degradation of George Neville, duke of Bedford, by act of parliament, on account of his poverty, which rendered him unable to support his dignity. But this is a singular instance; which serves at the same time, by having happened, to shew the power of parliament: and by having happened but once, to shew how tender the parliament hath been in exerting so high a power. It hath been said, indeed, that if a baron wastes his estate, so that he is not able to support the degree, the king may degrade him: but it is expressly held by later authorities, that a peer cannot be degraded but by act of parliament.

NODE, NODUS, in surgery, denotes a tumour, arising on the bones; and usually proceeding from some venereal cause. *Node* amounts to the same with what is otherwise called *exostosis*. *Node* is more particularly applied to the tumours or protuberances arising on the joints of old gouty people; called also *tophi*. They are supposed to be formed of a thick, crude, heavy, viscid, indigested matter, mixed with a hot, sharp, bilious juice, the grosser and more terrestrial part whereof being detained, grows into a stony sort of concretion.

NODES, in astronomy, the two points wherein the orbit of a planet intersects the ecliptic. For a definition, see the *System*, Sect. VII.

NOMENCLATURE, NOMENCLATURA, a catalogue of several of the more usual words in any language, with their significations, compiled in order to facilitate the use of such words, to those who are to learn the tongue: such are our Latin, Greek, French, &c. *Nomenclatures*. The Chymical *Nomenclature* has, within these few years, undergone a total change: in our *System* we have accordingly stated the motives which induced M. Lavoisier, and other eminent French chymists, to propose and adopt the New *Nomenclature*. We have explained the principles on which the new terms are founded; and, to render those new terms more intelligible, we have prefixed the old terms, by which the several articles were denominated, previous to the introduction and general adoption of the New *Nomenclature*. See the *System*, under the head NEW *NOMENCLATURE*, and the several articles, as they respectively occur.

NOMINATIVE, in grammar, the first case of nouns which are declinable. The simple position, or laying down of a noun, or name, is called the *Nominative case*; yet it is not so properly a case, as the matter or ground whence the other cases are to be formed, by the several changes and reflections given to this first termination. See the *System*, Part I. Chap. I. Sect. I. and Part II. Chap. III. Article III.

NONCONFORMISTS, those who refuse to join the established worship. Nonconformists, in England, are of two sorts. First, such as absent themselves from divine worship in the established church, through total irreligion, and attend the service of no other persuasion. These, by the stat. 1 Eliz. c. 2; 23 Eliz. c. 1; and 3 Jac. I. c. 4, forfeit one shilling to the poor, every Lord's day they do absent themselves, and 20*l.* to the king, if they continue such default for a month together; and if they keep any inmate, thus irreligiously disposed in their houses, they forfeit 10*l.* per month.

The second species of Nonconformists are those who offend through a mistaken or perverse zeal. Such were esteemed, by the English laws, enacted since the time of the Reformation, to be Papists and Protestant Dissenters; both of which were supposed to be equally schismatics, in not communicating with the national church; with this difference, that the Papists divided from it upon material, though erroneous, reasons; but many of the dissenters upon matters of indifference, or, in other words, upon no reason at all. "Yet certainly (says Sir William Blackstone) our ancestors were mistaken in their plans of compulsions and intolerance. The sin of schism, as such, is by no means the object of temporal coercion and punishment. If, through weakness of intellect, through misdirected piety, through perverseness and acerbity of temper, or (which is often the case) through a prospect of secular advantage, in herding with a party, men quarrel with the ecclesiastical establishment, the civil magistrate has nothing to do with it, unless their tenets and practice are such as threaten ruin or disturbance to the state. He is bound indeed to protect the established church: and, if this can be better effected by admitting none but its genuine members to offices of trust and emolument, he is certainly at liberty so to do; the disposal of offices being matter of favour and discretion. But, this point being once secured, all persecution for diversity of opinions, however ridiculous or absurd they may be, is contrary to every principle of sound policy and civil freedom. The names and subordination of the clergy, the posture of devotion, the materials and colour of the minister's garment, the joining in a known or unknown form of prayer, and other matters of the same kind, must be left to the option of every man's private judgment.

"With regard therefore to Protestant dissenters, although the experience of their turbulent disposition in former times occasioned several disabilities and restrictions (which I shall not undertake to justify) to be laid upon them by abundance of statutes, yet, at length the legislature, with a true spirit of magnanimity, extended that indulgence to these sectaries, which they themselves, when in power, had held to be countenancing schism, and denied to the church of England.

"As to Papists, what has been said of the Protestant Dissenters would hold equally strong for a general toleration of them; provided their separation was founded only upon difference of opinion in religion, and their principles did not also extend to a subversion of the civil government. If once they could be brought to renounce the supremacy of the pope, they might quietly enjoy their seven sacraments, their purgatory, and auricular confession; their worship of relics, and images; nay, even their transubstantiation. But while they acknowledge a foreign power superior to the sovereignty of the kingdom, they cannot complain, if the laws of that kingdom will not treat them upon the footing of good subjects.

"The laws against the Papists are so rigorous, though not professedly of the sanguinary kind, that they do all the hurt that can possibly be done in cold blood. But in answer to this, it may be observed (what foreigners who only judge from our statute-book are not fully apprized of) that these laws are seldom exerted to their utmost rigour; and, indeed, if they were, it would be very difficult to excuse them; for they are rather to be accounted for from their history, and the urgency of the times which produced them, than to be approved (upon a cool review) as a standing system of law. The restless machinations of the Jesuits during the reign of Elizabeth, the turbulence and uneasiness of the Papists under the new religious establishment, and the boldness of their hopes and wishes for the succession of the queen of Scots, obliged the parliament to counteract so dangerous a spirit by laws of a great, and then perhaps necessary, severity. The powder-treasure, in the succeeding reign, struck a panic into James I. which operated in different ways; it occasioned the enacting of new laws against the Papists; but deterred him from putting them in execution. The intrigues of queen Henrietta, in the reign of Charles I. the prospect of a Popish successor in that of Charles II. the assassination-plot in the reign of king William, and the avowed claim of a Popish pretender to the crown, in subsequent reigns, will account for the extension of these penalties at those several periods of our history."

But now, that all fears of a pretender are vanished; and the power and influence of the pope has become feeble, ridiculous, and despicable, not only in Britain, but in almost every kingdom of Europe; and as, in fact, the British Catholics solemnly disclaim the dangerous principles ascribed to them; the British legislature, giving way to that liberality of sentiment becoming Protestants, have lately repealed the most rigorous of the above edicts, viz. the punishment of Popish priests or Jesuits, who should be found to teach, or officiate in the service of the church; which acts were felony in foreigners, and high-treason in the natives of this kingdom:—The forfeitures of Popish heirs, who had received their education abroad; and whose estates went to the next Protestant heir:—The power given to the son, or other relation, being a Protestant, to take possession of the father's, or other relation's, estate, during the life of the real proprietor:—And the debarring Papists from the power of acquiring any legal property by purchase.

In proposing the repeal of these penalties, it was observed, That besides that some of them had now ceased to be necessary, others were at all times a disgrace to humanity. The imprisonment of a Popish priest for life, only for officiating in the service of his religion, was horrible in its nature; and, although the mildness of government had hitherto softened the rigour of the law in the practice, it was to be remembered, that the Roman Catholic priests constantly lay at the mercy of the basest and most abandoned of mankind—of common informers; for, on the evidence of any of these wretches, the magisterial and judicial powers were of necessity bound to enforce all the shameful penalties of the act. Others of these penalties held out the most powerful temptations for the commission of acts of depravity, at the very thought of which our nature recoils with horror: They seemed calculated to loosen all the bands of society, to dissolve all civil, moral, and religious obligations and duties, to poison the sources of domestic felicity, and, to annihilate every principle of honour. The encouragement given to children to lay their hands upon the estates of their parents, and the restriction which debars any man from the honest acquisition of property, need only to be mentioned to excite indignation in an enlightened age.

In order the better to secure the English established church against perils from Nonconformists of all denominations, Infidels, Turks, Jews, Heretics, Papists, and Sectaries; there are, however, two bulwarks erected: called the *corporation* and *test act*: by the former of which, no person can be legally elected to any office relating to the government of any city or corporation, unless, within a twelvemonth before, he has received the sacrament of the Lord's supper, according to the rites of the church of England; and, he is also enjoined to take the oaths of allegiance and supremacy, at the same time that he takes the oath of office; or, in default of either of these requisites, such election shall be void. The other, called the *Test Act*, directs all officers, civil and military, to take the oaths, and make the declaration against transubstantiation, in any of the king's courts at Westminster, or at the quarter-sessions, within six calendar months after their admission; and also, within the same time to receive the sacrament of the Lord's supper, according to the usage of the church of England, in some public church, immediately after divine service and sermon, and to deliver into court a certificate thereof signed by the minister and churchwardens, and also to prove the same by two credible witnesses; upon forfeiture of 500*l.* and disability to hold the said office. And of much the same nature with these is the statute 7 Jac. I. c. 2, which permits no person to be naturalized or restored in blood, but such as undergo a like test; which test having been removed in 1753, in favour of the Jews, was the next session of parliament restored again, with some precipitation.

NON-JURORS, are persons that refuse to take the oaths to the

the government, who are liable to certain penalties; and for a third offence to abjure the realm.

The Non-jurors, or high-church men, were particularly distinguished by the following principles: 1. They maintained the doctrine of passive obedience. 2. That the hereditary succession to the throne is of divine institution, and therefore can never be interrupted, suspended, or annulled, on any pretext. 3. That the church is subject to the jurisdiction, not of the civil magistrate, but of God alone, particularly in matters of a religious nature. 4. That, consequently, the bishops deposed by king William III. remained, notwithstanding their deposition, true bishops to the day of their death; and that those who were substituted in their places were the unjust possessors of ecclesiastical dignities, were rebels against the state, as well as schismatics in the church, and that all, therefore, who held communion with them, were also chargeable with rebellion and schism. And, 5, that this schism, which rends the church in pieces, is a most heinous sin, whose punishment must fall heavy on all those who do not return sincerely to the true church, from which they have departed.

NON-NATURALS, in Medicine, *res non naturales*, are the causes and effects of diseases, whether near or remote. Physicians have digested all the causes of diseases into six classes, which they call the six *non-naturals*. These are, 1. Air. 2. Meat and drink. 3. Motion and rest. 4. The passions of the mind. 5. Excretions and retentions. 6. Sleep and waking. They are thus called, because, by their use or abuse, they become either good, *naturals*; or evil, *contra-naturals*. But the division, in effect, is of no great use; the causes of diseases being much more commodiously laid down otherwise.

NORTH, one of the four cardinal points of the horizon, being that intersection of the horizon and meridian which lies nearest our pole.

NORTH-East Passage, The advocates for the north-east passage, says a late writer, have divided that navigation into three parts; and by endeavouring to shew that these three parts have been passed at different times, they conclude from thence, that the whole, taken collectively, is practicable. These three parts are, 1. From Archangel to the river Lena: 2. From the Lena round Tschukotkoi Nofs (or the north-eastern promontory of Asia) to Kamtschatka: and 3. From Kamtschatka to Japan. With respect to the first part, no one ever asserted that it has been performed in one voyage: from an account of the several voyages that have been made in these seas, it appears, that there is a cape between the rivers Chatanja and Pisida, that has never yet been doubled. As to the second division of the north-east passage, it has been affirmed, that a passage has been effected by several vessels, which have at different times, sailed round the northern extremity of Asia. But from the Russian accounts it is inferred, that it has been performed but once, viz. by one Deshneff, who, in 1648, is said to have doubled this formidable cape. Of the third, or remaining part of this passage, no doubt can be entertained. The connection between the seas of Kamtschatka and Japan has been established by many voyages. Coxe's Account of the Russian Discoveries, &c. 4to, 1780.

NORTH-West Passage, A north-west passage by Hudson's bay into the Pacific Ocean, has been more than once attempted of late years, but, hitherto, without success. Some greatly doubt of the practicability of such an enterprise, and think the observations made by the Russians give us small hopes. But, as they have not yet published the particulars of their discoveries, little can be said about them. Some general things may be seen in the Phil. Trans. N° 482, Sect. 14. It appears from thence, that the Russians have passed between the land of Nova Zembla, and the coast of Asia, and as the Dutch did formerly discover the northern coasts of Nova Zembla, we may be well assured, that the country is really an island. Captain Meres, in the account of his voyage to the north-west coast of America, suggests an idea of the practicability of this passage.

NORTHERN-Lights, the same with *aurora borealis*, under which article we have given a copious account of this phenomenon, and of the supposed causes of it. Natural science, however, does not arrive at perfection at once, and it is well if it does so after trials repeated for years with care and accuracy. How far the causes that have been assigned for this appearance will account for it, or, whether they will be able to remove all difficulties, it is not for us to determine; but it is the part of philosophers to hear all sides, and to attend with patient assiduity to every hypothesis, rejecting or receiving as reason, after the strictest investigation, shall seem to favour the one side or the other. Wishing to lay before our readers every thing important either in science or in literature, we cannot let pass the opportunity which the present article affords us, of mentioning an hypothesis which Doctor Stearns, an American, formed, about the year 1788, to account for the appearances called *aurora borealis*, and *aurora australis*. For this last, see AURORA BOREALIS, N° 3.

Doctor Stearns supposes, that these phenomena originate from aqueous, nitrous, sulphureous, bituminous, and other exhalations, from the fumes of various kinds of earths, or other minerals, vegetables, animals, fires, volcanoes, &c. These, he thinks, become rarefied, and being charged with electrical fluid, become

specifically lighter than the circumambient air; hence, of course, they ascend: and, being elevated to the upper regions of the air, and driven by the winds from warmer to colder climates, the cold makes them combine and stiffen. When they are afterwards agitated by different currents of air, they sparkle, and crackle like the hairs of cats and other animals when stiffened with cold. This corrufcation in quite cold atmospheres, and in those which are more temperate, appears in different positions in the horizon, zenith, or otherwise, according to the situation of the spectator, and the position of the elevated exhalations. The difference of colours, the Doctor supposes to arise from the different qualities of the articles combined, those of the most inflammable nature shining with the greatest lustre.

The Doctor likewise tries to account for these lights not appearing, or but seldom appearing, in ancient times. The atmosphere, he thinks, was not impregnated with materials proper to produce them. He imagines, that the increased consumption of fuel, in America in particular, the burning of volcanoes, and the approach of blazing stars, whose atmospheres have been so expanded by the sun's heat, that part of them have fallen into the earth's atmosphere, and communicated to it new matter, have so changed and prepared our air, that whenever its consilience is proper, then, if the light of the sun and moon is not too powerful, the *aurora borealis* will appear.

NOSE, the organ of smell. The uses of the nose are, its giving us the sense of smelling; its serving in the great office of respiration, and in modelling the voice; in receiving the abundant humours from the eyes, and in adding to the beauty of the face. For description, as an organ of sense, see the System of ANATOMY, Part VII. Sect. III. For those parts which relate to the bones, see Part I. Sect. II. Art. II. For those which relate to the muscles, see Part II. Sect. II. Table of Muscles, Art. V. For representation of the bones and muscles of this part of the human face, see the Plates I. and II. with their explanations.

In Tartary, the greatest beauties are those who have the least noses. Ruybrock mentions the wife of the great Jenghiz Khan as a celebrated beauty, because she had only two holes for a nose. The Crim Tartars break the noses of their children while young, as thinking it a great piece of folly to have their noses stand before their eyes. In most other countries, China excepted, great noses are an honour.

In what the beauty of the nose consists, different nations have different opinions: and the following reflections of Sir Joshua Reynolds on this subject are perhaps the most philosophical account of the beauty of form that is to be found in any language: "I suppose (says Sir Joshua) it will be easily granted, that no man can judge whether an animal be beautiful in its kind, or deformed, who has seen only one of that species; that is as conclusive in regard to the human figure: so that, if a man born blind was to recover his sight, and the most beautiful woman was brought before him, he could not determine whether she was handsome or not; nor, if the most beautiful and the most deformed were produced, could he any better determine to which he should give the preference, having seen only these two. To distinguish beauty, then, implies the having seen many individuals of that species. If it is asked, how is more skill acquired by the observation of greater numbers? I answer, that, in consequence of having seen many, the power is acquired, even without seeking after it, of distinguishing between accidental blemishes and excellence; which are continually varying the surface of Nature's works, and the invariable general form which Nature most frequently produces, and always seems to intend in her productions.

"Every species of the animal as well as the vegetable creation may be said to have a fixed or determinate form, towards which nature is continually inclining, like various lines terminating in the centre; or, it may be compared to pendulums vibrating in different directions over one central point; and as they all cross the centre, though only one passes through any other point, so it will be found that perfect beauty is oftener produced by nature than deformity: I do not mean than deformity in general, but than any one kind of deformity. To instance in a particular part of a feature: the line that forms the ridge of the nose is beautiful when it is straight; this then is the central form, which is oftener found than either concave, convex, or any other irregular form that shall be proposed. As we are then more accustomed to beauty than deformity, we may conclude that to be the reason why we approve and admire it, as we approve and admire customs and fashions of dress, for no other reason than that we are used to them: so that, though habit and custom cannot be said to be the cause of beauty, it is certainly the cause of our liking it; and, I have no doubt, but that, if we were more used to deformity than beauty, deformity would then lose the idea now annexed to it, and take that of beauty; as if the whole world should agree, that yes and no should change their meaning, yes would then deny, and no would affirm.

"Whoever undertakes to proceed further in this argument, and endeavours to fix a general criterion of beauty respecting different species, or to shew why one species is more beautiful than another, it will be required from him first to prove that one species is really more beautiful than another? That we prefer one to the other, and with very good reason, will be readily granted; but it does not

not follow from thence that we think it a more beautiful form, for we have no criterion of form by which to determine our judgment. He who says a swan is more beautiful than a dove, means little more than that he has more pleasure in seeing a swan than a dove, either from the stateliness of its motions, or its being a more rare bird; and he who gives the preference to the dove, does it from some association of ideas of innocence that he always annexes to the dove: but if he pretends to defend the preference he gives to one or the other, by endeavouring to prove that this more beautiful form proceeds from a particular gradation of magnitude, undulation of a curve, direction of a line, or whatever other conceit of his imagination he shall fix on as a criterion of form, he will be continually contradicting himself, and find at last that the great mother of nature will not be subjected to such narrow rules. Among the various reasons why we prefer one part of her works to another, the most general, I believe, is habit and custom: custom makes, in a certain sense, white black, and black white; it is custom alone determines our preference of the colour of the Europeans to the Ethiopians; and they, for the same reason, prefer their own colour to ours. I suppose nobody will doubt, if one of their painters was to paint the goddess of beauty, but that he would represent her black, with thick lips, flat nose, and woolly hair: and it seems to me he would act very unnaturally if he did not; for by what criterion will any one dispute the propriety of his idea? We indeed, say, that the form and colour of the European is preferable to that of the Ethiopian; but I know of no other reason we have for it, but that we are most accustomed to it. It is absurd to say, that beauty is possessed of attractive powers, which irresistibly seize the corresponding mind with love and admiration, since that argument is equally conclusive in favour of the white and the black philosophers.

The black and white nations must, in respect of beauty, be considered as of different kinds, at least a different species of the same kind; from one of which to the other, as I observed, no inference can be drawn.

"Novelty is said to be one of the causes of beauty: that novelty is a very sufficient reason why we should admire, is not denied; but because it is uncommon, is it therefore beautiful? The beauty that is produced by colour, as when we prefer one bird to another, though of the same form, on account of its colour, has nothing to do with this argument, which reaches only to form. I have here considered the word beauty as being properly applied to form alone. There is a necessity of fixing this confined sense; for there can be no argument if the sense of the word is extended to every thing that is approved. A rose may as well be said to be beautiful, because it has a fine smell, as a bird because of its colour. When we apply the word beauty, we do not mean always by it a more beautiful form, but something valuable on account of its rarity, usefulness, colour, or any other property. A horse is said to be a beautiful animal; but had a horse as few good qualities as a tortoise, I do not imagine that he would be then esteemed beautiful.

"A fitness to the end proposed is said to be another cause of beauty: but supposing we were proper judges of what form is the most proper in an animal to constitute strength or swiftness, we always determine concerning its beauty before we exert our understanding to judge of its fitness.

"From what has been said, it may be inferred, that the works of nature, if we compare one species to another, are all equally beautiful; and that preference is given from custom, or some association of ideas; and that in creatures of the same species beauty is the medium or centre of all various forms."

NOSOLOGY, Νοσολογια, compounded of νοσος, *malady, disease*, and λογος, *discourse, reason*: a discourse or treatise of diseases; otherwise called **PATHOLOGY**.

The celebrated Linnæus adopted a plan, and framed a set of institutes, under the title *Genera Morborum*: his scheme was first published in a thesis in 1759, in a small quarto, in 1763. In the classification of diseases, he has nearly retained the arrangement of M. Sauvages, but has altered his terms, changed the order of the classes, and added a new class, with which he begins his method.

The symptomatic plan of arranging diseases has since been followed by some other professors of physic. Dr. Vogel of Gottingen, in 1764, published his *Definitones Generum Morborum*; Dr. Cullen of Edinburgh has also published a *Synopsis Nosologæ Methodicæ*, and made it the basis of his *First Lines of the Practice of Physic*; in which, by omitting many genera, and reducing others to the rank of species only, he has very considerably abridged the whole; upon this plan is formed our *System of Medicine*.

NOSTRILS, Nares, the two apertures or cavities of the nose, through which the air passes, and which serve to convey odours and to carry off the pituita separated in the sinus of the base of the cranium. The nostrils are separated by a cartilage, called *septum narium*, and lined with a very sensible membrane. See the *System of Anatomy*, Part VII. Sect. III.

NOTHING, Nihil, Nihilum, or *Non ens*. The learned distinguish between nothing taken strictly, which is what is impossible, or implies a contradiction; and nothing taken more generally, which is both applied to what is possible, and impossible. Again,

No. 118.

they distinguish nothing into negative, which is the absence of reality in any subject, and privative, which is the absence of reality in a subject capable thereof, or wherein it ought to be found.

NOTION, *Notto*, in logic, an idea or representation of any thing in the mind. This term, and the word *idea*, are often taken in the same sense; but an ingenious author observes that we cannot strictly be said to have an idea of an active being, or of an action; although we may be said to have an notion of them. I have some knowledge, or notion of my mind, and its acts about ideas, inasmuch as I know, or understand, what is meant by those words: What I know, that I have some notion of. However, the terms *idea* and *notion* may be used convertibly: But yet it conduces to clearness and propriety, that we distinguish things very different by different names. It is also to be remarked, that of all relations including an act of the mind, we cannot so properly be said to have an idea, but rather a notion of the relations or habitudes between things; but if, in the modern way, the word *idea* is extended to spirits, relation, and acts, this is, after all, an affair of verbal concern. Berkeley Princip. of Hum. Knowl. Sect. 142, p. 160, 161. See also the Article **IDEA**.

NOVEL, a fictitious narrative in prose, which professes to exhibit the natural workings of the human heart, the happiness and misery of private life, and, above all, the nature of the affection called *Love*, and the consequence of indulging it in certain circumstances.

The novel sprung out of the old romance, and has been censured for insipidity, as its parent was for extravagance. (See **ROMANCE**.) That the greater part of those absurd things which, under this title, are daily issuing from the press, deserve all the contempt with which they can be treated, is a position which we feel not ourselves inclined to controvert; but we cannot admit that any species of writing is in itself insipid, merely because numbers have attempted it without success. The heroic poems of Blackmore are universally known to be contemptible performances; and if we had before us all the heroic poetry that has ever been written, how many thousand of volumes should we have as mean as either *Prince Arthur*, *King Arthur*, *Eliza*, or *Alfred*? Yet no critic has hitherto dared to maintain that heroic poetry is an insipid species of writing.

It has been often affirmed, with learned solemnity, that the perusal of novels tends to corrupt the youth of both sexes; to produce effeminacy in men, and extravagant notions of the happiness of love in women; that it diverts the minds of the former from more serious and useful studies, and exposes the latter to the arts of seduction. That there are some novels to which this objection is applicable, is certainly a fact. That a novel might be written so as to interest the heart in behalf of virtue, as much as any one has ever warped it to the side of vice, is a truth which no man will ever venture to call in question who has any knowledge of human nature; and therefore we are decidedly of opinion that there may be novels worthy at once of the perusal of inexperienced youth and hoary wisdom. A critic, by no means too indulgent to works of fancy, and among whose failings laxity of morals has never been numbered, thus expresses himself on the subject of novel-writing:—"These familiar histories may perhaps be made of greater use than the solemnities of professed morality, and convey the knowledge of vice and virtue with more efficacy than axioms and definitions. But if the power of example is so great, as to take possession of the memory by a kind of violence, and produce effects almost without the intervention of the will, care ought to be taken, that, when the choice is unrestrained, the best examples only should be exhibited; and that what is likely to operate so strongly, should not be mischievous or uncertain in its effects."

We have said, that the novel professes, above all things, to exhibit the nature of love and its consequences. Whether this be essential to such performances may perhaps be reasonably questioned; but it has been made an important part of the drama in most novels, and we think with great propriety. It is the object of the novelist to give a true picture of life, diversified only by accidents that daily happen in the world, and influenced by passions and qualities which are daily to be found in conversing with mankind. To accomplish this object, he conceives a hero or heroine, whom he places in a certain rank of life, endues with certain qualities of body and mind, and conducts through many vicissitudes of fortune, either to the summit of happiness or to the abyss of misery, according to the passion which he wishes to excite in his readers. In the modern novel, this hero or heroine is never placed on a throne, or buried in a cottage; because to the monarch and the cottager no difficulties occur which can deeply interest the majority of readers. But among the virtuous part of the intermediate orders of society, that affection which we call *love* seldom fails, at some period of life, to take possession of the hearts of both sexes; and wherever it has place, it must be productive of happiness or of misery. In the proper management of this passion consists much of the difficulty of the novel-writer. He must exhibit his hero as feeling all the pangs and pleasures of love, as sometimes animated with hope, and sometimes ready to sink into despair, but always exerting himself to obtain the gratification of his wishes. In doing this, care should be taken, either

that

that he never transgress the laws of virtue, or at least that he never transgress them with impunity.

"It is justly considered as the greatest excellency of art to imitate nature; but it is necessary to distinguish those parts of nature which are most proper for imitation: greater care is still required in representing life, which is so often discoloured by passion or deformed by wickedness. If the word be promiscuously described, I cannot perceive (says the great critic already quoted) of what use it can be to read the account; or why it may not be as safe to turn the eye immediately upon mankind, as upon a mirror which shows all that presents itself without discrimination. It is therefore not a sufficient vindication of a character, that it is drawn as it appears; for many characters ought never to be drawn; nor of a narrative, that the train of events is agreeable to observation; for that observation which is called knowledge of the world will be found much more frequently to make men cunning than good. The purpose of these writings is surely not only to show mankind, but to provide that they may be seen hereafter with less hazard; to teach the means of avoiding the snares which are laid by treachery for innocence, without incurring any wish for that superiority with which the betrayer flatters his vanity; to give the power of counteracting fraud, without the temptation to practise it; to initiate youth by meek encounters in the art of necessary defence; and to increase prudence without impairing virtue.

"Many writers, for the sake of following nature, so mingle good and bad qualities in their principal personages, that they are both equally conspicuous; and as we accompany them through their adventures with delight, and are led by degrees to interest ourselves in their favour, we lose the abhorrence of their faults, because they do not hinder our pleasure; or perhaps regard them with some kindness for being united with so much merit. There have been men, indeed, splendidly wicked, whose endowments threw a brightness on their crimes, and whom scarce any villainy made perfectly detestable, because they never could be wholly divested of their excellences: but such have been, in all ages, the great corruptors of the world; and their resemblance ought no more to be preserved than the art of murdering without pain.

"In narratives where historical veracity has no place, there should be exhibited the most perfect idea of virtue; of virtue not angelical, nor above probability (for what we cannot credit we shall not imitate) but the highest and purest that humanity can reach, which, exercised in such trials as the various revolutions of things shall bring upon it, may, by conquering some calamities, and enduring others, teach us what we may hope, and what we can perform. Vice (for vice is necessary to be shown) should disgust; nor should the graces of gaiety or the dignity of courage, be so united with it, as to reconcile it to the mind. Wherever it appears, it should raise hatred by the malignity of its practices, and contempt by the meanness of its stratagems; for, while it is supported by either parts or spirit, it will seldom be heartily abhorred."

If these observations be just, and to us they appear unanswerable, Richardson's *Lovelace* is a character which ought never to have been drawn. In the graces of gaiety, and the dignity of courage, in liberality without profusion, in perseverance and address, he every where appears as the first of men; and that honour with which he protects the virtue of his "Rose-bud," if any instruction is to be drawn from it, can only lead the admirers of Richardson to believe, that another *Clarissa* might be in perfect safety, were she to throw herself upon the honour of another *Lovelace*. Yet, in the composition of this splendid character, there is not one principle upon which confidence can securely rest; and *Lovelace*, whilst he is admired by the youth of both sexes, and escapes the contempt of all mankind, must exist in the breast of the cool moralist, sentiments of abhorrence and detestation.

A French critic, speaking of this character, says, "By turns I could embrace and fight with *Lovelace*. His pride, his gaiety, his drollery, charm and amuse me: his genius confounds me, and makes me smile; his wickedness astonishes and enrages me; but at the same time I admire, as much as I detest him." Surely this is not the character which ought to be presented to the inexperienced and ardent mind!

The most perfect characters which we at present recollect in any novel are, Richardson's *Grandison*, and Fielding's *Allworthy*.—The virtues of the former are perhaps tinged with moral pedantry, if we may use the expression; and the latter suffered himself to be long imposed upon by the arts of the hypocrite, and the philosophical coxcomb; but without some defects they would not be human virtues, and therefore no objects of human imitation. *Clarissa* is an excellent character: She has as much perfection as can be expected in woman, whilst she exhibits, at the same time, some obvious defects.

As to the object of the Novelist to interest the heart, and to communicate instruction through the medium of pleasure, his work, like a tragedy or comedy, should be one, exhibiting a hero or heroine, whose success every incident should contribute to forward or to retard. In this respect no work of fancy has ever surpassed the *Tom Jones* of Fielding. It is constructed upon principles of the soundest criticism, and contains not a single event which does

not, in some way, contribute towards the winding up of the piece. A living author, deeply read in Grecian literature, and far from being prejudiced in behalf of any modern, has been heard to say, that had Aristotle seen *Tom Jones*, he would have pronounced it a poem, perfect in its kind.

The business of the Novelist is to interest the heart by a display of the incidents of common life. In doing this, he must exhibit scenes that are probable, and record speeches that are natural. He is not at liberty to invent, but only to select, objects, and to call, from the mass of mankind, those individuals upon which the attention ought most to be employed. The more closely he adheres to this rule, the more deeply does he interest us in his narrative; because every reader sees at once, that it is possible he may, at some time or other, be in circumstances nearly resembling those of the hero of the tale. But the business of life is not transacted in pompous language, nor the speeches of real lovers made in verse, either rhimed or blank. Was *Tom Jones* to be translated into verse, we shall venture to assert, it would quickly lose its hold of the public mind: because the hero would appear in a light which every heart must feel to be unnatural.

It is well observed by Johnson, "that the task of the Novel-writer requires, together with that learning which is to be gained from books, that experience which can never be attained by solitary diligence, but must arise from general converse, and accurate observation of the living world. Their performances have, as *Horace* expresses it, *plus oneris quantum varia minus*, little indulgence, and therefore more difficulty. They are engaged in portraits of which every one knows the original, and can detect any deviation from exactness of resemblance. Other writings are safe, except from the malice of learning, but these are in danger from every common reader; as the slipper, ill-executed, was censured by a shoemaker, who happened to stop in his way, at the *Venus of Apelles*." It is in this faithfully copying nature that the excellence of Fielding consists. No man was ever better acquainted with the shades which diversify characters, and none ever made his personages act and speak more like real men and women, in the particular circumstances which he describes.

"But the fear of not being approved as a just copier of human manners is not the most important concern that an author of this class ought to have before him. Novels are written chiefly to the young, the ignorant, and the idle, to whom they serve as lectures of conduct, and introduction into life. In every such work it should therefore be carefully inculcated, that virtue is the highest proof of understanding, and the only basis of greatness; and that vice is the natural consequence of narrow thoughts; that it begins in mistake and ends in ignominy: And, since love must be introduced, it should be represented as leading to wretchedness, whenever it is separated from duty or from prudence."

NOVELTY, or NEWNESS. Of all the circumstances that raise emotions, not excepting beauty, nor even greatness, says Lord Kames, in his *Elements of Criticism*, Novelty hath the most powerful influence. A new object produces instantaneously an emotion, termed wonder, which totally occupies the mind, and for a time excludes all other objects. Conversation, among the vulgar, never is more interesting than when it turns upon strange objects, and extraordinary events. Men tear themselves from their native country in search of things rare and new; and Novelty converts into a pleasure the fatigues, and even perils, of travelling. To what cause shall we ascribe these singular appearances? To curiosity undoubtedly; a principle implanted in human nature for a purpose extremely beneficial, that of acquiring knowledge; and the emotion of wonder raised by new and strange objects, inflames our curiosity to know more of such objects. This emotion is different from admiration: Novelty, wherever found, whether in a quality or action, is the cause of wonder; admiration is directed to the person who performs any thing wonderful.

The highest degree of wonder arises from unknown objects that have no analogy to any species we are acquainted with. Shakspeare in a simile introduces that species of novelty:

As glorious to the fight
As is a winged messenger from heaven
Unto the white up-turned wond'ring eye
Of mortals, that fall back to gaze on him
When he bestrides the lazy pacing clouds,
And sails upon the bosom of the air.

Romeo and Juliet.

NOUN, *Nomen*, in grammar, a name or word which expresses the subject spoken of; or expresses a subject whereof something is or may be, affirmed; as man, food, whiteness, Henry, &c. See the **SYSTEM**, Part I. Chap. I. Sect. I. Chap. III. Article II.

NOURISHMENT. See **NUTRITION**.

NUCLEUS, in general, denotes the kernel of a nut, or even any seed inclosed within a husk. The term *Nucleus* is also used for the body of a comet.

NUCTA, a dew, which, falling in Egypt, about St. John's day is, by the superstitious natives of the country, considered as miraculous, and the peculiar gift of that saint. Its effects are, indeed, so beneficial, that this belief is little surprising among a people so totally ignorant of natural causes as the modern Egyptians, for it is acknowledged, by the most enlightened travellers, to flow

the plague, and announces a speedy and plentiful inundation of the country. These effects are thus rationally accounted for, by Mr. Bruce:

"In February and March the sun is on its approach to the zenith of one extremity of Egypt, and, of course, has a very considerable influence upon the other. The Nile having now fallen low, the water, in certain old cisterns, which, though they still exist, are suffered to accumulate all the filth of the river, becomes putrid, and the river itself has lost all its finer and volatile parts, by the continued action of a vertical sun; so that, instead of being subject to evaporation, it grows daily more and more inclined to putrefaction. About St. John's day it receives a plentiful mixture of the fresh and fallen rain from Ethiopia, which dilutes and refreshes the almost corrupted river, and the sun, near at hand, exerts its influence upon the water, which is now become light enough to be exhaled, though it has still with it a mixture of corrupted fluid. It is in February, March, or April only, that the plague begins in Egypt."

Our philosophical traveller does not believe it an endemical disease; but assigns very sufficient reasons for thinking that it comes from Constantinople, with merchandize, or with passengers, at the very time of the year when the air, by the long absence of dews, has attained a degree of putridity proper to receive it. In this state of the atmosphere, the infection continues to rage till the period of St. John's day, when it is suddenly stopped by the dews occasioned by a refreshing mixture of rain-water, which is poured into the Nile, at the beginning of the inundation. The first, and most remarkable sign of the change effected in the air, is the sudden stopping of the plague. Every person, though shut up from society, for months before, buys, sells, and communicates with his neighbour, without any sort of apprehension; and as far as our author could learn, upon fair enquiry, it was never known that one fell sick of the plague after the anniversary of St. John. He admits that some have died of it after that period; but of them the disease had got such hold, under the most putrid influence of the air, that they could not recover. To corroborate this theory, which attributes so much to the benign influence of the falling dew, he observes, that immediately after St. John's day, the clothes of the many thousands who have died during the late continuance of the plague, are publicly exposed in the marketplace; and that all these, though consisting of furs, cotton, silk, and woollen cloths, which are the stuffs most retentive of infection, imbibing the moist air of the evening and the morning, are handled, bought, put on, and worn, without any apprehension of danger, and without a single accident being known to have happened to any one, possessing this happy confidence.

NUISANCE, in law, is used not only for a thing done to the hurt or annoyance of another, in his free lands or tenements, but also for the siffize, or writ lying for the same.

The word is mentioned 22 Hen. VIII. cap. 4. Nuisances are either public or private: a public nuisance is an offence against the public in general, either by doing what tends to the annoyance of all the king's subjects, or, by neglecting to do what the common good requires: in which case annoyances and injuries to streets, highways, bridges, and large rivers; as also disorderly ale-houses, bawdy-houses, gaming-houses, stages for rope-dancers, mountebanks, &c. cottages erected singly on the waste, making and selling of squibs and fire-works, or throwing them about in any street, eaves-droppers, a common-field, and keeping of hogs in any city, or market-town, are held to be common nuisances. A private nuisance is when only one person or family is annoyed, by the doing of any thing; as where a person stops up the light of another's house, or builds in such a manner, that the rain falls from his house upon his neighbour's; as likewise the turning or diverting water from running to a man's house, mill, meadow, &c. corrupting or poisoning a water-course, by erecting a dye-house, or a lime-pit, for the use of trade, in the upper part of the stream; stopping up a way that leads from houses to lands; suffering a house to decay, to the damage of the next house; erecting a brew-house in any place not convenient; or, a house of office, &c. so near another person's house as to offend him by its smell; or exercising any offensive trade, and setting up a fair or market to the prejudice of another.

Indictment lies for a public or common nuisance at the king's suit, whereon the party offending shall be fined and imprisoned; but no action can be brought in this case, except one man suffers more by a common nuisance than another; as where a pit is dug in the highway, and he falls into it. Action on the case, or assize of nuisance, lies, for any private nuisance, at the suit of the party aggrieved, and on such actions judgment is given that the nuisance shall be removed, and the injured party recover damages: but if a person has only a term of years in a house or lands, as he has no freehold therein, he can have only an action on the case, by which means the nuisance will be removed without his recovering damages. The continuation of a nuisance is by the law considered as a new nuisance, and therefore where a person suffers a nuisance to be set up, and then alienates and lets the land, &c. without removing it, an action of the case lies against him who erected it; and also against the alienee or lessee, for continuing it. It has been adjudged that any person may remove a nuisance, in

which case, even the cutting down a gate that crosses the highway is legal; yet, if a man destroys the nuisance himself, before he commences his action, he cannot have it afterwards, nor recover damages. Neither the lord of a manor, nor the king himself, can licence any person to make or erect a nuisance. Manwood makes three kinds of nuisances in the forest; the first, common nuisance; the second, special nuisance; the third, general nuisance. The writ of nuisance, *de nocumeto*, is either simply *de nocumeto*, or *de parvo nocumeto*. Writs of nuisance are now properly termed trespasses, and actions upon the case.

NUMBER, in grammar, is a modification of nouns, verbs, &c. to accommodate them to the varieties of their objects, considered with regard to number. See the System, Part I. Chap. I. Sect. I.

NUMBERS, in poetry, oratory, &c. are certain measures, proportions, or cadences, which render a verse, period, or song, agreeable to the ear. *Poetical* and *Prosaic* NUMBERS are somewhat different.

Poetical NUMBERS consist in a certain harmony in the order, quantities, &c. of the feet and syllables, which make the piece musical to the air, and fit for singing; for which all the verses of the ancients were intended. The numbers are what constitute the air and character of a verse, and denominate it smooth, or soft, or low, or rough, or sonorous. The following lines of Milton furnish an instance of soft, easy numbers:

Then feed on thoughts, which voluntary move
Harmonious numbers; as the tuneful bird
Sings darkling, and, in shallow covert hid,
Tunes her nocturnal note:-----

How different from the numbers of these!

Arms met with arms, flashions with flashions clash,
And sparks of fire, struck out from armour flash.

Rhetorical, or *Prosaic* NUMBERS, are a sort of simple unaffected harmony, less glaring than that of verse; yet such as is perceived and affects the mind with pleasure. The numbers are that by which the style is said to be easy, free, round, flowing, &c.

Numbers are things absolutely necessary in all writings, and even in all speech. Hence Aristotle, Tully, Quintillian, &c. lay down abundance of rules as to the best manner of intermixing dactyls, spondees, anapests, iambuses, choraic, dichoraic molosses, &c. in order to have the numbers perfect.

The substance of what we have said, is reducible to what follows:

1. The style becomes numerous, by the alternate disposition and temperature of long and short syllables; so as that the multitude of short ones neither render it too hasty, nor that of longer ones too slow and languid.

Sometimes, indeed, long or short syllables are designedly thrown together, without any such mixture, to paint the celerity or slowness of a thing by that of the numbers.

Quadrupedante putrem sonitu quatit ungula campum.
Lactantes ventos, tempestatesque feras.

Æneid. l. 8.
Id. l. 1.

2. The style becomes numerous, by the intermixing words of one, two, or more syllables. Whereas, the too frequent repetition of monosyllables renders the style pitiful and grating.

3. It contributes greatly to the numerousness of a period, to have it closed by magnificent and well-sounding words.

4. The numbers depend not only on the nobleness of the words in the close, but in those of the whole tenor of the period; as in that fine oration of Cicero for Fonteius, a brother of one of the Vestal maids: *Nolite pati, judices, aras, deorum immortalium, Vestæque matris, quotidianis virginum lamentationibus de vestro judicio commoveri.*

5. To have the period flow easily and equably, the harsh concurrence of letters and words is to be very studiously avoided, particularly the frequent meeting of rough consonants: as, the beginning the first syllable of a word with the last of the preceding: the frequent repetition of the same letter or syllable; and the frequent use of like-ending words. Lastly, the utmost care is to be taken, lest in aiming at *oratoral numbers* you should fall into *poetical* ones; and instead of prose write verse; which even Cicero himself is sometimes guilty of: witness, *Cum loquitur, tanti, stetus gemitusque fiebant.*

With regard to English composition, the following cautions should be observed: a number of monosyllables should not be crowded together, nor several words of the same termination, especially if the accent falls on the same syllable in each of them; nor should a sentence end with a monosyllable: to which may be added, that very long words are not suited to the beginning or conclusion of a period. Ward's Orat. vol. 1. p. 380, &c.

NUMERATION, in arithmetic, the art of estimating or pronouncing any number or series of numbers. The characters whereby numbers are ordinarily expressed, are the nine following ones; 1, 2, 3, 4, 5, 6, 7, 8, 9. See the System, Chap. I.

NUMERATOR, in speaking of fractions, signifies the number which shews how many of those parts which the integer is supposed to be divided into, are expressed by the fraction. The numerator is that part of a fraction which is placed over the little bar, by which it is separated from the under number, called the denominator, and which shews into how many parts the integer is divided. For a full definition, see the System of ARITHMETIC, Chap. IV.

NUR

NUMIDA, in ornithology, a genus belonging to the order *Gallina*. On each side of the head there is a kind of coloured fleshy horn; and the beak is furnished with cere near the nostrils. There is but one species, the *meleagris pintado*, or Guinea-hen; a native of Africa. It is of the size of the common hen, but with a longer neck. Its body is sloped like that of a partridge, and its colour is all over a dark grey, very beautifully spotted with small white specks; there is a black ring round the neck; its head is reddish, and it is blue under the eyes. They naturally herd together in large numbers, and breed up their young in common; the females taking care of the broods of others, as well as of their own. Barbut informs us, that in Guinea they are in flocks of 200 or 300, that perch on trees, and feed on worms and grasshoppers; that they are run down and taken by dogs; and that their flesh is tender and sweet, generally white, though sometimes black. They breed very well with us. For representation, see Plate III. Genus 49.

NUNCIO, or **NUNTIO**, an ambassador from the pope to some catholic prince or state; or a person who attends on the pope's behalf, at a congress, or an assembly of several ambassadors. The word *nuncio* has the same import with ambassador; but is restrained in its use to the ambassadors of popes alone; as that of *internuncio* is to their envoys extraordinary. The *nuncio* has a jurisdiction, and may delegate judges, in all the states where he resides, except in France, where he has no authority but that of a simple ambassador.

NUN, a woman, in several Christian countries, who devotes herself, in a cloister or nunnery, to a religious life. See the article **MONK**.

In some few instances, perhaps, it may have happened that nunneries, monasteries, &c. have been useful as well to morality and religion as to literature: in the gross, however, they have been highly prejudicial: and however well they might be supposed to do when viewed in theory, in fact they are unnatural and impious. It was surely far from the intention of Providence to exclude youth and beauty in a cloistered ruin, or to deny them the innocent enjoyment of their years and sex.

NUPTIAL RITES, the ceremonies attending the solemnization of marriage, which are different in different ages and countries. We cannot omit here a custom which is practised by the Hottentots on these occasions. The ceremony is performed in this very singular manner. The men squat in a circle, the bridegroom is placed in the centre: the women squat and form another circle to surround the bride. The priest then goes from one circle to the other, and alternately urines on both bride and bridegroom, who make furrows with their nails in the grease with which they are plastered, in order to rub in the precious libation. The priest then pronounces the benediction in these words, "May you live happily together; may you have a son before the year's end; may he be a good huntsman and a great warrior."

NURSING OF CHILDREN. The following observations are the result of long experience. A child, when it comes into the world, is almost a round ball; it is the nurse's part to assist nature, in bringing it to a proper shape. The child should be laid (the first month) upon a thin mattress, rather longer than itself, which the nurse will keep upon her lap, that the child may always lie straight, and only sit up as the nurse flants the mattress. To set a child quite upright before the end of the first month, hurts the eyes, by making the white part of the eye appear below the upper eye-lid. Afterwards the nurse will begin to set it up and dance it by degrees. The child must be kept as dry as possible.

The clothing should be very light, and not much longer than the child, that the legs may be got at with ease, in order to have them often rubbed in the day with a warm hand or flannel, and in particular the inside of them.

Rubbing a child all over takes off scurf, and makes the blood circulate. The one breast should be rubbed with the hands one way, and the other the other way, night and morning at least.

The ankle-bones and inside of the knees should be rubbed twice a day; this will strengthen those parts, and make the child stretch its knees and keep them flat, which is the foundation of an erect and graceful person. A nurse ought to keep a child as little in her arms as possible, lest the legs should be cramped, and the toes turned inwards. Let her always keep the child's legs loose. The oftener the posture is changed, the better. Tossing a child about, and exercising it in the open air in fine weather, is of the greatest service. In cities, children are not to be kept in hot rooms, but to have as much air as possible. Want of exercise is the cause of large heads, weak and knotted joints, a contracted breast, which occasions coughs and stuffed lungs, an ill-shaped person, and waddling gait, besides a numerous train of other ills.

The child's flesh is to be kept perfectly clean, by constantly washing its limbs, and likewise its neck and ears; beginning with warm water, till by degrees it will not only bear, but like to be washed with cold. Rising early in the morning is good for all children, provided they awake of themselves; which they generally do: but they are never to be waked out of their sleep, and as soon as possible to be brought to regular sleeps in the day. When laid in bed or cradle, their legs are always to be laid straight, Children, till they are two or three years old, must never be suf-

NUT

fered to walk long enough at a time to be weary. A principal thing to be always attended to is to give your children constant exercise, and to keep them in a proper posture.

Two caps are to be put on the head, till the child has got most of its teeth. The child's dress for the night may be a shirt, a blanket to tie on, and a thin gown to tie over the blanket. For further particulars, see the *System of Midwifery*, Part IX. Sect. I. IV.

NUTATION, in astronomy, a kind of trepidation, or tremulous motion of the axis of the earth; whereby its inclination to the plane of the ecliptic is not always the same; but varies backwards and forwards some seconds; and the period of these variations is nine years. This nutation was discovered by Dr. Bradley, who published an account of his discovery in the year 1737. He also discovered the cause of this phenomenon in the Newtonian system of attraction.

NUTMEG. The tree which produces this fruit was formerly thought to grow only in the Banda islands. It is now past a doubt, however, that it grows in the Isle of France, and in all or most of the isles of the south seas. 'Tis seems a little remarkable that this trade, which is certainly a lucrative one, should have been so long monopolized by the Dutch. Their cunning and desire to retain it in their own hands seems to account for the idea that so generally prevailed formerly that it grew only in their settlements. (See *MYRISTICA*.) It was reported as early as the year 1751, upon what appeared at that time to be good grounds, that it was likely to be produced in the West-Indies. An English sailor said he had seen some trees in Jamaica, and the governor on enquiry found it so, and that they agreed exactly with the description given of those in the Spice Islands in the East Indies. This account, which was given in the Gentleman's Magazine for January 1751, we have never seen confirmed; and therefore we suppose that the expectations formed were either frustrated or premature: however, it is certain, as we have observed under the generic name, that a wild species of it grows at Tobago. To avoid repetition, or the appearance of prolixity, we must refer those who wish for farther information respecting the trade in this article to M. P. Sonnerat's Account of a Voyage to the Spice Islands and New-Guinea, which was printed at Paris in 1775, and translated into English, and printed at Bury St. Edmund's, in 1781, &c. and to Bougainville's Voyage, and Dr. Hawkesworth's Compilation of English Voyages.

It will not, however, we trust, be deemed improper nor beside our purpose, if we lay before our readers the following account of the dangerous consequences of using this article to excess. It was given by Dr. Jacob Schmidius, published in the Gentleman's Magazine for 1767.

"A gentleman of Lower Silesia, about thirty-six years old, of a good constitution, and who enjoyed a good state of health, having felt, during some days, some cholic pains, took it in his head, by way of remedy, to eat four nutmegs, which weighed altogether two ounces, and he drank, in eating them, some glasses of beer; which he had no sooner done, but he was seized with a great heat, a violent pain in the head, a vertigo and delirium, and was instantly deprived of the use of sight, speech, and of all his senses. He was put to bed, where he remained two days and two nights; his body was oppressed with lassitude, always drowsy, yet without being able to sleep. The third day he was in that lethargic state which is called a *coma vigil*, with a weak and intermitting pulse. Cephalic remedies, cordials, among others the spirit of cephalic vitriol, and essence of castoreum, were administered in good spirit of sal ammoniac. The fourth day he recovered a little, but had absolutely lost his memory, so as not to remember the least thing he had done in his life. A continued fever then came on, accompanied by an obstinate watchfulness; a palpitation of the heart seemed to be the forerunner of other symptoms, and he was finally struck with a palsy in all his limbs.

"At the expiration of eight days, he recovered the use of reason, and said, that during the first four days of his illness, he seemed to himself to have constantly a thick veil before his eyes, and that a great number of sparks and flashes continually issued from it. All the bad symptoms of this malady yielded at last successively to the continued use of remedies suited to his condition; and in three months' time he was perfectly recovered, but he was particularly indebted for his cure to mercurial and ammoniacal remedies.

"According to chemical principles, it might perhaps be said, that the aromatic and oily salt contained in the nutmeg, of which this patient had taken too large a dose, had immediately excited so great an agitation in the humours, and so rapid a motion in the animal spirits, as in some measure to partake of the nature of fire, and that a viscid and narcotic sulphur, which rises likewise in the nutmeg, though in a less sensible manner, being carried at the same time into the mass of blood, by suddenly fixing the animal spirits, and intercepting their course in the nerves, had afterwards caused the stupor in the limbs, the aphony, and the palsy. But I leave others to explain these phenomena; my only view, by communicating this observation, being to show that the immoderate use of nutmeg may be attended with very great danger."

NUTRITION.

NUTRITION, in the animal economy, the accession or apposition of new parts to the body, similar to those it already consisted of, either for its augmentation, or for the reparation of such as are worn out.

By the continual motion of the fluids in the minute vessels of the body and the action of the muscles, &c. small parcels are of necessity worn off from the solids, become mixed with the fluids, move with them, and are at length eliminated and exhaled through the pores. And, at the same time, the fluids, diminished, as they are, by a constant attrition, apply to the orifices of the perspiring vessels, and vanish out of the body. Hence the animal body, by the very condition of its frame, becomes soon liable to destruction. To preserve life, therefore, it is necessary, that a restitution be made to the juices and solids of the body, equal and similar to what is lost in those motions; which is what we call the *action of nutrition*. Now, the lost juices are easily supplied by meat, drink, air, &c. taken in the stomach, digested, converted into chyle, then into blood, and thence secreted by the proper duct, and carried, by the action of the body, to the proper receptacles; after the manner laid down under **DIGESTION, CHYLIFICATION, BLOOD,** and the **System of ANATOMY, Part V. Sect. VI. and VII.**

But the nutrition of the solid parts is much more obscure. This, indeed, has proved the subject of infinite doubts and differences among authors: nor had we any rational or satisfactory accounts of the same, till that of the accurate Boerhaave, whose doctrine is as follows: Every solid part of the body consists of other lesser ones, in all respects like the larger; vessels, v. g. of vesicles, and those of others still smaller; bones of ossicles, &c. Which structure goes beyond all limits of sense, however assisted by art; as appears by the experiments and observations of Malpighi, Ruysch, Leewenhoeck, and Hook. Yet it is scarce possible this division and subdivision should be infinite, as those of foods and juices are.

Again, it appears from microscopic views, injections, small wounds, excisions, &c. that the solid parts of the body are very small, compared with the fluids; and it is also demonstrable, from considering the rise and generation of the vessels, and the resolution of the greater vessels into their smaller constituent ones, that all the solid parts of the body are constructed of mere nerves, as its elements. And, in effect, all this mass, an incredibly small particle only excepted, at first, arose out of what was a very small coagulum, much like the nervous juice itself; as is abundantly shewn by the great Malpighi, in his two treatises on incubated eggs. For neither does the white of the egg nourish, till, by means of the incubation, it have passed innumerable degrees of fluidity, from its first thickness, to that exceeding subtilty wherein it terminates. But even then, the liquor thus given to the embryo, is exceedingly thick, in comparison with what it is to be, when converted into its vessels and viscera. Now, the first tender solids, arising from this subtle humour, do again pass infinite intermediate degrees before they arrive at their utmost state and consistence; as is shewn by Malpighi in eggs, and by Ruysch in embryos and testules. Hence, therefore, it follows, that the solids, in their first formation out of the liquids whence they arise, only differ from them in rest, cohesion, and figure. Therefore, such a particle, now in its fluid state, will become a part of the solid to be formed out of it, as soon as there happens to be a power to effect its cohesion with the other solid parts, howsoever that cohesion be effected.

This cohesion is easily produced in a fibre already formed, if there happen to be a proper cavity in the solid, left open by some lost particle, and, at the same time, a particle in the fluid, answerable thereto in bulk, figure, and nature; and lastly, if there be a power wherewithal to intrude it in that place, or accommodate it thereto. Thus will arise a real nutrition of the solids in the minute vessels, by whose union the large ones are formed; that is, in the nerves, or in vessels similar thereto. Which being impracticable by any other liquid than that brought into these vessels, it appears very evident that the nervous juice, at least a juice perfectly like it, is the immediate matter of nutrition: hence nutrition appears one of the last and most perfect actions of the body: since, to have this laudable, all the precedent actions must of necessity have been so.

The chyle, therefore, which some make the immediate matter of nutrition, is, indeed, fitted to fill the larger vessels; but it cannot nourish or restore them. This, when attenuated, changed, more intimately mixed in the lungs by means of respiration, and thus fitted for the passage of certain vessels, is indeed rendered finer, yet far from being quite fit, to be the matter of nutrition. But, by the repeated action of the lungs, the viscera, vessels, &c. there is formed out of this humour, a soft, tenacious, plastic, insipid serum, which, thickening by the fire, becomes perfectly like the white of an egg. This fluid, therefore, has in it all the conditions found in that, from whence, by sure experience, we know all the solid parts of an animal arise by mere incubation. It is, therefore, a step nearer, but is not quite disposed for nutriment; much less is the cruor, or red globular part of the blood so. Neither are yet fitted to enter the vessels; yet both the one and the other are, by different authors, made the nutritive juice.

But as the heat of the incubation, so the action of the viscera

and vessels on the serum, introduces various changes therein, till at length a part of it be rendered subtle enough for the purpose required. This, when exhausted, is instantly repaired; and thus we have the true immediate matter of nutrition. But this same humour, losing too many of its oily parts, by many repeated circulations, is rendered too sharp; and being likewise stripped of its most liquid parts, from the same cause, becomes too dense; and is thus rendered unfit for this secretion. Hence the necessity of new chyle, and new food, to keep up nutrition.

The matter of nutrition, thus ascertained, the manner wherein, and the cause whereby, it is effected, are as follow: a juice being driven directly through a full, conic, or cylindric, elastic or rigid canal; if its course be from a wider to a narrower part, or if it have any thing to oppose its motion, will endeavour to stretch the sides of its canal, according to the axis of its length. This must be the case every where in the body, except, perhaps, in the veins and receptacles. By this nifus, or endeavour, how weak soever, continually repeated, the vessels will be insensibly lengthened out; and, in lengthening, they will be made more and more slender. Hence the last extremities of the vessels, which in man are extremely small, are continually stretched, and rendered less and less coherent, i. e. still nearer to a dissolution; and thus at length will they cohere so weakly as scarce to differ from fluids. While such motion goes on, therefore, and the propulsion is continued, there will, of necessity, happen these two things: first, the utmost particles of the minutest tubes being torn off, will again be converted into a kind of humour, what part of the body soever they stick in. Secondly, the smallest particles, which, by their union, composed the slenderest fibrillæ, will be so separated from each other as to leave open interstices in those places where before they cohered. Both these effects are produced at all times, and in all parts of the body, so long as life continues, especially where nature is strong, and the action of the body is violent. But the same humour whereby these effects are produced containing abundance of particles similar to those thus separated and lost, conveys and applies them to those interstices, by that very impetus whereby it endeavours to distend the canals; and, thus intercepted, at length, it forms, adapts, and fastens them, so as to adhere in the same manner as the former.

The matter, preparation, application, energy of motion, still remaining the same; what, from time to time, is lost, is thus presently restored; and the solids continue in the same state as before, i. e. they are perpetually *nourished*, and supplied, and preserved. In this the Creator's wisdom is very conspicuous; in that the same power which inevitable destroys, does repair again at the same time, and by the same action; and that the greater the loss is, the more copious the supply; and, lastly, that those parts first spent in the action of the body, are the first restored. Farther, it is evident, that the newer, the more tender, and the nearer to the moving cause, these vessels are, the more easily will they be lengthened, distended, destroyed, and repaired: our bodies, therefore, the nearer to their origin, the more do they grow. For, the action, still continuing, the greater vessels become more extended by their fluid; and at the same time, the smaller, whereof the membranes, or coats, of the larger sort are composed, are compressed, dried, and at last concreted, and grow up; whence arises a firmness, indeed, of the fibres, but a loss of the vesicles. Thus what were formerly vessels, commence mere hard ligaments; and thus the fluids being once fixed, the several vessels coalesce: from the concurrence of these causes arise the strength, hardness, rigidity, and thickness, of the solid parts. Hence the number of vessels is greatest in embryos, and as age comes on, it sensibly diminishes; and hence it is, that their weakness constantly declines, and their strength and firmness increase. In young people, therefore, the quantity of humours is redundant, and greatly exceeds the solids: in old men, the solids exceed the fluids. And hence we see the reason, manner, and appearance, of growth, state, declension, and, at length, of death, from pure old age.

A person who considers this account, and compares it with what is actually observable in the body, will find every circumstance to obtain; thus the whole cuticula is every where, and at all times, constantly desquamating, peeling off, and again renewing; and thus the hair, nails, teeth, continually rubbed, torn, and worn off, come again: parts taken off from the vessels and the bones soon grow again: and the fordes, or filth, rubbed off from the extremities of the vessels, when examined by the microscope, or diluted, and viewed in water, appear plainly to consist both of solid and fluid parts; and those carried off by washing, shaving, &c. are the same. Hence, too we see, that a general increase of the bulk of the body, with regard to habit, as in fat, fleshy, brawny persons, does not arise from any increase of the solids, but by their extension into large cavities, crowded with stagnant humours. And hence fatness becomes hurtful, as it loads, weakens, and suffocates.

Whence arises a very considerable distinction between *nutrition* and *repletion*, to which a physician must have special regard; the one strengthening and condensing the vessels, the other weakening, loosening, and extending the same. Hence, lastly, we see, why the fabric of the solids is not destroyed by the contained fluids; how our machine comes to subsist so long; why, when a nerve is

NYL

corrupted, the nutrition of that part it belongs to ceases; and why the same obtains in the artery: why in an embryo there are no solids, in a fœtus very few, in old men a great deal; and why even the nerves, tendons, arteries, and receptacles, become first cartilaginous, and then bony. Dr. Priestley concludes, from some experiments undertaken with a view of discovering the principle of nutrition, in vegetable and animal substances, that the principle is phlogiston, in such a state as to be capable of becoming, by putrefaction, a true inflammable air, but not generally such as to burn with explosions; but rather with a blue and lambent flame, mixed with a certain proportion of fixed air. This principle in nutrition is immediately held in solution by the gastric juice, and in the chyle formed by it: and when it has entered into circulation with the chyle, and answered the purpose in the animal economy for which it is designed, it is thrown out again by means of the blood in the lungs, and communicated to the air, which is phlogisticated with it. Exp. and Obs. Vol. V. Sect. 6.

Buffon, in order to account for nutrition, supposes the body of an animal or vegetable to be a kind of mould, in which the matter necessary to its nutrition is modelled and assimilated to the whole. But (continues he) of what nature is this matter which an animal or vegetable assimilates to its own substance? What power is it that communicates to this matter the activity and motion necessary to penetrate this mould? and, if such a force exist, would it not be by a similar force that the internal mould itself might be reproduced?

As to the first question, he supposes that there exists in nature an infinite number of living organical parts, and that all organized bodies consist of such organical parts; that their production costs nature nothing, since their existence is constant and invariable; so that the matter which the animal or vegetable assimilates to its substance, is an organical matter of the same nature with that of the animal or vegetable, which consequently may augment its volume without changing its form or altering the quality of the substance in the mould.

As to the second question: There exists (says he) in nature certain powers, as that of gravity, that have no affinity with the external qualities of the body, but act upon the most intimate parts, and penetrate them throughout, and which can never fall under the observation of our senses.

And as to the third question, he answers, that the internal mould itself is reproduced, not only by a similar power, but it is plain that it is the very same power that causes the unfolding and reproduction thereof: for it is sufficient (proceeds he) that in an organized body that unfolds itself, there be some part similar to the whole, in order that this part may one day become itself an organized body, altogether like that of which it is actually a part.

NYL-GHAU, in mammalia, a species of the genus *Bos*, a native of the interior parts of India. "It seems (says Bewick, in his History of Quadrupeds) to be of a middle nature, between the cow and the deer, and carries the appearance of both in its form. In size it is as much smaller than the one, as it is larger than the other: its body, horns, and tail, are not unlike those of a bull; and the head, neck, and legs, are similar to those of a deer. The colour in general is ash or grey, from a mixture of black hairs and white: all along the ridge or edge of the neck, the hair is blacker, longer, and more erect, making a short, thin, and upright mane, reaching down to the hump. Its horns are seven inches long, six inches round at the root, tapering by degrees, and terminating in a blunt point: the ears are large and beautiful, seven inches in length, and spread to a considerable breadth; they are white on the edge, and on the inside, except where two black bands mark the hollow of the ear with a zebra-like variety. The height of this animal, at the shoulder, is four feet one inch; behind the loins it only measures four feet.

"The female differs considerably from the male, both in height and thickness, being much smaller; in shape and colour very much resembling a deer; and has no horns. She has four nipples, and is supposed to go nine months with young: She commonly has one at a birth, but sometimes two.

"Several of this species were brought to this country in the year 1767, which continued to breed annually for some years after. Dr. Hunter, who had one of them in his custody for some time, describes it as an harmless and gentle animal; that it seemed pleased with every kind of familiarity, always licked the hand that either stroked or fed it, and never once attempted to use its horns offensively. It seemed to have much dependence on the organs of smell, and snuffed keenly whenever any person came in sight; it did so likewise when food or drink was brought to it; and would not taste the bread which was offered it, if the hand that presented it happened to smell of turpentine.

"Its manner of fighting is remarkable, and is described thus.—Two of the males at Lord Clive's being put into an inclosure, were observed, while they were at some distance from each other, to prepare for the attack, by falling down upon their knees; they then shuffled towards each other, keeping still upon their knees; and at the distance of a few yards they made a spring and darted against each other with great force.

NYM

"The following anecdote will serve to shew that during the rutting season these animals are fierce and vicious, and not to be depended upon. A labouring man, without knowing that the animal was near him, went up to the outside of the inclosure; the Nyl-ghau, with the quickness of lightning, darted against the woodwork with such violence that he broke it to pieces, and broke off one of his horns close to the root. The death of the animal, which happened soon after, was supposed to be owing to the injury he sustained by the blow.

"Bernier says, that it is the favourite amusement of the Mogul emperor to hunt the Nyl-ghau: and that he kills them in great numbers, and distributes quarters of them to his omrahs; which shews that they are deemed good and delicious food. The Nyl-ghau is frequently brought from the interior parts of Asia, as a rare and valuable present to the Nabobs and other great men, at our settlements in India. It remains to be considered, whether this rare animal might not be propagated with success in this country? That it will breed here is evident from experience; and, if it should prove docile enough to be easily trained to labour, its great swiftness and considerable strength might be applied to the most valuable purposes."

NYMPH, in mythology, an appellation given to certain inferior goddesses, inhabiting the mountains, woods, waters, &c. said to be the daughters of Oceanus and Tethys. All the universe was represented as full of these nymphs, who are distinguished into several ranks or classes. The general division of them is into celestial and terrestrial; the former of which were called *Uranias*, and were supposed to be intelligences that governed the heavenly bodies or spheres. The terrestrial nymphs, called *Epigeas*, presided over the several parts of the inferior world; and were divided into those of the water and those of the earth. The nymphs of the water were the *Oceanides*, or nymphs of the ocean; the *Nereids*, the nymphs of the sea; the *Naiads* and *Ephydriads*, the nymphs of the fountains; and the *Limniades*, the nymphs of the lakes. The nymphs of the earth were the *Orades*, or nymphs of the mountains; the *Napæas*, nymphs of the meadows; and the *Dryads* and *Hamadriads*, who were nymphs of the forests and groves. Besides these, we meet with nymphs who took their names from particular countries, rivers, &c. as the *Cithæroniades*, so called from Mount Cithæron in Boeotia: the *Dodoines*, from Dodona; *Tiberiades*, from the Tiber, &c.—Goats were sometimes sacrificed to the nymphs; but their constant offerings were milk, oil, honey, and wine.

NYMPH, among naturalists, that state of winged insects between their living in the form of a worm, and their appearing in the winged or most perfect state. The eggs of insects are first hatched into a kind of worms or maggots, which afterwards pass into the nymph state, surrounded with shells or cases of their own skins: so that, in reality, these nymphs are only the embryo insects wrapped up in this covering; from whence they at last get loose, though not without great difficulty. During this nymph-state the creature loses its motion. Swammerdam calls it *nympha aurelia*, or simply *aurelia*; and others give it the name of *chrysalis*, a term of the like import. See the article CHRYsalis.

NYMPHA is used by naturalists for the insects themselves, while they have yet only the form of worms or maggots. The word properly signifies bride, or a new married woman; it being now, when it has laid aside its former skin, that it begins to shew all its parts distinctly. In this change it loses its motion for a while, as when in the egg; so that these insects are twice in their nymph state, first in the maggot, which is their first nymph; and again in this change, which is the second. See CATERPILLAR, CHRYsalis; see also METAMORPHOSIS OF INSECTS, in the System of ENTOMOLOGY.

NYMPHÆ, in anatomy, are two soft, spongy, red bodies, of a cavernous structure, somewhat resembling the wattles under a cock's throat, descending from the tip of the clitoris to the sides of the urinary passage, thus reaching to about the middle of the orifice of the vagina; where they grow less and less till they disappear. See the System, Part III. Sect. XV. Art. II.

Their breadth is uncertain; usually in maids half a finger: sometimes they are large, and are capable of being distended to a great degree, so as to hang a good way out of the body: whence, in some, it has been necessary to cut these, as well as the clitoris. The use of the nymphæ is by swelling, in the act of coition, to embrace the penis, and by their sensibility to affect the woman, and mutually invite to procreation. The substance is very spongy, composed of membranes, and vessels loosely cohering, and therefore easily distensible.

NYMPHOMANIA, in medicine, the same with *Furor Uterinus*. For the Causes, Systems, and Cure, see the System, Genus 69.

NYMPHOTOMIA, in surgery, the operation of cutting off part of the nymphæ, or of the clitoris, by some also called *nympha*, when they are so large and tumid as to prevent the consummation of marriage, or render it very difficult. The Egyptians, Galen observes, frequently practised the *Nymphotomia*; but in our parts of the world it is rarely found necessary. The *Nymphotomia* is, properly speaking, the circumcision of women.

O A K O A T

O, THE 14th letter, and fourth vowel, of our alphabet, pronounced as in the words *nose, rose*, &c. The sound of this letter is often so soft as to require it double, and that chiefly in the middle of words; as *goose, reproof*, &c. And in some words this *oo* is pronounced like an *u* short, as in *flood, blood*, &c.

Among the Irish, the letter *O*, at the beginning of the name of a family, is a character of dignity, annexed to great houses. Thus, in the history of Ireland, we frequently meet with the *O'Neals, O'Carrolls*, &c. considerable houses in that island. Camden observes, that it is the custom of the lords of Ireland to prefix an *O* to their names to distinguish them from the commonalty.

OAK, the English name of the genus *Quercus*, for description see **QUERCUS**.

The ancient druids had a most profound veneration for oak-trees. Pliny says that "the druids (as the Gauls call their magicians or wise men) held nothing so sacred as the mistletoe, and the tree on which it grows, provided it be an oak. They make choice of oak groves in preference to all others, and perform no rites without oak-leaves; so that they seem to have the name of druids from thence, if we derive their name from the Greek," &c. (See **DRUIDS** and **CARNEDDE**.) Maximus Tyrius says the Celts, or Gauls, worshipped Jupiter under the figure of a lofty oak.

This useful tree grows to such a surprising magnitude, that were there not many well authenticated instances of them in our own country, they would certainly appear difficult of belief. In the 18th volume of the *Gentleman's Magazine* we have the dimensions of a leaf twelve inches in length and seven in breadth, and all the leaves of the same tree were equally large. On the estate of Woodhall, purchased in 1775, by Sir Thomas Rumbold, Bart. late governor of Madras, an oak was felled which sold for 43l. and measured 24 feet round. We are also told of one in Milwood forest, near Chaddesley, which was in full verdure in winter, getting its leaves again, after the autumn ones fell off. In Hunter's *Evelyn's Sylva*, we have an account of a very remarkable oak at Greendale; which Gough, in his edition of Camden, thus minutely describes: "The Greendale oak, with a road cut through it, still bears one green branch. Such branches as have been cut or broken off are guarded from wet by lead. The diameter of this tree at the top, whence the branches issue, is 14 feet two inches; at the surface of the ground 11½ feet: circumference there 35 feet; height of the trunk 53, height of the arch 10, width 6. Mr. Evelyn mentions several more oaks of extraordinary size in *Workshop park*."

In the *Gentleman's Magazine* for 1773, we have an account of one differing very essentially from the common one; it is frequent about St. Thomas in Devonshire, and is in that county called *Lucombe oak*, from one William Lucombe who successfully cultivated it near Exeter. It grows as straight and handsome as a fir; its leaves are evergreen, and its wood as hard as that of the common oak. Its growth is so quick as to exceed in 20 or 30 years the altitude and girth of the common one at 100. It is cultivated in various places, Cornwall, Somersetshire, &c.

The bark, in medicine, is also a strong astringent; and hence stands recommended in hæmorrhages, alvine fluxes, and other preternatural or immoderate secretions; and in these it is sometimes attended with good effects. Some have alleged, that by the use of this bark every purpose can be answered which may be obtained from Peruvian bark. But after several very fair trials, we have by no means found this to be the case. Besides the bark, the buds, the acorns, and their cups are used; as also the galls, which are excrescences caused by insects on the oaks of the Eastern countries, of which there are divers sorts: some perfectly round and smooth, some rougher with small protuberances, but all generally having a round hole in them. All the parts of the oak are styptic, binding, and useful in all kinds of fluxes and bleedings, either inward or outward. The bark is frequently used in gargarisms, for the relaxation of the uvula, and for sore mouths and throats: it is also used in refrigerant clysters, and injections, against the prolapsus uteri or ani. The acorns, beaten to powder, are frequently taken by the vulgar for pains in the side. The only official preparation is the *aqua germinum quercus*.

Oak-leaves. The uses of oak-bark in tanning, and in hot-beds, is generally known. For the latter of these purposes, however, oak-leaves are now found to answer equally well, or rather better. In the notes to Dr. Hunter's edition to Evelyn's *Treatise on Forest-trees*, we find the following directions for their use by W. Speechly. The leaves are to be taken up as soon as possible after they fall from the trees. When raked into heaps, they should immediately be carried into some place near the hot-houses, where they may lie to couch. Mr. Speechly says it was his custom to fence them round with charcoal hurdles or any thing else, to keep them from being blown about the garden in windy weather. In this place they tread them well, and water them in case they happen to have been brought in dry. The heap is made six or seven feet thick, and covered over with old mats, or any thing else, to prevent the upper leaves from being blown away. In a few days the heap will come to a strong heat. For the first year or two in which he used these leaves our author did not continue them in the heap longer than ten days or a fortnight; but by this method or management they settled so much when brought to the hot-house, that a supply was very soon

required; and he afterwards found that it was proper to let them remain five or six weeks in the heaps before they are brought to the hot-house. In getting them into the pine-pits, if they appear dry, they are to be watered, and again trodden down exceedingly well, in layers, till the pits are quite full. The whole is then covered with tan-bark, to the thickness of two inches, and well trodden down, till the surface becomes smooth and even. On this the pine-pots are to be placed in the manner they are to stand; beginning with the middle row first, and filling up the spaces between the pots with tan. In this manner we are to proceed to the next row, till the whole be finished; and this operation is performed in the same manner as when tan only is used. The leaves require no further trouble through the whole season; as they will retain a constant and regular heat for 12 months without stirring or turning; and our author informs us, that if he may judge from their appearance when taken out (being always entire and perfect) it is probable they would continue their heat through a second year; but, as an annual supply of leaves is easily obtained, the experiment is hardly worth making. After this, the pines will have no occasion to be moved, but at stated times of their management, viz. at their shifting them in their pots, &c. when at each time a little fresh tan should be added, to make up the deficiency arising from the settling of the beds; but this will be inconsiderable, as the leaves do not settle much after their long couching. During the first two years of our author's practice he did not use any tan, but plunged the pine-pots into the leaves, and just covered the surface of the beds, when finished, with a little saw-dust, to give it a neatness. This method, however, was attended with one inconvenience; for by the caking of the leaves, they shrunk from the sides of the pots, whereby they became exposed to the air, and at the same time the heat of the beds was permitted to escape.

"Many powerful reasons, says Mr. Speechly, may be given why oak-leaves are preferable to tanners' bark.

"1. They always heat regularly; for during the whole time that I have used them, which is near seven years, I never once knew of their heating with violence; and this is so frequently the case with tan, that I affirm, and indeed it is well known to every person conversant with the management of hot-houses, that pines suffer more from this one circumstance, than all the other incidents put together, insects excepted. When this accident happens near the time of the fruiting, the effect is soon seen in the fruit, which is exceedingly small and ill shaped. Sometimes there will be little or no fruit at all; therefore gardeners who make use of tan only for their pines, should be most particularly careful to avoid an over-heat at that critical juncture, the time of shewing the fruit.

"2. The heat of oak-leaves is constant: whereas tanners' bark generally runs cold in a very short time after its furious heat is gone off. This obliges the gardener to give it frequent turnings, in order to promote its heating. These frequent turnings, not to mention the expence, are attending with worse consequences; for by the continual moving of the pots backwards and forwards, the pines are exposed to the extremes of heat and cold, whereby their growth is considerably retarded; whereas, when leaves are used, the pines will have no occasion to be moved but at the times of potting, &c. The pines have one peculiar advantage in this undisturbed situation; their roots grow through the bottoms of the pots, and mat among the leaves in a surprising manner. From the vigour of the plants when in this situation, it is highly probable that the leaves, even in this state, afford them an uncommon and agreeable nourishment.

"3. There is a saving in point of expence; which is no inconsiderable object in places where tan cannot be had but from a great distance.

"4. The last ground of preference is, that decayed leaves make good manure; whereas rotten tan is experimentally found to be of no value. I have often tried it both on sand and clay, and on wet and dry land; and never could discover, in any of my experiments, that it deserved the name of a manure; whereas, decayed leaves are the richest, and of all others the most proper manure for a garden. Leaves mixed with dung make excellent hot-beds; and I find that beds compounded in this manner, preserve their heat much longer than when made entirely with dung; and in both cases, the application of leaves will be a considerable saving of dung, which is a circumstance on many accounts agreeable. See close of the *System of GARDENING*, under the article *CULTURE of Pines in the Hothouse*.

OAT, in botany. See **AVENA**.

The native place of the common oat, cultivated in our fields, is unknown; that the only account of it, in its natural state, which we then had, is in Anson's Voyage; and that the report of such an author respecting facts in natural history is not intitled to implicit credit. We had not then seen the Travels of Mr. Bruce, whose botanical knowledge is very superior to that of most voyagers, or we should have mentioned his account of the oats which he found growing wild in Aroossi, a small territory in Abyssinia, not far from the source of the Nile. "Wild oats (says he) grow up here spontaneously to a prodigious height and size, capable often of concealing both the horse and his rider, and some of the stalks being little less than an inch in circumference.

rence. They have, when ripe, the appearance of small canes. The inhabitants make no sort of use of this grain in any period of its growth; the uppermost thin husk of it is beautifully variegated with a changeable purple colour; the taste is perfectly good. I often made the meal into cakes, in remembrance of Scotland." Our author informs us that the Abyssinians could never be brought to relish these cakes, which they said were bitter, burnt their stomachs, and made them thirsty. He is, however, decidedly of opinion that the wild oat of Aroossi is the oat in its original state; and that it has degenerated every where in Europe. From the facts which he states, this opinion seems to be well founded.

OATH, an affirmation or promise, accompanied with an invocation of God to witness what we say; and with an imprecation of his vengeance, or a renunciation of his favour, if what we affirm be false, or what we promise be not performed.

The laws of all civilized states have required the security of an oath for evidence given in a court of justice, and on other occasions of high importance; and the Christian religion utterly prohibits swearing, except when oaths are required by legal authority. Indeed, no serious and reflecting thief, whether he admits the truth of revelation or not, can look upon swearing on trivial occasions as any thing else than a sin of a very heinous nature. To call upon that infinite and omnipresent Being, who created and sustains the universe, to witness all the impertinence of idle conversation, of which great part is commonly uttered at random, betrays a spirit so profane, that nothing short of experience could make us believe it possible for a creature endowed with reason and reflection to be habitually guilty of a practice so impious. No man can plead in extenuation of this crime, that he is tempted to swear by the importunity of any appetite or passion implanted in the human breast: for the utterance of a profane oath communicates no pleasure, and removes no uneasiness; it neither elevates the speaker, nor depresses the hearer.

Quakers and Moravians, swayed by these considerations, and by the sense which they put upon certain texts of Scripture, refuse to swear upon any occasion, even at the requisition of a magistrate, and in a court of justice. These scruples are groundless; and seem to proceed from an incapacity to distinguish between the proper use and abuse of swearing. It is unquestionably impious to call upon God to witness impertinences, or to use his tremendous name as a mere expletive in conversation; but it by no means follows that we may not piously call upon him to witness truths of importance, or invoke his name with reverence and solemnity. No individual could, without gross profaneness, pray for a thousand times more wealth than he may ever have occasion to use: but it was never thought profane to pray "day by day for our daily bread, for rain from heaven, and fruitful seasons." If it be lawful to ask of God these earthly blessings, because he alone can bestow them; it cannot surely be unlawful, where the lives or properties of our neighbours, or the security of government, is concerned, to invoke him with reverence to witness the truth of our assertions, or the sincerity of our intentions; because of our truth in many cases, and of our sincerity in all, none but he can be the witness.

The text of Scripture upon which the Quakers chiefly rest their argument for the unlawfulness of all swearing under the Gospel, is our Saviour's prohibition (Matt. v. 34) "I say unto you, swear not at all." But whoever should take the trouble of turning over his Bible, and looking at the context, will perceive, that it is only in ordinary conversation, and by no means in courts of justice, that our Lord prohibits his followers from swearing at all.

But though a nation has an undoubted right to require the security of an oath upon occasions of real importance, we do not hesitate to say, that, in our opinion, it is something worse than bad policy to multiply oaths; and to hold out to the people temptations to perjure themselves. The security which an oath affords depends entirely upon the reverence which attaches to it in the mind of him by whom it is given; but that reverence is much weakened by the frequency of oaths, and by the careless manner in which they are too often administered. An excellent moralist, Mr. Paley, observes, with truth, that "the levity and frequency with which oaths are administered, has brought about a general inadvertency to the obligation of them, which both in a religious and political view is much to be lamented: and it merits (continues he) public consideration, whether the requiring of oaths on so many frivolous occasions, especially in the qualification for petty offices, has any other effect than to make them cheap in the minds of the people? A pound of tea cannot travel regularly from the ship to the consumer without costing half a dozen oaths at least: and the same security for the due discharge of his office, namely that of an oath, is required from a churchwarden and an archbishop, from a petty constable and the chief justice of England. Let the law continue its own sanctions, if they be thought requisite; but let it spare the solemnity of an oath: and where it is necessary, from the want of something better to depend upon, to accept a man's own word or own account, let it annex to perjury penalties proportioned to the public consequence of the offence."

That these pernicious consequences of frequent oaths are not felt only in England, we have the evidence of another respectable writer, whose acuteness well qualified him to observe, whilst his station in society furnished him with the best opportunities of

observing the effects of repeated swearing upon the morals of Scotchmen. "Custom-house oaths (says Lord Kaimes, in his *Sketches of the History of Man*) have become so familiar among us, as to be swallowed without a wry face; and is it certain that bribery and perjury in electing parliament-members are not approaching to the same cool state? Men creep on to vice by degrees. Perjury, in order to support a friend, has become customary of late years; witness fictitious qualifications in the electors of parliament-men, which are made effectual by perjury; yet, such is the degeneracy of the present times, that no man is the worse thought of upon that account. We must not flatter ourselves that the poison will reach no farther: a man who boggles not at perjury to serve a friend, will in time become such an adept as to commit perjury in order to ruin a friend when he becomes an enemy."

Coronation OATH, see the article *KING*.

OBADIAH, or the *Prophecy of OBADIAH*, a canonical book of the Old Testament, which is contained in a single chapter, and is partly an invective against the cruelty of the Edomites, who mocked and derided the children of Israel as they passed into captivity; and, with other enemies, their confederates, invaded and oppressed those strangers, and divided the spoil among themselves; and partly a prediction of the deliverance of Israel, and of the victory and triumph of the whole church over her enemies.

OBELISK, in architecture, a truncated, quadrangular, and slender pyramid, raised as an ornament, and frequently charged either with inscriptions or hieroglyphics.

Obelisks appear to be of very great antiquity, and to be first raised to transmit to posterity precepts of philosophy, which were cut in hieroglyphical characters; afterwards they were used to immortalize the great actions of heroes, and the memory of persons beloved. The first obelisk mentioned in history was that of Ramesses king of Egypt, in the time of the Trojan war, which was 40 cubits high. Phius, another king of Egypt, raised one of 55 cubits; and Ptolemy Philadelphus, another of 88 cubits, in memory of Arsinoë. Augustus erected one at Rome, in the Campus Martius, which served to mark the hours on an horizontal dial, drawn on the pavement. They were called by the Egyptian priests, the *Fingers of the Sun*, because they were made in Egypt also to serve as styles or gnomons to mark the hours on the ground. The Arabs still call them *Pharaoh's Needles*; whence the Italians call them *aguglia*, and the French *aiguille*.

OBJECT, something apprehended, or presented to the mind by sensation or by imagination. An object is something that affects us by its presence, that moves the eye, ear, or some other of the organs of sense; or, at least, is represented to us by the imagination. The school-philosophers define object to be that about which a power, act, or habit is employed. Thus, good is the object of the will; truth of the understanding; so colour is the object of sight; sound of hearing, &c.

Objects are usually divided into next, *proxima*, which are those the power or habit is immediately applied on; in which sense, colour is the next object of light: and remote, which are those only perceived by means of the former; in which sense, the wall is the remote object of sight, since we only see it by means of its colour, &c.

Ideas are the immediate objects of the mind in thinking; bodies, their relations, attributes, &c. are the mediate objects. Hence it appears that there is a sort of subordination of objects. But note, that a next object, with regard to a remote one, is properly a subiect, not an object.

Objects reflect or emit the rays of light, which occasions vision. Objects of themselves are invisible; we only seem to perceive them, because the different texture of their surface, disposing them to reflect differently coloured rays, occasion in us several sensations of colour, which we attribute to them.

The objects of the eye, or vision, are painted on the retina; though not there erect, but inverted, according to the laws of optics. This is easily shewn, from Carte's experiment of laying bare the vitreous humour on the back part of the eye, and putting over it a bit of white paper, or the skin of an egg, and then placing the fore part of the eye to the hole of a darkened moon. By this means is had a pretty landscape of the objects abroad, painted invertedly on the back of the eye. How, in this case, the objects which are painted inverted should be seen erect, is matter of controversy.

OBLIQUUS, in anatomy, is applied to several muscles of the head, eye, and abdomen. For their respective names, origins, insertions, and uses, see the *System*, Part II. Table of Muscles under the several heads.

OBTURATOR, in anatomy, a name given to two muscles of the thigh. For their origin, insertion, and uses, see the *System*, Part II. Table of Muscles, Art. 25.

OCCIPITO *Frontalis*, in anatomy, a muscle of the head. For its origin, insertion, and use, see the *System*, Part II. Table of Muscles, Art. 1.

OCCULT, something secret, hidden, or invisible. The occult sciences are magic, necromancy, cabbala, astrology, &c. See these articles. Agrippa has several books of occult philosophy, full of the vainest, wildest dreams imaginable: and Fludd nine volumes of the *Cabbala*, or Occult Sciences, wrapt up under figures or

or Hebrew characters. Weak philosophers, when unable to discover the cause of an effect, and unwilling to own their ignorance, say, it arises from an occult virtue, an occult cause, an occult quality.

OCEAN, in Geography, that vast collection of salt and navigable waters, in which the two continents, the first including Europe, Asia, and Africa, and the last America, are inclosed like islands.

The ocean is distinguished into three grand divisions. 1. The Atlantic ocean, which divides Europe and Africa from America, which is generally about 3000 miles wide. 2. The Pacific ocean, or south-sea, which divides America from Asia, and is generally about 10,000 miles over. And, 3. The Indian ocean, which separates the East Indies from Africa; which is 3000 miles over. The other seas, which are called oceans, are only parts or branches of these, and usually receive their names from the countries they border upon. For description of the several oceans, seas, &c. see the system of GEOGRAPHY, under the distinct Articles of EUROPE, ASIA, AFRICA, and AMERICA. For representation, see the respective MAPS, annexed to the System.

OCTANDRIA, formed of *οκτα*, eight, and *ανδρ*, male, in Botany, the eighth class of plants in Linnæus's Sexual System, with hermaphrodite flowers, and eight stamens, or male parts in each. This class comprehends four orders, viz. *monogynia*, including thirty-one genera of plants with one style; *dignia*, containing four genera of plants with two styles; *trigynia*, comprehending five genera with three styles; and *tetragynia*, containing three genera with four styles. See the System, Sect. IV. Art. IV. and Plate IV.

OCULUS, *the Eye*, in Anatomy. For description at large of the several component parts, see the System, Part VII. Sect. V. for representation, see Plate II. Fig. 10, 11, 12, 13, and 14. For the diseases incidental to the eye see the System of MEDICINE, Class IV. Order I. Genus 62 and 63.

ODE, *οδα* from the Greek *ωδη*, cantus, song, or singing, in poetry, a song, or a composition proper to be sung, and composed for that purpose.

ODYSSEY, the name of an epic poem, composed by Homer, which, when compared with the Iliad, exhibits its author as the setting sun, whose grandeur remains without the heat of his meridian beams.

The poet's design in the Odyssey was to paint the miseries of a kingdom in the absence of its supreme governor, and the evil consequences resulting from a disregard of law, and of that subordination without which society cannot exist. With this view he sets before his countrymen the adventures of a prince who had been obliged to forsake his native country, and to head an army of his subjects in a foreign expedition; and he artfully contrives, without interrupting the narrative, to make the reader acquainted with the state of the country in the absence of its sovereign. The chief having gloriously finished the enterprise in which he was engaged, was returning with his army; but, in spite of all his eagerness to be at home, he was detained on the way by tempests for several years, and cast upon several countries, differing from each others in manners and in government. In these dangers his companions, not strictly obeying his orders, perish through their own fault. In the mean time the grandees of his country abuse the freedom which his absence gives them; consume his estate; conspire to destroy his son; endeavour to compel his queen to accept one of them for her husband; and indulge themselves in every species of violence, from a persuasion that he would never return. In this they are disappointed. He returns; and discovering himself only to his son, and some others who had maintained their allegiance, he is an eye-witness of the insolence of his enemies, punishes them according to their deserts, and restores to his island that tranquillity and repose to which it had been a stranger during the many years of his absence.

Such is the fable of the Odyssey, in which there is no opportunity of displaying that vigor and sublimity which characterize the Iliad. "It descends from the dignity of gods and heroes, and warlike achievements; but in recompence we have more pleasing pictures of ancient manners. Instead of that ferocity which reigns in the other poem, this presents us with the most amiable images of hospitality and humanity; entertains us with many a wonderful adventure; and instructs us by such a constant vein of morality and virtue which runs through the poem, sometimes in precepts, and always in the conduct of the hero, that we should not wonder if Greece, which gave the appellation of wife to men who uttered single sentences of truth, had given to Homer the title of the Father of Virtue, for introducing into his work such a number of moral maxims. As a poem, however, the Odyssey has its faults. The last twelve books are tedious and languid; and we are disappointed by the calm behaviour of Penelope upon the discovery of her long lost husband.

ÆCONOMY, denotes the prudent conduct, or discreet and frugal management, whether of a man's own estate, or that of another.

Animal ÆCONOMY, comprehends the various operations of nature in the generation, nutrition, and preservation of animals. The No. 119.

doctrine of the animal œconomy is nearly connected with physiology, which explains the several parts of the human body, their structure, use, &c. See the Articles GENERATOR and NUTRITION, see also the Systems of ANATOMY and MEDICINE.

CEDEMA, *οιδημα*, a tumour which appears whitish, soft, and lax, without any notable change of colour, heat, pain, or pulsation; and which yields to the pressure of the finger, so as for some time to retain the dent or impression thereof.

CEDEMATOUS, something that is of the nature of an œdema; or seized, or afflicted, with an œdema. Thus we say, an œdematous arm, œdematous leg, &c. Physicians divide tumours into inflammatory, œdematous, scirrhus, scrophulous, cancerous, &c. For the causes, symptoms, and methods of treating external tumours in general, see the System of MEDICINE, Order II. Genus, 8, and Order III. Genus 58.

CESOPHAGUS, *οισοφάγος*, in Anatomy, the gula, or gullet; a membranous pipe or passage, whereby our food and drink are conveyed from the mouth to the stomach. See the System, Part III. Sect. IV.

OESTRUS, in Entomology, a genus of insects belonging to the order of diptera. It has no mouth; but three punctures, without trunk or beak: Antennæ taper, proceeding from a lenticular joint. There are five species, of which the following is the most remarkable.

The Tarandi.---Thorax yellow; with a black line between the wings, which are immaculate; Abdomen tawny, last segment black. They infest the back of the rein-deer, so as greatly to retard the breed. The rein-deer of Lapland are obliged every year to fly to the Alpine mountains, to escape the pursuit of these insects; yet a fourth part of their number perish by them at two years old; the rest are emaciated, and have their skins spoiled. It is one of the most curious genera of insects. They are distinguished into several species, by reason of the different places wherein they deposit their eggs. Some, instructed by nature that their eggs cannot be hatched but under the skins of living creatures, such as bulls, cows, rein-deer, stags, and camels, fix upon them at the instant of laying their eggs. From the hinder part of their body issues a whimble of wonderful structure. It is a scaly cylinder, composed of four tubes, which draw out like the pieces of a spying-glass; the last is armed with three hooks, and is the gimblet with which the œstri bore through the tough hides of horned cattle. The animal seems to experience no pain from the puncture, unless the insect, plunging too deep, attacks some nervous fibre; in which case, the beast runs about, and becomes furious. The eggs being hatched, the grub feeds on the matter of the wound. The place of its abode forms upon the body of the quadruped a bunch, sometimes above an inch high. When full-grown, the larva breaks through the tumour and slides down to the ground; for doing which it takes the cool of the morning, that it may neither be overpowered by the heat of the day, nor chilled by the cold of the night; it then digs itself a burrow, into which it retires. Its skin grows hard, and turns to a very solid shell. There it is transformed to a chrysalis, and afterwards to a winged insect. Nature has provided for every exigence: the shell wherein the œstrus is inclosed, is of so strong a texture that it could not make its way out, if at one of the ends there were not a small valve, fastened only by a very slight filament. The first push the œstrus makes, the door gives way and the prison opens. The insect wings its way to woods and places frequented by cattle.

OFFICINAL, formed of *officina*, a shop; in pharmacy, a term applied to such medicines, whether simple or compound, as are required to be constantly kept in readiness in the apothecaries shops, to be mixed up in extemporaneous prescriptions. The *officials* simples are appointed, among us, by the college of physicians; and the manner in making the compositions is directed in their Dispensatory.

OFF-SETS, in gardening, &c. are those young shoots which spring and grow from roots that are round, tuberous, or bulbous. For the planting and management of the several roots alluded to, see the System, Months January, May, and September.

OIL, in Natural History, an unctuous inflammable substance drawn from several natural bodies, as animal and vegetable substances.

Animals oils are their fats, which are originally vegetable oils; all animal substances yield them, together with their volatile salts, in distillation. Vegetable oils are obtained by expression, infusion, and distillation. The oils by expression are obtained from the seeds, leaves, fruit, and bark of plants; thus the seed of mustard, and of the sun-flower, almonds, nuts, beech-mast, &c. afford a copious oil by expression; and the leaves of rosemary, mint, rue, wormwood, thyme, sage, &c. the berries of juniper, olives, Indian cloves, nutmeg, mace, &c. the barks of cinnamon, saffra, and clove, yield a considerable proportion of essential oil by distillation. The method of procuring oils by expression is very simple: thus, if either sweet or bitter almonds, that are fresh, be pounded in a mortar, the oil may be forced out with a press, not heated; and in the same manner should the oil be pressed from linseed and mustard. The avoiding the use of heat in preparing these oils, intended for internal medicinal use, is of great importance, as heat gives them a very prejudicial rancidness.

OIL

This method holds of all those vegetable matters that contain a copious oil, in a loose manner, or in certain cavities or receptacles: the sides whereof being broke, or squeezed, makes them let go the oil they contain: and thus the zest or oil of lemon peel, orange peel, citron peel, &c. may be readily obtained by pressure, without the use of fire. But how far this method of obtaining oil, may be applied to advantage, seems not hitherto considered. It has been commonly applied to olives, almonds, linseed, rape-seed, beech-mast, ben-nuts, walnuts, bay-berries, mace, nutmeg, &c. but not, that we know of, to juniper-berries, calhew-nuts, Indian cloves, pine-apples, and many other substances that might be enumerated, both of foreign and domestic growth. It has however, been of late successfully applied to mustard-seed, so as to extract a curious gold-coloured oil, leaving a cake behind, fit for making the common table mustard. Certain dry matters, as well as moist ones, may be made to afford oils by expression, by grinding them in a meal, which being suspended to receive the vapour of boiling water, will thus be moistened so as to afford an oil, in the same manner as almonds; and thus an oil may be procured from linseed, hemp-seed, lettuce-seed, white poppy seed, &c.

As to the treatment of oils obtained by expression, they should be suffered to dehydrate themselves by standing in a moderately cool place, to separate from their water, and deposit their faeces; from both which they ought to be carefully freed. And if they are not thus rendered sufficiently pure, they may be washed well with fresh water, then thoroughly separated from it again by the separating glass, whereby they may be rendered bright and clear.

The next class of oils are those made by infusion, or decoction, wherein the virtues of some herb or flower is drawn out in the oil; as the oils of roses, chamomile, hypericum, alder, &c. However, these require to be differently treated: thus, for the scented flowers, particularly roses, insolation does best; because much boiling would exhale their most fragrant parts: but oils impregnated with green herbs, as those of chamomile and alder, require long boiling, before they receive the green colour desired. And, in general, no oils will bear to be boiled any longer than there remains some aqueous humidity, without turning black. There are many compound oils prepared in the same manner, viz. by boiling and insolation, and then straining off the oil for use.

The same contrivance has likewise its use in making essences for the service of the perfumer: not only where essential oils cannot be well obtained in sufficient quantities, but also where they are too dear. The essential oil of jessamine-flowers, honey-suckles, sweet-briar, damask-roses, lilies of the valley, &c. are either extremely dear, or scarcely obtainable by distillation; and in some of them the odorous matter is so subtle as almost to be lost in the operation. But if these flowers be barely infused in fine oil of nuts, or oil of ben, drawn without heat, and kept in a cool place, their subtle odorous matter will thus pass into the oil, and richly impregnate it with the flavour. And these essences may be rendered still more perfect by straining off the oil at first put on, and letting it stand again, without heat, upon fresh flowers; repeating the operation twice or thrice.

Oils or fats may likewise be obtained by boiling and expression, from certain animal substances; for the membranes which contain the fat, being chopped small, and set in a pan over the fire, become fit for the canvas bag, and by pressure, afford a large quantity of fat, as we see in the art of chandlery, which thus extracting the oily matter, leaves a cake behind, commonly called graves.

As to the essential oils of vegetables, they are obtained by distillation with an alembic and a large refrigeratory. Water must be added to the materials, in sufficient quantity to prevent their burning; and they should be macerated or digested in that water, a little time before distillation. The oil comes over with the water, and either swims on the top, or sinks to the bottom, according as it is specifically heavier or lighter than water.

This process is applicable to the distilling of the essential oils from flowers, leaves, barks, roots, woods, gums, and balsams, with a slight alteration of circumstances, as by longer digestion, brisker distillation, &c. according to the tenacity and hardness of the subject, the ponderosity of the oil, &c.

Essential oils may be divided into two classes, according to their different specific gravities; some floating upon water, and others readily sinking to the bottom. Thus, the essential oil of cloves, cinnamon, and saffra, readily sink; whereas, those of lavender, marjorum, mint, &c. swim in water: the lightest of these essential oils is, perhaps, that of citron-peel which even floats in spirit of wine; and the heaviest seems to be oil of saffra.

For obtaining the full quantity of the more ponderous oils from cinnamon, cloves, saffra, &c. it is proper to reduce the subjects to powder; to digest this powder for some days in a warm place, with thrice its quantity of soft river water, made very saline by the addition of sea-salt, or sharp with oil of vitriol; to use the strained decoction or liquor left behind in the still, instead of common water, for fresh digestion; to use for the same purpose the water of the second running, after being cleared of its oil; not to distil too large a quantity of these subjects at once; to leave a considerable part of the still, or about one fourth, empty; to use a brisk fire, or a strong boiling heat at the first, but to slacken it afterwards; to have a slow full head, with a proper internal ledge and current leading to

OLE

the nose of the worm; and, finally, to cohobate the water, or pour back the liquor of the second running upon the matter in the still, repeating this once or twice. The directions here laid down for obtaining the ponderous oils to advantage, are easily transferred to the obtaining of the lighter; so that we need not dwell particularly upon them.

Many of the essential oils being dear, it is a very common practice to adulterate or debase them several ways, so as to render them cheaper both to the seller and the buyer. These several ways seem reducible to three general kinds, each of which has its proper method of detection, viz. 1. With expressed oils. 2. With alcohol. And 3. with cheaper essential oils.

If an essential oil be adulterated with an expressed oil, it is easy to discover the fraud, by adding a little spirit of wine to a few drops of the suspected essential oil, and shaking them together; for the spirit will dissolve all the oil that is essential, or procured by distillation, and leave all the expressed oil, that was mixed with it, untouched.

If an essential oil be adulterated with alcohol, or rectified spirit of wine, it may be done in any proportion, up to that of an equal quantity, without being easily discoverable, either by the smell or taste: the way to discover this fraud, is to drop a few drops of the oil into a glass of fair water; and if the oil be adulterated with spirit, the water will immediately turn milky, and, by continuing to shake the glass, the whole quantity of spirit will be absorbed by the water, and leave the oil pure at top.

Finally, if an essential oil be adulterated by a cheaper essential oil, this is commonly done very artfully: the method is to put fir-wood, turpentine, or oil of turpentine, into the still, along with the herbs to be distilled for their oil, such as rosemary, lavender, origanum, &c. and by this means, the oil of turpentine distilled from these ingredients, comes over in great quantity, and intimately blended with the oil of the genuine ingredient. The oils thus adulterated always discover themselves in time, by their own flavour, being overpowered by the turpentine smell: but the ready way to detect the fraud, is to drench a piece of rag or paper in the oil, and hold it before the fire; for thus the grateful flavour of the plant will fly off, and leave the naked turpentine-scent behind.

The virtues of oil being the same with those of the substances from whence they are obtained, may be learned under their several articles.

The use of oil in stopping the violent ebullition of various substances may be very great in many occasions of life. It is well known, that if a mixture of sugar, honey, or the like, be boiling on the fire, and in danger of railing over the sides of the vessel, the pouring in a little oil immediately makes it subside. In many cases the marking a circle round the inside of a vessel, in which a liquor of this kind is to be boiled, with a piece of hard soap, shall, like a magic ring, confine its ebullition to that height, and not suffer it to stir any farther: This is wholly owing to the oil, or fat, contained in the soap: but there is, besides these, another very important use of oil, on a like occasion, which is the pouring of a little of it on any metallic solution, while making; this restrains the ascent of the noxious vapours; preserves the operator from danger; and, at the same time, by keeping down the evaporating matter, gives redoubled strength to the menstruum.

Pliny has mentioned an extraordinary effect of oil, in stilling the surface of water when it is agitated with waves, and the use made of it by the divers, for this purpose. *Omne*, says he, *oleo tranquillari*, &c. lib. ii. cap. 103, and Plutarch, in *Quest. Natur. askis*, *Cur mare oleo conspersum per lucidum sit et tranquillum?* Pliny's account seems to have been either discredited or disregarded by our writers on experimental philosophy, till it was confirmed by several curious experiments of Dr. Franklin, which were published in the year 1744. The property of oil abovementioned has, however, been well known to modern divers, and dredgers for oysters, at Gibraltar and elsewhere.

OLEA, the OLIVE-TREE; a genus of the monogynia order, belonging to the diandria class of plants.

There are two species, 1. The European, or common olive-tree, rises with upright solid stems, branching numerously on every side, 20 or 30 feet high; spear-shaped, stiff, opposite leaves, two or three inches long, and half an inch or more broad; and at the axillas small clusters of white flowers, succeeded by oval fruit. This species is the principal sort cultivated for its fruit: the varieties of which are numerous, varying in size, colour, and quality. It is a native of the southern warm parts of Europe, and is cultivated in great quantities in the south of France, Italy, and Portugal, for the fruit, to make the olive-oil, which is in so great repute, and is transported to all parts, to the great advantage of those countries where the trees grow in the open ground: the green fruit is also in much esteem for pickling, of which we may see plenty in the shops.

2. The capensis, or cape box-leaved olive, rises with shrubby stems, branching numerously from the bottom, six or seven feet high; small, oval, thick, stiff, shining leaves; and, at the axillas, small clusters of whitish flowers; succeeded by small fruit of inferior value. These trees are often sent over from Italy to the Italian warehouses in London, along with orange-trees, &c. where pretty large plants may be purchased reasonably.

Olive has an acrid, bitter, extremely disagreeable taste: pickled

led, as we receive them from abroad, they prove less disagreeable. The Lucca olives, which are smaller than the others, have the weakest taste; the Spanish, or larger, the strongest; the Provence, which are of a middling size, are generally the most esteemed.

The oil obtained from this fruit has no particular taste or smell, and does not greatly differ in quality from oil of almonds. From the ripe fruit, two or three sorts are obtained, differing in degree of purity; the purest runs by light pressure; the remaining magma, heated and pressed more strongly, yields an inferior sort, with some dregs at the bottom, called *amurca*. All these oils contain a considerable quantity of aqueous moisture, and a mucilaginous substance, which subject them to run into a putrid state: to prevent this, the preparers add some sea-salt, which, imbibing the aqueous and mucilaginous parts, sinks with them to the bottom; by this means the oil becomes more homogeneous, and consequently less susceptible of alteration. In its passage to us, some of the salt, thrown up from the bottom, by the shaking of the vessel, is sometimes mixed with and detained in the oil, which in our colder climates, becomes too thick to suffer it freely to subside; and hence the oil is sometimes met with of a manifest saline taste.

Oil of olives is an ingredient in the composition of a great many balsams, ointments, plaisters, mollifying and relaxing liniments. It is of an emollient and solvent nature; mitigates gripes of the colic, and the pains accompanying dysentery: and is one of the best remedies when one has chanced to swallow corrosive poisons; but it by no means prevents the fatal accidents which ensue from the bite of a snake, as has been pretended. It is an effectual cure, as M. Bourgeois tells us, for the sting of wasps, bees, and other insects. A bandage soaked in the oil is immediately applied to the sting, and a cure is obtained without any inflammation or swelling.

As the laurel branch is the symbol of glory, so the olive-branch covered with leaves has from the most ancient times been the emblem of concord, the symbol of friendship and peace.

The leaves of olive trees have an astringent quality. Many people use them in making gargles for inflammations of the throat.

OLEAGINOUS, something that partakes of the nature of oil; or out of which oil may be expressed. Thus olives, nuts, almonds, &c. are *oleaginous* fruits, or fruits out of which oil is expressed. Pines, firs, &c. are *oleaginous* woods, yielding, resin, turpentine, &c. Of all woods, *oleaginous* ones burn the best. An *oleaginous* urine in malignant fevers is a sign of death.

OLFATORY Nerves, in Anatomy, the first pair of nerves, springing out of the medulla oblongata; so called as being the immediate instruments of smelling. See the System, Part VI. Sect. II. and Plate XI. Letter K.

OLIBANUM, in Pharmacy, a gummy resin, the product of the *juniperus lycia* (Lin.) brought from Turkey and the East Indies, usually in drops or tears like those of mastic, but larger; of a pale yellowish, and sometimes reddish, colour; a moderately warm pungent taste, and a strong not very agreeable smell.

This drug is not however, in any of its states, what is now called thus or frankincense in the shops. See Frankincense and the System of CHYMISTRY, Part IV. Chap. II. Sect. IV.

OLIO, or **OGLIO**, a savoury dish, or food, composed of a great variety of ingredients; chiefly found at Spanish tables. The forms of olios are various. To give a notion of the strange assemblage, we shall here add one from an approved author. Take rump of beef, neat tongues boiled and dried, and Bologna sausages; boil them together, and, after boiling two hours, add mutton, pork, venison, and bacon, cut in bits; as also turnips, carrots, onions, and cabbage; borage, endive, marigolds, forrel, and spinach; then spices, as saffron, cloves, mace, nutmegs, &c. This done, in another pot put a turkey or goose, with capons, pheasants, wigeons, and ducks, partridges, teals, and stock doves, snipes, quails, and larks, and boil them in water and salt. In a third vessel, prepare a sauce of white wine, strong broth, butter, bottoms of artichokes, and chestnuts, with cauliflowers, bread, marrow, yolks of eggs, mace, and saffron. Lastly, dish the olio, by first laying out the beef and veal, then the venison, mutton, tongues, and sausages, and the roots over all; then the largest fowls, then the smallest, and lastly pour on the sauce.

OLIGARCHY, formed from *ὀλιγος*, few, and *αρχη*, government, a form of government, wherein the administration is in the hands of a few persons. The states of Venice and Genoa may be ranked among oligarchies. Oligarchy amounts to much the same thing with aristocracy; unless perhaps the former imports a kind of defect or corruption; as if the sovereign power were monopolized by a few persons, in prejudice of the rights of a great number.

OLYMPIAD *Ὀλυμπιας*, in Chronology, a space or period of four years; whereby the Greeks reckoned their time. See *ΕΡΟΧΑ*. The Peloponnesian war began on the first year of the 87th Olympiad. Alexander the Great died the first year of the 114th; and Jesus Christ was born on the first year of the 195th Olympiad. The Olympiads, were also called *anni Iphiti*, from *Iphitus*, who instituted, or at least renewed, the solemnity of the Olympic games. We do not find any computation by Olympiads after the 364th, which ended with the year of Christ 440. Except that in a charter of our king Ethelbert, the years of his reign are said to be reckoned by Olympiads.

OLYMPICS, or **OLYMPIC Games**, were solemn games, which lasted five days, famous among the ancient Greeks; instituted, according to some, by Hercules, in honour of Jupiter, in the year of the world 2886, and re-established by Iphitus, 372 years after this period; and held at the beginning of every fifth year, that is, every 50th month, on the banks of the Alpheus, near Olympia, a city of Elis; to exercise their youth in five kinds of combats. The prize contended for was a crown made of a peculiar sort of wild olive appropriated to this use.

OMEN, is a word which, in its proper sense, signifies a sign or indication of some future event, taken from the language of a person speaking without any intent to prophecy.

It is more than probable that this practice of making ordinary events ominous of good or bad fortune took its rise in Egypt, the parent country of almost every superstition of Paganism; but wherever it may have arisen, it spreads itself over the whole inhabited globe, and at this day prevails in a greater or less degree among the vulgar of all nations.

In England, it is reckoned a good omen, or a sign of future happiness, if the sun shines on a couple coming out of the church after having been married. It is also esteemed a good sign if it rains whilst a corpse is burying;

Happy is the bride that the sun shines on;
Happy is the corpse that the rain rains on.

To break a looking-glass is extremely unlucky; the party to whom it belongs will lose his best friend. See the Article *AUGURY*.

This superstitious practice of auguring good or ill from trifling events, and from the particular phases of the moon, has no connection whatever with popish priestcraft: it shews that the Romish clergy, even in the darkest age, were at pains to eradicate it as idle and impious; and it may be inferred, that it is a relic of Druidism handed down by tradition from an era prior to the introduction of Christianity into the Highlands and isles of Scotland. That the Druids were acquainted with the particular doctrines of Pythagoras has been shewn elsewhere (see *DRUIDS*;) that Virgil was no stranger to the Pythagorean philosophy is known to every scholar; that Pythagoras and his followers were addicted to the dotages of magic has been made apparent in that article; and therefore it appears to us probable at least, that the attention paid to pretended omens, not only in the Highlands, but also in the low country of Scotland, and indeed among the vulgar in every country of Europe, is a remnant of one of the many superstitions which the Druids imposed upon their deluded followers. That it is contrary to every principle of sound philosophy, all philosophers will readily acknowledge: and whoever has studied the writings of St. Paul must be convinced that it is inconsistent with the spirit of genuine Christianity.

OMENTUM, in Anatomy, a fat-thin membrane, spread over the intestines, and following them in all their sinuosities. The *omentum* is the same with what is otherwise called *epibloon*, *caul*, *reticulum*, &c. See the System, Part. III. Sect. II. and Plate V. Fig. 6.

OMNIUM is a term of finance, denoting all the particulars included in the contract between government and the public for a loan: such a stock at 3 or 4 per cent. lottery tickets at a stipulated price, annuities for a certain term, &c. See *FUND*.

OMPHALO-MESENTERIC, in Anatomy. All foetuses are wrapped in at least two coats, or membranes; most of them have a third, called *allantoides*, or urinary.—Some, as the dog, cat, hare, &c. have a fourth, which has two blood-vessels; viz. a vein and an artery, called *omphalo mesenteries*; because passing along the string to the navel, and terminating in the mesentery.

ONANIA, or **ONANISM**, terms lately framed to denote the crime of self-pollution mentioned in scripture to have been committed by Onan, and punished in him with death. This practice, however common, hath among all nations been reckoned a very great crime. In scripture, besides the instance of Onan above-mentioned, we find self-polluters termed effeminate, unclean, filthy, and abominable. Even the heathens, who had not the advantage of revelation, were of the same opinion, as appears from the following lines of Martial.

Hoc nihil esse putes! scelus est, mihi crede, sed ingens
Quantum vix animo concipis ipse tuo.
You think it's nothing! it's a crime, believe!
A crime so great you scarcely can conceive.

Dr. Tissot has published a treatise on the pernicious effects of this shameful practice, which appears to be no less baneful to the mind than the body. He begins with observing, that by the continual waste of the human body, aliments are required for our support. These aliments, however, require certain preparations in the body itself; and when by any means we become so altered that these preparations cannot be effected, the best aliments then prove insufficient for the support of the body. Of all the causes, by which this morbid alteration is brought on, none is more common than too copious evacuations; and of all evacuations, that of the semen is the most pernicious when carried to excess. It is also to be observed, that though excess in natural venery is productive of very dangerous disorders, yet an equal evacuation by self-

self-pollution, which is an unnatural way, is productive of others still more to be dreaded. The consequences enumerated by Dr. Tissot are as follow :

1. All the intellectual faculties are weakened ; the memory fails : the ideas are confused, and the patient sometimes even falls into a slight degree of insanity. They are continually under a kind of inward restlessness, and feel a constant anguish. They are subject to giddiness ; all the senses, especially those of seeing and hearing grow weaker and weaker, and they are subject to frightful dreams.

2. The strength entirely fails, and the growth in young persons is considerably checked. Some are afflicted with almost continual watching, and others dose almost perpetually. Almost all of them become hypochondriac or hysteric, and are afflicted with all the evils which attend these disorders. Some have been known to spit calcareous matter ; and others are afflicted with coughs, slow fevers and consumptions.

3. The patients are affected with the most acute pains in different parts of the body, as the head, breast, stomach, and intestines ; while some complain of an obtuse sensation of pain all over the body, on the slightest impression.

4. There are not only to be seen pimples on the face, which are one of the most common symptoms ; but even blotches, or suppurative pustules, appear on the face, nose, breast, and thighs ; and sometimes fleshy excrescences arise on the forehead.

5. The organs of generation are also affected ; and the semen is evacuated on the slightest irritation, even that of going to stool. Numbers are afflicted with an habitual gonorrhœa, which entirely destroys the vigour of the constitution, and the matter of it resembles a fetid sanies. Others are affected with painful priapisms, dysurics, stranguaries, and heat of urine, with painful tumours in the testicles, penis, bladder, and spermatic cord. Impotence, in a greater or less degree, is the never-failing consequence of this detestable vice.

The functions of the intestines are sometimes totally destroyed ; and sometimes patients complain of costiveness, others of diarrhœa, piles, and the running of a foetid matter from the fundament.

With regard to the cure, the first step is to leave off those practices which have occasioned the disease : and which our author asserts is no easy matter ; as, according to him, the soul itself becomes polluted, and can dwell on no other idea ; or, if she does, the irritability of the parts of generation themselves quickly recal ideas of the same kind. This irritability is, no doubt, much more to be dreaded than any pollution the soul can have received ; and by removing it, there will be no occasion for exhortations to discontinue the practice. The principal means for diminishing this irritability are, in the first place, to avoid all stimulating, acrid, and spicy meats. A low diet, however, is improper, because it would further reduce the body, already too much emaciated. The food should therefore be nutritive but plain, and should consist of flesh rather roasted than boiled, rich broths, &c. It is certain, however, that as these foods contribute to restore the strength of the body, the stimulus on the organs of generation will be proportionably increased by the semen which is constantly secreted, and which will now be in larger quantity than ever in healthy persons, owing to the greater evacuations of it which have preceded. Some part of the semen is gradually absorbed by the lymphatics ; in consequence of which the remainder becomes thick, acrid, and very stimulating. To remedy this, exercise is to be used, and that not only for pleasure, but till it is attended with a very considerable degree of fatigue. The sleep also must be no more than is barely sufficient to repair the fatigues occasioned by the exercise, or other employment ; for an excess of sleep is as bad as idleness or stimulating foods. Excess in wine, or intoxicating liquors are also to be avoided ; or rather such liquors ought never to be tasted, unless as a medicine, to restore the exhausted spirits : and to all this ought to be joined the Peruvian Bark, which hath this admirable property, that with little or no stimulus, it restores the tone of the system, and invigorates the body, in a manner incredible to those who have not observed its effects. If these directions are followed, the patient may almost certainly expect a recovery, provided any degree of vital strength remains ; and those who desire a life of celibacy on a moral account, will find them much more effectual than all the vows of chastity they can make.

ONCA, in Mammalia, a species of the genus *Felis* : For description of the genus, see *FELIS*. Of this species, there are two varieties. See Plate IV. Order III. Genus XIII. Species IV. Variety 1 and 2.

ONION. Onions, leeks, and garlic, are all of the same genus, and in their recent state are acrid, but harmless to the human body. When by age or climate this acrimony is too great, we do not use them as food. In Spain, the garlic being equally mild with the onion, is used as common food. By the ordinary culinary preparation their acrimony is dissipated, and a remarkably mild substance remains, promising much nutriment, which those who can digest them raw will certainly obtain. Though sometimes shunned as food, yet they are on that account used in medicine, uniting the two qualities of pectorals, viz. on the account of their acrimony, being in their recent state expectorant ; in their boiled state, on account of their mucilage, demulcent, provided the quantity taken be sufficient. Some, of late, in this coun-

try, have found in leeks a somniferous quality ; but this is not yet confirmed by a sufficient number of experiments. Besides the three abovementioned, there are several others, belonging to the same tribe, which we use as condiment : but only the leek and onion as diet. In its recent state, the onion is the most acrid ; in its boiled state, the leek retains its acrimony most tenaciously. On account of this, and some difference of texture, the onion is more easily digested, and more universally used than the leek, being more easily broke down, and more generally agreeable.

The three sorts of onions propagated for the sake of their roots, for winter use, are the Straßburg onion ; the red Spanish onion ; and the white Egyptian onion. For the cultivation of this useful root, see Treatise on GARDENING ; Article *Kitchen-garden* ; Months February, July, and August.

ONYX, in Mineralogy, one of the semi-pellucid gems, with variously coloured zones, but none red ; being composed of crystal, debased by a small admixture of earth ; and made up either of a number of flat plates, or of a series of coats surrounding a central nucleus, and separated from each other by veins of a different colour, resembling zones or belts. We have four species of this gem. 1. A bluish-white one, with broad white zones. 2. A very pure onyx, with snow-white veins. 3. The jasponix, or horny-onyx, with green zones. 4. The brown onyx, with bluish-white zones.

The word, in the Greek language, signifies nail ; the Poets making this stone to have been formed by the Parca, from a piece of Venus's nails, cut off by Cupid, with one of his arrows. See the System.

OOROO, a kind of cloth, made by the people of Otaheite and of other islands in that neighbourhood, from the bark of the bread-fruit tree. Aouta is a name given in those countries to another kind of cloth, made of the bark of the paper mulberry-tree, precisely after the same manner. See Banks's Geography, page 51.

OPACITY, in Philosophy, a quality of bodies which render them opaque ; that is, impervious to the rays of light. The term opacity, is used in opposition to transparency.

Opacity, according to the Cartesians, consists in this : that the pores of the body are not all strait, or directly before each other ; or rather not pervious every way.

But this doctrine is deficient : for though it must be allowed, that to have a body transparent, its pores must be strait, or rather open every way ; yet how it should happen that not only glass and diamonds, but even water, whose parts are so very moveable, should have all their pores open and pervious every way ; and, at the same time, the finest paper, or the thinnest gold plate should exclude the light, for want of such pores, is inconceivable. So that another cause of opacity must be found. Now all bodies have vastly more pores or vacuities than are necessary for an infinite number of rays to find a free passage through them in right lines, without striking on any of the parts themselves ; for since water is nineteen times lighter, i. e. so much rarer, than gold ; and yet gold itself is so very rare that magnetic effluvia pass freely through it, without any opposition ; and quicksilver is readily received within its pores, and even water itself by compression ; it must have much more pores than solid parts : consequently, water must have, at least, forty times as much vacuity as solidity.

The cause, therefore, why some bodies are opaque, does not consist in the want of rectilinear pores, pervious every way ; but either in the unequal density of the parts, or in the magnitude of pores, and their being either empty, or filled with a different matter ; whereof the rays of light, in their passage, are arrested by innumerable refractions and reflections, till falling at length, on some solid part, they become quite extinct, and are utterly absorbed.

Hence cork, paper, wood, &c. are opaque ; while glass, diamonds, &c. are pellucid. For in the confines or joining of parts alike in density, such as those of glass, water, diamonds, &c. among themselves, there arises no refraction or reflection, by reason of the equal attraction every way ; so that such of the rays of light as enter the first surface, pass strait through the body, excepting such as are lost and absorbed, by striking on solid parts : but in the bordering of parts unequal in density, such as those of wood and paper, both with regard to themselves, and with regard to the air or empty space in their larger pores, the attraction being unequal, the reflections and refractions will be very great ; thus the rays will be unable to pass through such bodies, being continually driven about till they become extinct.

That this interruption or discontinuity of parts is the chief cause of opacity, Sir Isaac Newton argues, does appear hence ; that all opaque bodies immediately begin to be transparent, when their pores become filled with a substance of equal, or almost equal, density with their parts. Thus paper dipped in water or oil, the stone called *oculus mundi*, steeped in water, linen cloth dipped in oil or vinegar and other substances soaked in such fluids as will intimately pervade their little pores, become more transparent than before.

On the contrary, the most transparent substances, by emptying their pores, or separating their parts, may be rendered very opaque. Thus salts, or wet paper, or *oculus mundi*, by drying ; horn, by scraping ; glass, by pulverizing, or flaving ; and water itself, by being beat into bubbles or froth, are rendered opaque.

Indeed

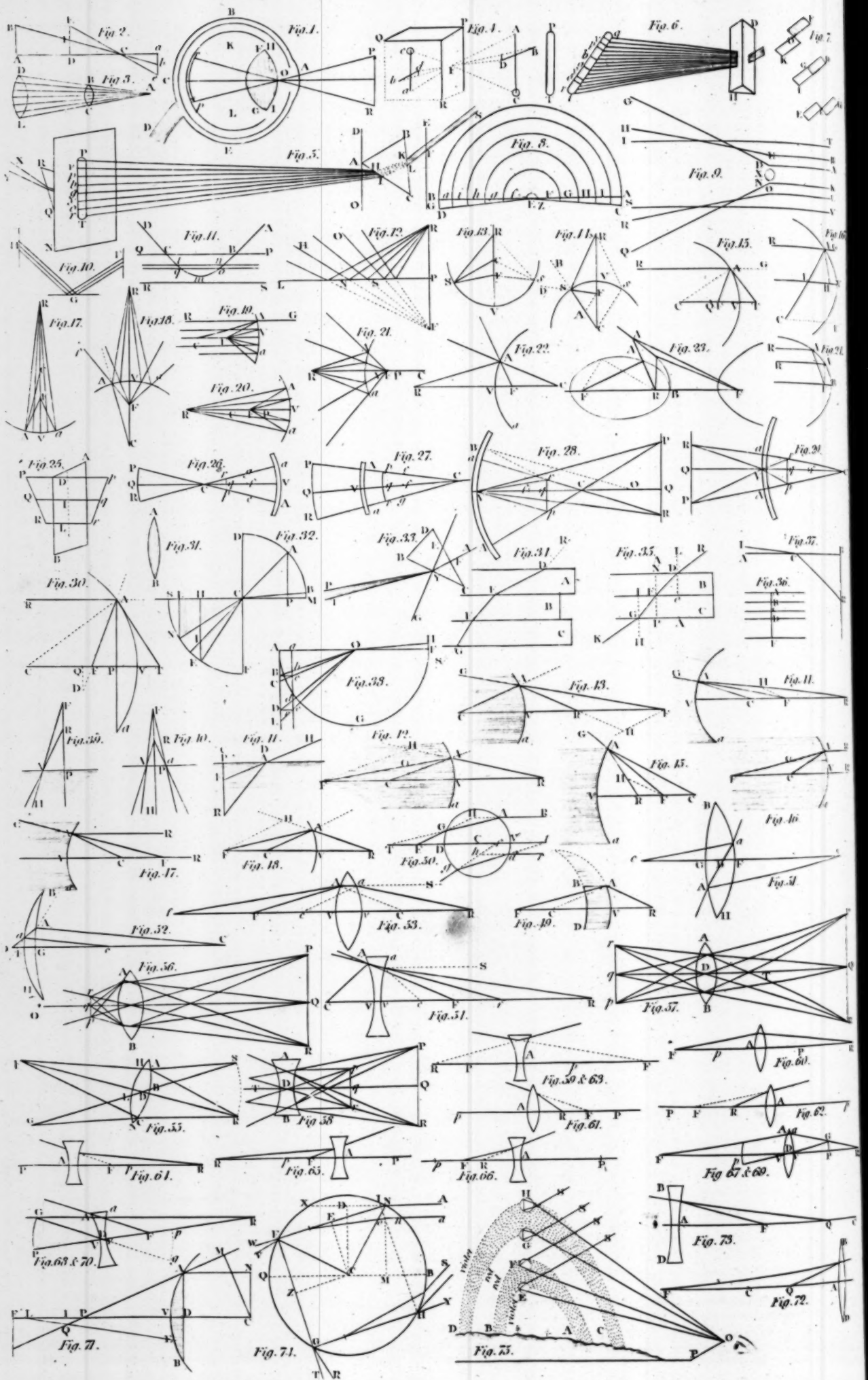
t
n
d
e
t
e
e
s
d
n
h
at

i-
i-
of
t-
n-
on
ed.
a-
rts
ng
he
as
ch
or-
pa-
or
ual,
ays
ven

use
at all
ores
stity
one
l or
inti-
than

ying
ake.
, by
, by
deed

Elements of Optics. See the System, Part 1. Section 3.



Indeed, to render bodies opaque, and coloured, their interstices must not be less than of some determinate size; for the most opaque bodies that are, if their parts be very minutely divided, as when metals are divided in acid menstruums, become perfectly transparent.

OPAL, in Natural History, a species of the chroastaces genus of gems.—This species of precious stone is generally esteemed the most beautiful of all the flinty tribe, which appears to be owing to its changeable appearance, when viewed by reflection.—The form of the opal is that of a pebble, like the agate, with which authors in general have classed it, from a supposed resemblance, of which there appears no sort of proof. On the contrary, Bergman's analysis points it out to be of a very different nature from the genus of flints, of which the agate is a species; magnesia constituting a large part of its composition, and not entering at all into that of the agate; if we are to judge from the analysis of the parent species, or flint, there being none yet published of agate. The specific gravity of the opal is likewise extremely different from that of the agate. Wallerius tells us, that its specific gravity is upwards of 1900. It loses its colour and transparency in the fire, and in other respects is affected by it in the very same manner as quartz or flint would be. It may be melted with borax, but not without great difficulty.

OPERA, a dramatic composition, set to music, and sung on the stage, accompanied with musical instruments, and enriched with magnificent dresses, machines, and other decorations. Bruyere says, that it is essential to the opera to keep the mind and the ears in an enchantment. St. Evremont calls the opera a chimerical assemblage of poetry and music, where the poet and musician take from the effect of each other's production.

When the language is thoroughly understood, we should imagine, that to make an opera agreeable to good sense, much would depend upon the choice of the subject; for it is surely absurd to have persons of all ranks, and on every occasion, perpetually accompanied with the regular responses of symphony. To hear Cæsar, Scipio, or Macbeth, when forming plans to ensure victory, or hatching plots of treason and murder, talking in recitative, and keeping time with fiddles, would surely disgust every person whose sense had not all evaporated in sound; but when the subject represented naturally admits of music in real life, we can suppose an opera to afford to persons of taste, one of the most exquisite and refined entertainments of which human nature is capable.

By those who were esteemed the best judges of the art, the English language was considered as too rough and inharmonious for the music of the opera; and, on the other hand, critics, whose taste was built on the basis of common sense, looked upon a drama in a foreign and unknown tongue as the greatest of all absurdities. Many of them, however, pleaded for operas in the English language; and it is well known that Addison, who was one of the opposers of the Italian opera on the London stage, wrote, in his native tongue, the opera of Rosamond. This is confessedly a beautiful poem; but, in the opinion of Dr. Burney, it adds nothing to Addison's fame, as it shews his total ignorance of the first principles of music, and of course his unsuitness for the task he had undertaken.

The connoisseurs in music give a preference to operas in the Italian language, from two considerations: first, they conceive that sense and sound are two separate gratifications, and that by blending elegant poetry with delightful harmony, the attention is divided between them: so that neither affords that exquisite gratification as when separately considered: another motive is, that the Italian language is the most harmonious of the living languages: and therefore best adapted to convey those exquisite sounds.

OPERATION, in Chymistry, denotes the processes, or experiments, by means whereof the proper changes are produced in bodies, and the effect of the art produced. The changes chymistry produces in bodies are reducible to two kinds; viz. an union of parts, and a separation thereof: thus, chymistry either separates spirits, salts, oils, &c. or compounds them together. All chymical processes, therefore, are reducible to two general kinds; viz. such whereby the parts of bodies, before joined or united are separated, which the ancient chymists called solution; and such whereby the parts before disjoined, are combined, or united, called coagulation. See those Articles; the other operative parts are inserted in the course of the Alphabet.

OPHIORHIZA, in Botany, a genus of the monogynia order belonging to the pentandria class of plants. The corolla is funnel-shaped; the capsule twin, bilocular, and polyspermous. There are two species; the most remarkable of which is the Asiaticum, or true *Lignum Colubrinum*. The root of this is known in the East Indies to be a specific against the poison of the most dreadful animal, called the Hooded-serpent. There is a treatise in *Amoen. Acad.* tom. iv. upon this subject, wherein the author, Joh. And. Darelus undertakes, from the description of such authors as had seen it upon the spot, to ascertain the plant from which the genuine root is taken; and asserts, that that which has been sold in the shops is very different, and of a poisonous nature.

OPHTHALMIA, in Surgery, a disease of the eyes; properly, an inflammation of the *tunica adnata* or *conjunctiva*; accompanied with a redness, swelling, heat, and pain. The ophthalmia is either

moist or dry; in the first there is a shedding of tears; in the second none at all. It sometimes happens in the ophthalmia that the two eyelids are so distorted that the eye continues constantly open, without being able to shut.

The immediate cause of the ophthalmia is the blood flowing in too great abundance in the little vessels of the *adnata*, so as to stagnate therein, and by that means distend them. The remote causes are the same with those of other inflammations. This disease may be occasioned by external injuries; by the stoppage of customary evacuations; by long exposure to the night air; by watching, and reading or writing much by candle-light; by drinking spirituous liquors; by excess of venery; by the acrid fumes of metals; by a venereal taint, and by a scrophulous or gouty habit. The disease is sometimes epidemic, especially after wet seasons; and Dr. Buchan observes, that he has frequently known it to prove infectious. It may be also occasioned by a moist air, or living in low damp houses. In children it often proceeds from imprudently drying up scabby heads, a running behind the ears, or other similar discharges, and it often succeeds the small-pox or measles, especially in children of a scrophulous habit. A slight inflammation of the eyes, especially from an external cause, is easily cured; but when the disease is violent, and continues long, it often leaves specks upon the eyes, or dimness of sight, and sometimes ends in total blindness.

OPHTHALMIC Nerves. The fifth pair of nerves of the brain, dividing into three branches: the first is called *ophthalmic*, because it goes to the eye. This, again, subdivides into two branches, after sending out several twigs, which compass the optic nerves, and are distributed into the choroides. See *System of ANATOMY* Part VI. and Plate XI. fig. 10. Lett. g.

OPIATES, medicines of a thicker consistence than a syrup, prepared with opium scarcely fluid. They consist of various ingredients, made up with honey or syrup; and are to be used for a long time either for purgative, alterative, or corroborative intentions. The word opiate is also used, in general, for any medicine given with an intention to produce sleep, whether in the form of electuaries, drops, or pills.

OPINION is that judgment which the mind forms of any proposition, for the truth or falsehood of which there is not sufficient evidence to produce science, or absolute belief.

That the three angles of a plane triangle are equal to two right angles, is not a matter of opinion, nor can it with propriety be called an object of the mathematician's belief: he does more than believe it; he knows it to be true. When two or three men, under no temptation to deceive, declare that they were witnesses of an uncommon, though not preternatural event, their testimony is complete evidence, and produces absolute belief in the minds of those to whom it is given: but it does not produce science like rigid demonstration. The fact is not doubted, but those who have it on report do not know it to be true, as they know the truth of propositions intuitively or demonstrably certain. When one or two men relate a story, including many circumstances, to a third person, and another comes who positively contradicts it either in whole or in part, he to whom those jarring testimonies are given weighs all the circumstances in his own mind, balances the one against the other, and lends an assent, more or less wavering, to that side on which the evidence appears to preponderate. This assent is his opinion respecting the facts of which he has received such different accounts.

Opinions are often formed of events not yet in being. Were an officer from the garrison of Nimeguen, invested by the French in November 18, 1794, to come while we are writing on this subject, and tell us that the soldiers in the garrison are in good health and high spirits; that every shot which they fire upon the assailants produces some effect; and that they have plenty of excellent provisions, whilst the assailants are perishing by hunger; we should absolutely believe every fact which he had told us, upon the evidence of his testimony; but we could only be of opinion that the assailants would raise the siege. In forming opinions of this kind, upon which, in a great measure, depends our success in any pursuit, every circumstance should be carefully attended to, and our judgments guided by former experience. Truth is a thing of such importance to man, that he should always pursue the best method of attaining it; and when the object eludes all his researches, he should remedy the disappointment, by attaching himself to that which has the strongest resemblance to it; and that which most resembles truth is called probability, as the judgment which is formed of it is termed opinion. See *PROBABILITY*.

OPIUM, in the *Materia Medica*, is an inspissated juice, partly of the resinous and partly of the gummy kind, brought to us in cakes, from eight ounces to a pound weight.

Opium is the juice of the papaver album, or white poppy, with which the fields of Asia Minor are in many places sown, as ours are with corn. When the heads are near ripening, they wound them with an instrument that has five edges, which on being stuck into the head makes at once five long cuts in it; and from these wounds the opium flows, and is next day taken off by a person who goes round the field, and put up in a vessel which he carries fastened to his girdle; at the same time that this opium is collected, the opposite side of the poppy head is wounded, and the opium collected from it the next day.

O P I

Opium at present is in great esteem, and is one of the most valuable of all the simple medicines. In its effects on the animal system, it is the most extraordinary substance in nature. It touches the nerves as it were by magic and irresistible power, and steepens the senses in forgetfulness; even in opposition to the determined will of the philosopher or physiologist, apprised of its narcotic effect.

The modification of matter is infinite; and who shall truly say by what peculiar or specific configuration of its parts, opium, even in the quantity of a single grain, administered to the human body shall assuage the most raging pain, and procure profound sleep. The action of matter upon matter, thus exemplified in the effect of opium, on the animal system, is not less astonishing and incomprehensible, than that of spirit upon matter, or the agency of mind on the motive powers of the body.

The first effects of opium are like those of a strong, stimulating cordial, but are soon succeeded by universal languor or irresistible propensity to sleep, attended with dreams of the most rapturous and enthusiastic kind. After those contrary effects are over, which are generally terminated by a profuse sweat, the body becomes cold and torpid: the mind pensive and desponding; the head is affected with stupor, and the stomach with sickness and nausea.

It is not our business, neither is it in our power, to reconcile that diversity of opinion which has lately prevailed concerning the manner in which opium produces its effects; or to determine whether it acts simply on the brain and nerves, or, according to the experiments of Fontana, on the mass of blood only.

Opium is the most sovereign remedy in the materia medica, for easing pain and procuring sleep, and also the most certain antispasmodic yet known; but, like other powerful medicines, becomes highly noxious to the human constitution, and even mortal, when improperly administered. Its liberal and long continued use has been observed greatly to injure the brain and nerves, and to diminish their influence on the vital organs of the body. By its first effects, which are exhilarating, it excites a kind of temporary delirium, which dissipates and exhausts the spirits; and, by its subsequent narcotic power, occasions confusion of ideas and loss of memory, attended with nausea, giddiness, head-ach, and constipation of the bowels; in a word, it seems to suspend or diminish all the natural secretions and excretions of the body, that of perspiration only excepted.

Those who take opium to excess, become enervated and soon look old; when deprived of it, they are faint, and experience the languor and dejection of spirits common to such as drink spirituous liquors in excess; to the bad effects of which it is similar, since, like those, they are not easily removed without a repetition of the dose.

By the indiscriminate use of that preparation of opium called Godfrey's cordial, many children are yearly cut off; for it is frequently given, dose after dose, without moderation, by ignorant women and mercenary nurses, to silence the cries of infants and lull them to sleep, by which they are at last rendered stupid, inactive, and rickety.

Opium is universally known to be used as a luxury in the east. Mr. Grose informs us, that most of the hard labouring people at Surat, and especially the porters, take great quantities of this drug, which they pretend, enables them to work, and carry heavier burdens than they otherwise could do. Some of these, our author assures us, will take more than an ounce at a time without detriment. Many people in opulent circumstances follow the same custom, but with very different motives. Some use it merely for the sake of the pleasing delirium it occasions; others for venereal purposes, as by this means they can lengthen the amorous congress as much as they please, though they thus are certain to bring on an absolute impotency and premature old age at last. For this purpose it is usually taken in milk: and when they have a mind to check or put an end to its operation, they swallow a spoonful or two of lime juice, or any similar acid.

It is also considered as a great inspirer of courage, or rather insensibility to danger; so that the commanders make no scruple of allowing large quantities of it to the soldiers when they are going to battle, or engaged in any hazardous enterprise.

The best opium in the world is said to come from Patna, on the river Ganges, where, at least, the greatest traffic of it is made, and from whence it is exported all over India; though in some parts, especially on the Malay coasts, it is prohibited under pain of death, on account of the madness, and murders consequent upon that madness, which are occasioned by it; notwithstanding which severe prohibition, however, it is plentifully smuggled into all these countries.

Opium applied externally is emollient, relaxing, and discutient, and greatly promotes suppuration; if long kept upon the skin, it takes off the hair, and always occasions an itching in it; sometimes it exulcerates it, and raises little blisters, if applied to a tender part. Sometimes, as an external application, it allays pain, and even occasions sleep: but it must by no means be applied to the head, especially to the sutures of the skull: for it has been known to have the most terrible effects in this application, and even to bring on death itself.

It appears, too, from some curious experiments made by Dr. Leigh

O P T

to act as the most powerful of all styptics. "Having laid bare the crural artery of a rabbit (says the Doctor), I divided it, when the blood instantly flew out with considerable velocity some of a strong solution was then applied to the divided artery, the ends of which in a short space of time contracted, and the hæmorrhage, ceased. The same experiment was performed on the brachial artery with like success."

The effects of a strong solution of opium upon the heart, appears from the same experiment to be very extraordinary. "I opened the thorax of a rabbit (says the Doctor) and by dissection, placed the heart in full view; the aorta was then divided, and the animal bled till it expired. After the heart had remained motionless ten minutes, and every appearance of life had ceased for the same length of time, I poured on the heart a quantity of my strong solution; it was instantly thrown into motion, which continued two minutes: I then added more of the solution, and the action was again renewed. By thus repeating my applications, the motions of the heart were supported more than ten minutes. Afterwards opened the thorax of a rabbit, and, without doing any injury to the large blood vessels, placed the heart in view. A quantity of my strong solution was then applied to it, which so accelerated the motions as to render it impossible to number them: by renewing the application, these were continued for some considerable time. The surface of the heart now appeared uncommonly red, and continued so some time."

Opium contains gum, resin, essential oil, salt, and earthy matter: but its narcotic or somniferous power has been experimentally found to reside in its essential oil.

Dr. Smyth, while at Smyrna, took pains to observe what the doses of opium taken by the Turks, in general were. He found that three drams in a day were a common quantity among the larger takers of it, but that they could take six drams a day without mischief. A Turk eat this quantity before him, three drams in the morning, and three in the evening, with no other effect than its giving him great cheerfulness. But the taking it thus habitually greatly impairs the constitution; the persons who accustom themselves to it, can by no means live without it, and are feeble and weak; their legs are usually thin, and their gums eaten away, so that the teeth stand bare to the roots; they are also often of a yellow complexion, and look much older than they really are. The Turkish messengers, when sent upon business of haste, always carry opium with them, and take largely of it when tired; they say it immediately gives them strength and spirits to proceed, taken with proper precaution. Phil. Trans. N^o 223.

Dr. Lewis has given us the following view of the general effects of opium. It renders the solids, while the operation of the opium continues, less sensible of every kind of irritation, whether proceeding from an internal cause, or from acrimonious medicines, as cantharides, and the more active mercurials of which it is the best corrector. It relaxes the nerves; abating or removing cramps or spasms, even those of the most violent kind; and increasing paralytic disorders and debilities of the nervous system. It incrassates thin serous humours in the fauces and adjacent parts; by which means, it proves frequently a speedy cure for simple catarrhs and tickling coughs; but in phthical and peripneumonic cases dangerously obstructs expectoration, unless this effect be provided against by suitable additions, as ammoniacum and squills. It produces a fullness and distension of the whole habit; and thus exasperates inflammations both internal, and external, and all plethoric symptoms. It promotes perspiration and sweat; but restrains all other evacuations, unless when they proceed from relaxation and insensibility of the parts, as the colliquative diarrhoea in the advanced state of hectic fevers. It promotes labour-pains, and delivery more effectually than the medicines of the stimulating kind usually recommended for that purpose; partly perhaps by increasing plentitude, and partly by relaxing the solids, or taking off spasmodic strictures. And indeed all the preceding effects are perhaps consequences of one general power, being nearly allied to those which natural sleep produces.

Willis, Sylvius, and Muller, look on opium as a coagulating poison, which fixes the spirits in the nerves. Wepfer and Piccirini, on the contrary, maintain it to be a hot dissolving poison, which subtilises the blood, exalts and reduces it to vapours, which bloat up the arteries; and the bloated arteries, compressing the veins and nerves, shut up the passage of the spirits.

OPOSSUM, in the system of Mammalia, a species of the Genus *Didelphis*. For description of the Genus, see *Didelphis*. For representation of the several species, see Plate VI. Order 3. Genus 17. Species, 1, 3, 6, 7, 8 and 9.

OPTATIVE, in Grammar, the third mood in the conjugation of verbs, serving to express an ardent desire or wish for any thing. Instead of a particular mood, or a particular set of inflections to express this desire, the English, Latins, &c. express it by an adverb of wishing prefixed to it. The Latins by *utinam*; the French by *plût à Dieu*; and the English by *would to God*. &c. See the System, Part I. Chap. I. Sect. I.

OPTIC Nerves, the second pair of nerves, springing from the crura of the medulla oblongata, and passing thence to the eye. See the System of Anatomy, Part VI. Sect. II. and Plate XI. Fig. 10. Letters a, a.

OPTICS, *optica*, is properly the science of direct vision.

SYSTEM

SYSTEM OF OPTICS.

OPTICS is a science which explains the properties of light, the nature of vision, and whatever relates to the sight.— In this, as well as other sciences, the ancient philosophers, though they pretended to search out the causes of natural things, pursued no other method than forming hypothetical conjectures without any rational foundation. And they endeavoured to defend their hypotheses, by plausible arguments of wit, and the figures of logic; flattering themselves, that thereby they had fully established them, and given a true account of natural causes and effects beyond the possibility of opposition.

But the moderns found it necessary to pursue another method. They saw clearly that the nature of things could never be known without careful observation and experience, they therefore set about to make all the possible experiments upon every subject that became the object of their enquiry. By these means they discovered what causes produced such and such effects, what causes and effects were necessarily linked together, and what relation and proportion they bore to each other.

Proceeding in this manner, the sagacious Newton, found out the nature of light, analysed it, and dissolved it into its constituent particles, which before were undiscovered by mankind. He has shewn, that light consists of particles of different colours and different degrees of refrangibility; and that the colour of each ray is permanent and lasting; and its degree of refrangibility invariable: that its particular colour can never be changed by any refraction or reflection. But in this, as in almost every subject he handled, he opened a new field, for the old philosophers were all of opinion, that light had no difference or variety of its constituent parts, but was in its own nature simple and uniform; and that colours were nothing but modifications of the light, or dilations of the rays, caused by reflections and refractions; whereas they depend upon a real separation of the heterogeneous rays. And optic writers were universally of opinion, that the reflection of light was caused by the particles thereof striking against the solid parts of bodies, into which they could not enter, and thence repelled back, like other reflected bodies. But Sir Isaac Newton amply proved, that they are driven back and reflected before they touch the body; and that by some inherent power in the reflecting body, which acts at a small distance from its surface, in lines perpendicular thereto.

Who could ever have thought, that the opacity of bodies depended on their porosity; and yet the same great philosopher has shewn, that their opacity arises from the multiplicity of reflections within the pores of bodies, when the particles are of a different size. And the same bodies become transparent, when their pores are filled with a medium of the same density as the particles of the body.

It is past dispute, that vision is caused by the rays of light entering into the eye; and painting the image of the object upon the retina at the bottom of the eye. When these rays pass through the same medium, continued between the object and the eye, they come from every part of the object to the eye in right lines; and this is direct vision. When they come not directly from the object to the eye, but fall upon some polished body, and are reflected from thence to the eye, in which they form the image of that object; then this sort of vision is called reflex vision. Here the eye properly sees the image caused by reflection, and not the object itself. A body must be truly polished to give a perfect image by reflection; for a rough uneven surface scatters the rays, that they make no image, or a very deformed one. If the rays passing from the object to the eye, go through different mediums, as air, water, glass, &c. then the rays will be refracted at entering a different medium, and come to the eye in other right lines, of different direction from the former; and this is called refracted vision. So that there are three different cases of vision, whereby objects may be seen; and these make three distinct parts of the science of Optics; of which the first is the most simple, and the last the most complex.

As vision is the most useful, as well as the most delightful sense we have; so the science of optics which teaches the improvement and perfection of this sense; must be the most valuable of any, as it not only explains the manner of vision, but from the same principles teaches how to supply a proper help for bad eyes, and to remedy the several defects of our sight, by the help of proper instruments, contrived according to the rules of this art.

PART I. DIRECT VISION.

SECT. I. DEFINITIONS.

1. A *Ray of light*, is an extremely small part of it, moving in a right line, or otherwise.
2. A *Beam of light* is a sensible part of it, consisting of a great number of rays.
3. A *Pencil of rays*, is a portion of light, of a conical form, proceeding from a point, or else tending to a point.
4. *Parallel Rays*, are such as run in parallel directions; converging rays, are those that tend to a point; diverging rays, are such as proceed from a point.
5. A *Medium*, is whatever the rays of light pass through, as water, oil, glass, air, or any transparent body; and even a vacuum.
6. *Reflection*, is when a ray of light flies off from the surface it falls upon, without entering into it.

7. *Refraction*, is the bending or breaking of a ray of light, when it goes out of one medium into another.

8. The *Angle of Incidence*, is the angle made by the incident ray, and the perpendicular to that point of the surface on which the ray falls.

9. The *Angle of Reflection*, is the angle comprehended between the reflected ray, and the perpendicular on that point of the surface, on which it falls.

10. The *Angle of Refraction*, is the angle which the refracted ray makes with the perpendicular to the refracting surface, at the point of incidence. And the refracted angle, is that contained between the incident and refracted rays.

11. The *Focus*, is a point in which all the reflected or refracted rays meet together. The point from which the rays seem to diverge, is called the virtual focus. The point to which parallel rays are reflected or refracted is the principal focus.

12. The *focal Distance*, is the distance of the focus from the reflecting or refracting surface. This generally relates to the principal focus.

13. *Conjugate Foci*, are two such points, that either of them being the radiant point, the other will be the focus.

14. A *Lens* is a solid piece of glass of which the two sides are segments of spheres, and polished.

15. A *Speculum or Mirror*, is any polished surface which reflects the rays of light.

SECT. II. AN EXPLANATION OF THE NATURE AND CONSTRUCTION OF THE EYE. (See Plate II. Fig. 1.)

ABCE is the eye, its figure spherical; by reason of which, it is easily moved any way in its socket. The fore part at A is more convex than the rest. It is contained in three membranes, the outermost is the *sclerotica*; the second the *tunica choroides*; the fore part of it is called the *iris*, which consists of many fibres like so many radii. The third or innermost is called the *retina*, which is nothing but the optic nerve, spread over the bottom of the eye. In these are contained the three humours of the eye; the first is HAI, called the *aqueous* humour, which is a thin liquor like water. The second is FG the *crystalline*, in the form of a lens, more convex behind towards C. Adjoining to this is the third KL, called the *vitreous* humour. The crystalline is more dense than the vitreous, and the vitreous more dense than the aqueous humour, and altogether make a compound lens, which refracts the rays of light, issuing from an object PR, to the bottom of the eye, and there paints its image *pr* in the focus upon the retina, inverted. The figure of the aqueous humour is a meniscus, and so is that of the vitreous. The fore part of the sclerotica is called the *cornea*, and that part adjoining to it, is called the *white* of the eye. Within the cornea is a coat called the *uvea*; in the middle of this is a hole O, called the *pupil*, to let in the rays of light. And the pupil is contracted or dilated by several muscular fibres in the uvea or iris, according as more or less light falls on the eye, and that by an involuntary motion. D is the optic nerve going from the retina to the common sensorium in the brain, where these images are perceived. This is not in the middle of the eye, but lies nearer the side E, which is towards the nose. Round the edge of the crystalline FG, is a ring of fibres, by help of which the distance AC is made longer or shorter, in order to bring the image *pr* upon the retina, for distinct vision. And perhaps these fibres also make the crystalline more or less convex at the same time. This ring of fibres is called the *ligamentum ciliare*; and its back part is black, to stifle the rays that are reflected upon it. The eye is moved in the head by several muscles inserted in the sclerotica, so that it may be quickly directed to any object. If the image of an object does not fall upon the retina at *pr*, the vision will be confused. If it falls short, or nearer FG; then a concave lens that makes the rays more diverging will bring them to the retina. This is the case of purblind or short-sighted people, who are forced to look very near an object: or else they must use concave spectacles. If the rays do not unite till they get beyond the retina, as in most old people; then a convex lens of a due focus, held between the eye and object, will make them converge, and fall upon the retina. Therefore long-sighted people must use convex spectacles. Although the image is painted inverted in the eye, yet we judge it erect; because by custom and experience we always find it so. The diameters of images at the bottom of the eye; as *pr*, are proportional to the angles which the objects subtend at the eye, as POR; the same as in a lens; and are reciprocally as the distances of the same object viewed in different places. The eye is in reality no more than a camera obscura, for the rays of light flowing from all the points of an object, through the pupil of the eye, do by the refraction of the humours of the eye, paint the image thereof in the bottom of the eye. Just so it is in the camera obscura, where all the rays refracted by a lens in the window shut, or passing through a small hole in it, paint the image on the opposite wall.

The eye can only see a very small part of an object distinctly at once. For the collateral parts of the object are not represented distinctly in the eye; and therefore the eye is forced to turn itself successively to the several parts of the object it wants to view, that they may fall near the axis of the eye, where alone distinct vision is performed.

When

OPTICS.

When any point of an object is seen distinctly with both eyes, the axes of both eyes are directed to that point, and meet there. But if the axes of both eyes are not directed to the object, that object will appear double, because the pictures in the two eyes do not fall upon correspondent or similar parts of the retina.

Whatever light falls upon that part of the retina, where the optic nerve, D, springs, makes no impression; and therefore if the picture of an object falls thereon, it is not perceived, and so that object is invisible. This will appear by placing a small bright object before you, and looking at it with one eye, and moving your eye laterally towards the contrary side (towards the left, if it be the right eye) the object will disappear, and seem to be lost; and, moving it still further it will appear again. Now this place is not at the bottom of the eye, but nearer the nose in both of them; so that no rays, either parallel or diverging, that come from any object, can fall upon that place in both the eyes; wherefore any object we direct the eyes to, will always be visible, at least to one eye.

SECT. III. OF SUCH PROPERTIES OF LIGHT AS ARE DEDUCED FROM EXPERIMENTS.

PROP. I. *When the eye views many objects at great distances, it refers all their places to the surface of a sphere, whose centre is the eye itself.*

For as far as an eye can see distinctly in any one direction, so far it can see in any other direction, if not hindered by intermediate bodies; and this it can do quite round. Hence, when the objects we look at are at great distances, it is natural to suppose them at equal distances. For under equal circumstances, nothing appears to make one distance to be judged greater than another. Therefore we take the simplest way, and suppose them all equidistant, or consider them as so. Whence these distances being all equal or supposed equal, and all proceeding from one point, it is plain they are the radii of a spherical surface, whose centre is that point. That is, the eye places all these objects in the surface of a sphere, whose centre is the eye itself. Hence these inferences:

1. The eye is always placed in the centre of its own view.
2. Any portion of the heavens which falls under our view, appears as the portion of the concave surface of a sphere.

PROP. II. *Such rays as enter the eye perpendicularly, have the greatest power to cause distinct vision.*

This is matter of observation; and it is plain that rays which are oblique have less force to produce their effects; and may be so oblique as to produce no sensible effect at all. Therefore, those rays that are most direct, are most efficacious in causing vision.

PROP. III. *An object appears greater or less, according as it is seen under a greater or lesser angle.*

Let ACa (Plate II. fig. 2.) be the axis of the eye; AB, DE two equal objects. To the eye at C, draw BCB, and ECc. Then the object BA appears under the angle BCA, or *bca*, and ED under the angle ECD, or *cCa*. But *cCa* is greater than *bCa*; and *ac* greater than *ab*. But *ac ab*, are the appearances or pictures of the objects DE, AB, upon the retina of the eye. Therefore the former appears greater than the latter. Hence,

1. The distance between two objects A and B, appears to be greater, as the distance of the spectator is less—For at the distance CD, the distance of the object appears under the angle ECD or *cCa*. And at the distance AC, it appears under the angle BCA, or *bCa*.

2. The apparent linear magnitude of an object AB, is reciprocally as the distance CA—for AB appears no greater than DF. But DF : DE or AB :: CD : CA. That is, the apparent magnitude of AB : apparent magnitude of DE :: CD : CA.

3. The superficial magnitude of an object is reciprocally as the square of the distance.—For the apparent heights will be reciprocally as the distance. And for the same reason the apparent breadths will also be reciprocally as the distance. Therefore the apparent surface compounded of these, will be reciprocally as the square of the distance.

PROP. IV. *An object appears situated in that place, from which the rays lost of all diverge, in coming to the spectator's eye.*

For an object always appears to be situated in that place from which the rays diverge, and come directly to the eye. If the rays are brought there by reflection or refraction, they make the same picture in the bottom of the eye as when they come directly from that place. And all vision being performed by the pictures upon the retina; when these are alike, we must judge the situation of the object to be alike.

PROP. V. *From every point of a luminous object, the rays of light diverge and flow every where in right lines, through the same medium.*

For if the rays do not flow from every part of the object, such parts as have none flowing from them cannot be visible. And it flows in all manner of directions, because, in any situation of the eye, the same part of the object appears and may be seen; and being visible in all situations, the light must flow in all directions. And it must flow in right lines in the same medium, for no reason can be given why it should deviate more to one side than another.

Experiments likewise confirm that it moves in right lines. Hence these inferences:

1. No rays of light are naturally converging; but always diverge.
2. Rays that shew things far distant, fall upon the eye parallel. And to shew things near hand, they diverge from a point; which to cause distinct vision, ought to have a proper distance, as 6, 8, 12 inches, &c. or as near as the eye will permit.

PROP. VI. *The density of rays flowing from an object, or any part of an object, is reciprocally as the square of the distance.*

Let the rays flow from A, (Plate 2. fig. 3.) and fall upon the plane BC; then taking the plane BC away, let the same light fall on any other plane DE, which is done by producing the lines AB, AC, to D and E. Then the area of the surface BC, is to the area of the surface DE; as BC² to DE²; or as AB² to AD². Let *s* be any small place, *l* the quantity of light contained in DAE.

Then BC² : *s* :: l : $\frac{l}{BC^2}$ = the number of rays on the space *s*, at the distance AB. And DE² : *s* :: l : $\frac{l}{DE^2}$ = number of rays on the space *s*, at the distance AD. And the density of light being as the number of rays; it will be, density of light at B : density of light at D :: $\frac{l}{BC^2}$:: $\frac{l}{DE^2}$:: DE² : BC² :: AD² : AB².

- Hence, 1. The quantity or intensity of light, flowing from a luminous object, is reciprocally as the square of the distance.
2. The brightness of an object, is the same at all distances from the eye; if none of the rays be prevented.—For the brightness is the same, when the same quantity of light falls upon the same quantity of the retina, in the eye; or when the density of the light on the retina is the same. But the density of light falling on the pupil, or the quantity of light falling on it, is reciprocally as the square of the distance. And by (Prop. III. Cor. 3.) the apparent magnitude of the object is reciprocally as the square of the distance. Therefore the quantity of light on the pupil, is as the apparent magnitude of the object, that is, as the space taken up on the retina; and hence the quantity of light being as the space taken up, its density is given; and therefore the brightness is given, or remains the same.

PROP. VII. *If a Room be made quite dark, and a small hole in the window shut be made. The objects out of the House being strongly illuminated; the rays proceeding from them, through the hole, will form their pictures on a paper, or on the opposite wall, in their proper colours; but in an inverted position.*

Let PQR, (fig. 4.) be the dark room; F, the hole in the window shut; ABCD an object without. The rays proceeding from the top A, in the right line AF, will form its image at *a* towards the bottom of the wall. And the rays proceeding from the bottom C, in the line CF, will paint its image at the top *c*. Likewise the rays proceeding from the left B, in the line BF, will make the image of B on the right hand at *b*. And those proceeding from the right hand D, in the line DF, will form its image on the left at *d*. Likewise all the rays proceeding from the line AC, will form its image *ac*. And those from BD will make its image *bd*. And the like for any other object exposed to the hole F. If the hole F be very small, the pictures will be very distinct, but hardly visible for want of light. And if the hole be large, the pictures will be brighter, but not distinct. To remedy these things, a broad convex lens of a proper focus, must be placed in the hole made wide enough to receive it.

PROP. VIII. *The light of the sun consists of rays differently refrangible.*

EXPER. I. To prove this by experiment, In a very dark chamber, make a round hole as F, (fig. 5.) about $\frac{1}{4}$ inch diameter, in the window shut EG. Place a glass prism ABC very near the hole, so that a beam of light SF coming in at the hole, may pass through the prism and be refracted upwards, towards the opposite wall of the chamber, and there form a coloured image of the sun PT. This prism is triangular at each end, 3 or 4 inches long, and is polished on the 3 sides AB, BC, CA. It is here placed parallel to the horizon, and its axis perpendicular to the beam SF. Turn the prism slowly about the axis, and you will see the refracted light on the wall, or the coloured image of the sun, first to descend, and then to ascend. Between the descent and ascent, when the image seems stationary, stop the prism and fix it there. For in that posture the refractions of the light on the two sides CB, CA, are equal to one another.

So likewise in other experiments, when you would have the refractions on both sides the prism to be equal, you must note the place on the wall where the image stands still between two contrary motions; and make it fast there. In this posture of the prism all the following experiments are to be made, unless some other posture is described. The prism remaining in this position, let the refracted light fall perpendicularly upon a sheet of white paper at the opposite wall of the chamber, and you will see the solar image formed on the paper to be oblong, and not oval, but terminated with two rectilinear and parallel sides, and two semi-circular ends: the sides bounded pretty distinctly, but the ends very confusedly and indistinctly, the light there decaying, and vanishing by degrees. Here the breadth answers to the sun's diameter; at 18 $\frac{1}{2}$ feet from the prism, the breadth diminished by $\frac{1}{4}$ inch; the diameter of the hole, is $\frac{1}{2}$ inch, and subtends an angle at the prism of half a degree, which is the sun's

OPTICS.

sun's apparent diameter. The length is $10\frac{1}{2}$ inches, when the refracting angle of the prism C is 64 degrees. With a less angle of the prism the length of the image will be less. If the prism be turned about its axis that way which makes the rays emerge more obliquely to the side AC, the image soon becomes an inch or two longer, or more. And if the prism be turned about the contrary way, so as to make the rays fall more obliquely on the side CB, the image becomes an inch or two shorter. And therefore in trying this experiment, one must be careful in placing the prism so that the refractions on both sides may be alike.

This experiment tried with a prism, whose refracting angle C is $62\frac{1}{2}$ degrees, the length of the image will be $9\frac{1}{2}$ or 10 inches, at the same distance. The magnitude of the hole in the window shut, the different thickness of the prism, where the rays pass through, the different inclinations of the prism to the horizon, (or different heights of the sun), make no sensible changes in the length of the image. Neither does the different matter of the prism make any; for in a prism made of plates of glass and water within, there is the same result. Also the rays always go in right lines from the prism to the image. And therefore at their going out of the prism, have all that inclination to one another, which causes the length of the image; that is, the inclination of $2\frac{1}{2}$ degrees or more. From all which it is plain, the rays falling on P are more refrangible than those falling on T. For if the rays were all alike refrangible, the image PT would be a circle, whose length is equal to its breadth; which is easily proved thus: Let SKHP be a ray coming from the lower part of the sun to the higher part of the image, and refracted by the prism at K and H; SLIT a ray which comes from the higher part of the sun, to the lower part of the image, and is refracted at L and I. Suppose the refraction on both sides the prism, are equal; we have, refraction at K = refraction at I, and refraction at H = refraction at L. Then by addition, the refractions at K and H = refractions at I and L. And therefore the two rays being equally refracted, have the same inclination to one another after refractions as before; that is, half a degree, equal to the sun's apparent diameter. So then PT would subtend an angle at the prism of half a degree, and therefore would be equal to the breadth, and consequently the image would be round. But instead of that it is five times longer than it is broad.

Likewise the image PT is coloured: for from T to P it has these different colours, in this order, red, orange, yellow, green, blue, purple, violet, at the places, r, o, y, g, b, p, v, respectively. So that the most refracted part at P is violet, and the least refracted at T is red. And the intermediate part, all the other colours.

EXP. 2. When a beam of light is let in at the hole F, of the window shut; hold the prism in such a position that its axis may be perpendicular to the beam. Then look through the prism to the hole, and turning the prism backward and forward, to find when the image is stationary, there stop the prism, the refraction on both sides being then equal. Then looking through it, at the hole; the length of the image will appear to be many times greater than the breadth. The most refracted part being violet; and the least refracted, red. The middle parts blue, green, yellow in order. And if the prism be removed out of the sun-beam, and then looking through it at the hole, you will have the same appearance. Now if all the rays were refracted alike, the hole would appear round when refracted through the prism. So that at equal incidences there is a considerable inequality of refraction.

EXP. 3. To try what is the effect of refracting the rays a second time. Things being ordered as in the first experiment, place a second prism close by the first in a cross position as DH, (fig. 6), that it may again refract the beam which comes through the first prism. The first prism refracts it upwards; and the second, sideways. By the first prism alone the beam is refracted to PT, and q is the image made by the refraction of the two cross prisms together. Then it will appear by the refraction of the second prism, that the breadth of the image is not increased, but the upper part P suffers a greater refraction in both prisms; and the lower part T, a less refraction in both prisms: and that without any dilatation of the image in breadth. Likewise as before, the upper part q appears violet; and the lower part r, red; and the rest as before. So that there is no dilatation or splitting of rays. And if a third and even a fourth prism be placed in the same manner after the second, the result will be the same; and the most refrangible rays will be most refracted, as before; and the least, the least refracted, whilst their colours remain unchanged.

Hence, 1. Every ray of light has a peculiar degree of refrangibility which cannot be changed by any reflexions or refractions; but remains constantly and invariably the same.

2. The confused vision of any object seen through a refracting body or medium, arises from the different refractions of the light.—For different rays flowing from the same point of an object, will be refracted to different points on the retina at the bottom of the eye.

3. The light reflected or emitted from all bodies, consists of rays differently refrangible.—For the light reflected from all bodies on the earth, is the sun's light. And besides, if one looks at any object through a prism, that object will appear tinged with different colours.

4. Hence also the simple primary colours are seven; red, orange, yellow, green, blue, purple, violet. The red being least refracted,

and so in order to the violet, which is most. And the spaces taken up by these, are not equal; the orange and purple being little more than half each of the rest, which are nearly equal.—This is known by measuring the parts of the image PT, (fig. 5.)

5. Objects seen through glasses in purified or homogeneal light will appear distinct; but very confused in heterogeneous or common light.

SCHOL. Sir J. Newton, by accurately measuring the spaces, that the several colours take up, found them as follows:

red, orange, yellow, green, blue, indigo, violet.

$\frac{1}{10}, \frac{2}{10}, \frac{3}{10}, \frac{4}{10}, \frac{5}{10}, \frac{6}{10}, \frac{7}{10}$
Where the whole length of the image is 1.

PROP. IX. Rays of light which differ in colours differ also in degrees of refrangibility.

EXPER. Take an oblong piece of paper as DGI, (fig. 7.) draw a line cross it in the middle, to divide it into two equal parts. Paint one end DG with blue, the other GI with red, as strong as you can. Lay it flat where there is light enough; look at it through a glass prism, held parallel to it, and to the horizon; then if the refracting angle of the prism be upwards, so that the paper may seem to be lifted upwards by refraction, the blue half FO will be lifted higher by refraction, than the red half OK. But if the refracting angle of the prism be turned downwards, so that the paper may seem to be carried lower by refraction, its blue half will be carried lower than the red half. Therefore the light from the blue is more refracted, and consequently is more refrangible, than the light from the red.

Hence 1. All light naturally consists of heterogeneous rays, which exhibit different colours.

2. Every sort of homogeneal ray produces its proper colour, according to its degree of refrangibility. And such colour cannot be changed by any reflexions or refractions. Also those rays that agree in colour are of the same degree of refrangibility.

3. There are as many simple colours as there are degrees of refrangibility, and therefore an infinite number.

For though in Exp. 1. Prop. VIII. there are only seven simple colours mentioned; yet each of them consists of an infinite number of degrees, and therefore are infinitely various.

4. If the sun's light consisted but of one sort of rays, there would be but one colour in the whole world, for all things would be of one colour. Nor would it be possible to produce any new colour by reflexion or refraction. And of consequence the variety of colours depends upon the composition of light.

PROP. X. Whiteness, or the Sun's light is compounded of all the Primary colours mixed in a due Proportion.

EXPER. Let a beam of light be refracted by a prism, as in Exper. 1. Prop. VIII. and made to form the image P on a piece of paper (fig. 5.) Then let the paper be taken away, and a lens held in the refracted rays so as they may fall upon it, and it will cause the coloured light which diverged from the prism to converge, and meet again at its focus. If you hold a paper behind the lens, the solar image will appear upon it intensely coloured; and by receding from the lens, those colours will come more and more towards one another; and by mixing together, will more and more dilute one another continually; till at length the paper comes to the focus, where by a perfect mixture, all the colours will wholly vanish, and be converted into whiteness; the whole light appearing now upon the paper, like a little white circle. And afterwards by moving farther from the lens, the rays which converged and met at the focus, will now cross one another there, and diverge from thence, and thereby make the colours to appear again, but in a contrary order, the red being now above, and the violet below. Here then the sun beam SE, which at first was white, is by the refraction of the prism ABC resolved into its original colours; these colours, by the refraction of the lens, are again intimately mixt, and reduced to their original whiteness.

Now it is evident this whiteness is made up of all the colours of the image. For if any of the colours be stoppt at the lens, the whiteness will cease, and degenerate into that colour which is made by the composition of the remaining colours. And if the intercepted colour be then let pass, and fall upon that compound colour, it will immediately restore its whiteness by mixing with them. Thus if the blue rays be intercepted, the rest will appear reddish, and then letting the blue pass, the whiteness is restored. And if the red be stoppt, the rest will appear bluish; and letting the red pass, the whiteness is again restored.

And in making this white, the several rays do not suffer any change by acting upon one another. For if the paper be held beyond the focus, and the red colour be stoppt, and then let pass again, the violet colour on the paper suffers no change. Neither will the red be changed by stopping and letting pass the violet.

When the paper is held in the focus, and the white image there be viewed through a prism, you will have a coloured image like PT. And if any colour at the lens be stoppt, and let pass by turns, it will disappear and return as often; but the remaining colours will not suffer any change. One colour then depends on one sort of rays, and another colour on another sort.

Hence, 1. A mixture of colours may be made, which shall be

*

S

like

OPTICS.

like the colour of homogeneous light. But it will differ in this, that the parts of it will be differently refrangible.

Hence 1. All colours in the world are either the colour of homogeneous light; or compounded of them.

2. A body that reflects no colour is black.

3. Black is no colour, and white is all colours.

PROB. XI. *If any body be placed in simple or homogeneous light of any colour; it will appear of the same colour.*

EXPER. Suppose the beam of light SF (fig. 5.) to pass through the hole F, in the window shut, and being refracted by the prism ABC, to cast the image PT on the opposite wall, and to form all the original prismatic colours. Take a bit of paper, and hold in the red light, and it will appear red. Hold it in the orange, yellow, green, blue, &c. successively; and it will appear orange, yellow, green, blue, &c. successively.

Take a bit of coloured paper, and hold it in the red light, and it will appear red: also hold it in the orange, yellow, green, &c. and it will appear orange, yellow, green, &c. respectively. But it will appear more luminous when placed in the light of its own kind. The room must be dark in trying this experiment.

The colours of all bodies arise from hence, that some bodies reflect one sort of rays, others another sort of rays, more copiously than the rest. And they become coloured, by reflecting the light of their own colours more plentifully, and that of all other colours more sparingly. Therefore it is light only that gives colour to bodies; and they have naturally no colour in themselves; and a body may be made to be of any colour, by holding it in the light of that colour.

PROB. XII. *The colours of natural bodies depend upon the size and density of the compounding particles.*

EXPER. 1. Take two object glasses belonging to two long telescopes, one a plane convex, the other a double convex. Lay the plane side of one, as AEB upon the convex side of the other CED (fig. 8.) Then, looking perpendicularly upon them, you will see a black spot in the middle where they touch; and several concentric rings of colours about it, as Z, E, G, H, I, A, &c. These rings may be reckoned of several orders, by reason of the same colour coming over again. These orders are as follow, 1. Z, black, blue, white, yellow, red. 2. F, violet, blue, green, yellow, red. 3. G, purple, blue, green, yellow, red. 4. H, green, red. 5. I, greenish blue, red, &c. Which colours grow weaker and weaker from the centre; and also narrower and narrower.

But if the light be made to pass through the glasses to the eye, the spot in the middle will be white; and the orders of colours, going from the centre, quite contrary to the others. 1. White, yellowish red. 2. Black, violet, blue, white, yellow, red. 3. Violet, blue, green, yellow, red, &c. The black lines between the glasses, at, F, G, H, I, A, are distances in arithmetical progression, being the places where the same colour returns, by reflected light, as at the first trial.

Measuring the diameters of the rings in the brightest part, their squares are found to be in arithmetical progression of the odd numbers 1, 3, 5, 7, 9, 11, &c. And since one of the glasses is plane and the other spherical; their distances at these rings, that is, at Z, F, G, H, &c. must be in the same progression. Also measuring the diameters of the faint rings, in the middle between the bright ones; their squares, and consequently the distances of the glasses there, appear to be in the arithmetical progression of the even numbers, 2, 4, 6, 8, 10, 12, &c. And from the known radius of the lower glass, the diameter of any ring may be computed, and consequently the distance of the glasses in that place. Hence the distance of the glasses in the middle of the first dark ring is found to be $\frac{1}{8000}$ part of an inch. And half of it multiplied by 1, 3, 5, 7, &c. gives the distance of the glasses or the thickness of included air, at the most luminous parts of all the bright rings, $\frac{1}{16000}$, $\frac{1}{8000}$, $\frac{1}{5333}$, $\frac{1}{4000}$, $\frac{1}{3200}$, &c. and $\frac{1}{1600}$, $\frac{1}{1066}$, $\frac{1}{800}$, $\frac{1}{640}$, &c. the thickness at the darkest parts.

EXPER. 2. Wetting the objects with water: as the water crept in between them, the circular rings grew less. And by measuring their diameters, and from thence finding the distances of the glasses, these distances were found less than before in proportion as 3 to 4; that is, as the sines of refraction out of water into air.

EXPER. 3. Viewing these rings of colours in a dark room, in homogeneous light, they become more distinct. And trying all the prismatic colours successively, the red circles will appear to be bigger than the blue or violet. The distances of the glasses, at the red and violet circles, are as $14\frac{1}{2}$ to 9. These rings are not of various colours, but appear only of that prismatic colour, with which they are illuminated. And the light which falls on the deep spaces between the coloured rings is transmitted through the glasses without any variation of colour. From hence the origin of these rings is manifest; viz. That the air between the glasses, according to its various thickness, is disposed in some places to reflect, and in others to transmit the light of any one colour; and in the same place, to reflect that of one, where it transmits that of another. The diameter of the 6th circle made by the yellow was $\frac{1}{1600}$ of an inch.

EXPER. 4. Take very thin plates of isinglass, or Muscovy glass, that shew the colours; then by wetting these plates, the co-

lours remain the same as before, only they become more faint and languid, especially when wet on the under side. Therefore the thickness of the plate to produce any colour, depends only on the density of the plate, and not on the density of the inclosing medium. But the colours are more vivid as their densities are different.

EXPER. 5. Two object glasses being laid on one another as in Experiment 1. If a spectator looks obliquely at them, the rings of colours will be increased in bigness. Hence the colour of some plates will change by changing the position of the eye. From these experiments it is plain, that the colour of bodies depend upon the thickness and density of the particles that compose them.

Hence, 1. If the density or size of the particles in the surface of a body be changed: the colour is likewise changed.

2. When the thickness of the particles of a body is such, that one sort of light or colour is reflected; another light or other colours will be transmitted. And therefore the body will appear of the first colour. This appears by Exper. 1. where the transmitted light is different from the reflected light.

3. The thickness of a plate of air, between two glasses, which reflects a deep yellow; must be $\frac{1}{16000}$, or $\frac{1}{8000}$, or $\frac{1}{5333}$, &c. parts of an inch. And that of a plate of water between two glasses will be $\frac{1}{4}$ of it.

4. The thickness of a plate may be such, that it will reflect different colours.

5. The particles of bodies reflect rays of one colour, and transmit those of another. And this is the ground of all their colours.

6. The cause of reflection, is not the impinging of light on the solid parts of bodies. But it is by a certain power, uniformly diffused over the whole surface of the reflecting body.

7. Bodies reflect and refract light by one and the same power; For when light goes out of the glass into the air, very obliquely, if its incidence be made more oblique, it is totally reflected. Again, experience shews, that light is alternately reflected and transmitted, by thin plates of glass for many successions, according to the thickness of the glass. Likewise those bodies that have the greatest refracting power, reflect the greatest quantity of light.

PROP. XIII. *Every ray of light in its passage through any refracting surface, is put into a certain transient constitution or state, which in the progress of the ray returns at equal intervals and disposes the ray at every return, to be transmitted, and between the returns to be reflected by it.*

This is manifest by Exper. 1, 2, and 3. By these experiments it appears, that one and the same sort of rays at equal angles of incidence, on any thin transparent plate, is alternately reflected and transmitted, according as the plate increases in progression of the numbers 0, 1, 2, 3, 4, &c. so that at the thickness 1, 3, 5, 7, &c. the rays are reflected; and at the thicknesses 2, 4, 6, 8, &c. they are transmitted; and thereby make the rings of light. And this (by Exper. 4.) depend on both the surfaces of the glass. Hence,

1. The reason why the surfaces of bodies reflect part of the light falling on them, and transmit the rest, is because some rays at their incidence, are in fits of easy reflection, and others in fits of easy transmission; calling the returns of these dispositions of the rays, the fits of easy reflection or transmission.

2. Those surfaces which refract the rays most strongly in fits of easy refraction; do reflect them more strongly in fits of easy reflection.

3. When rays of a deep yellow pass perpendicular out of any medium into air; the interval of the fits of easy reflection are the $\frac{1}{8000}$ th part of an inch. And of the same length are the fits of easy transmission.

4. When a plate is thinner than $\frac{1}{8000}$ the rays are all transmitted.

5. The intervals of the fits are shortest in the most refrangible rays.

6. All bodies appear transparent, whose particles and pores are too small to cause any reflections.

7. The opacity of bodies arises from the multitude of reflections within them.

8. The constituent parts of bodies are the greatest whose colours are most dilute.

9. A body becomes transparent, by filling the pores of it with a fluid of the same density with itself. For all the parts being of equal density, there can be no refraction within it, and therefore the rays will go straight forward and pass through it.

PROP. XIV. *Bodies act upon light at small distances, by attraction and repulsion.*

EXPER. 1. Make a hole with a pin in a thin piece of lead; and placing it in the hole of a window shut, let a beam of the sun's light pass through it, into a dark room. Then will the shadows of hairs, threads, pins, straws, &c. be bigger than they would be, if the rays of light passed by them in right lines. And it is the same thing, whether the small body be encompassed with air or water, &c. The shadows of scratches in glass, and the veins in it, are broader than they ought to be.

Let X (fig. 9.) be a hair placed in the beam; ADG, BEH, KNQ, LOR, rays of light passing by the sides of it, bent at X, and falling upon the paper GQ, TI, VS, the direct light. The light passing nearest the hair, as at D and N, is the most bent; passing

OPTICS.

ing to G and Q, the farthest asunder; those that are further off, as at E and O, are less bent; and so on, to TI and VS. Therefore the force acting upon the light is strongest at the least distance, making the shadow GQ; and weaker at greater distances.

EXPER. 2. The shadow of all sorts of bodies are bordered with three parallel fringes of coloured light; the nearest to the shadow, the brightest; and the furthest, very faint. The order of the colours, reckoning from the innermost, are violet, blue, green, yellow, red. So by looking on the sun through a feather or black ribbon, held close to the eye, several fringes of colours will appear.

EXPER. 3. Let the sun shine through a small hole made by a pin in a plate of lead; and place a prism at the hole to refract the light, on the opposite wall. The shadows of all bodies held in the coloured light, will be bordered with fringes of the colour of that light in which they are held: in the red they will be red; in the blue, blue, &c. And the fringes made in the red light will be largest, those in the violet, least; the green ones of a middle size. When a hair is held in a white beam of the sun's light (Experim. 1 and 2) and casts a shadow, which is bordered by three fringes of coloured light; these colours arise from the various inflexions by which the rays are separated, and being separated, produce each its own colour. From these experiments it is obvious, that the rays of light are acted on by some force or other that turns them out of their direct course. And as this force bends the rays not into the shadow of the body that acts upon them, but from the shadow; in that respect it must be a repulsive force, and (by Exper. 1.) is strongest at the least distance.

INFER. 1. It is probable that the rays of lights in the points of contact with bodies, and extremely near it, are acted on by an attractive force. And at greater distances with a repulsive one. For if the rays were acted on in all cases and circumstances by a repulsive force, the light would be expelled at once out of the luminous body. But it is more probable, that these particles of light are kept in the body by some attractive force; till they be shaken off by the vibrating motion of the body, and thrown beyond the reach of attraction; the contrary power of repulsion then begins, and drives it away with amazing velocity.

2. This power which acts upon light is infinitely stronger than the force of gravity.—For the velocity of light being surprisngly great, and the small distance the active force extends to, makes the time of acting, small beyond all comprehension. And therefore in such an infinitely small time, the finite force of gravity would have no manner of effect.

3. But the force of repulsion acting on light, decreases very fast in regard to the distance; so that in a very small space it becomes nothing.

4. Bodies and light act mutually upon one another; bodies, upon light by emitting, reflecting, refracting, and inflecting it. And light upon bodies, by heating them, and putting their parts into motion.

5. Black bodies, grow hot sooner by light than any other bodies; and white bodies later. For the light falling on them is not reflected, but enters the bodies; and by being often reflected and refracted within it, excite a brisk motion among the internal parts. But white bodies reflect most of the light, and therefore, are but little affected by it.

PROP. XV. The motion of light is not instantaneous, but is performed in time; and spends about eight minutes in passing from the sun to the earth.

This is proved from the eclipses of Jupiter's satellites; for when the earth is between the sun and Jupiter, these eclipses happen about eight minutes sooner than they ought to do, by the rules of calculation. And when the earth is beyond the sun, a less distance to move over, from the satellites to the earth, in the first case, than in the second, by the diameter of the earth's orbit. And therefore the radius of the earth's orbit requires eight minutes of time for the light to pass through it.

Hence it appears that the rays of light are extremely small bodies, projected with incredible velocity from the luminous body.

PROP. XVI. If light enters into a dense medium, and in its motion, in that medium, a part of it be lost, so that only the part p . gets through the space a . Then the quantity of light which gets through the space na in the same continued medium, will be p^n .

I take it for granted, that if any quantity of light passes into a dense medium, and in moving through the space a loses any part, as $\frac{1}{9}$ thereof; if half the quantity of light enters it, it will lose $\frac{1}{18}$ of that half in the same space; or if a quarter of the light enters it, it will lose $\frac{1}{36}$ of that quarter, and so on. Therefore there will always be a certain part of the incident light, get through equal spaces.

Suppose then $\frac{8}{9}$ the light gets thro' the space a ; then $\frac{8}{9}$ of that, or $\frac{64}{81}$ of $\frac{8}{9}$ will get through the next space a , that is, $\frac{512}{6561}$ will get thro'

$2a$, and $\frac{8}{9}$ of that or $\frac{4096}{531441}$ will get through $3a$; and so on. There-

fore $\frac{8^n}{9^n}$ of the entering light will get through the space na . And instead of $\frac{8}{9}$ putting p , the quantity of light getting through the space na will be p^n .

Hence, 1. If $1-p$ be the light lost or destroyed in passing through the space or depth a ; $1-p^n$ will be the light lost in passing through the depth na .

2. The light transmitted at the depth ma , is to the light transmitted at the depth na , as p^m to p^n .

3. The light transmitted through any depth as a , is to the light transmitted through the depth na , as 1 to p^n-1 .

For the lights transmitted are as p to p^n , that is, as 1 to $\frac{p^n}{p}$ or p^n-1 ; where n may be whole or fractional.

4. The brightness of an object is nearly the same, at all distances of the eye from it.

5. In general at $\frac{1}{n}$ of the distance, n times the light comes into the eye, and the picture is n times as big, and the density the same as before, because n times the light is spread over n times the space.

PROP. XVII. The proportion of moon light to day light, or the light of the sun, at full moon, is as 1 to 96 thousand, nearly.

For the moon's radius is to the earth's radius as 1 to 3.65 ; and since the radius of the moon's orbit is 60 of the earth's radii; therefore the radius of the moon's orbit, or its distance from the earth is 60×3.65 or 219 of the moon's radii. Now suppose equal spaces at the earth and moon to be equally illuminated; and that the whole surface of the moon was thus equally illuminated, and the light reflected therefrom all around, so far as the surface of a sphere passing through the earth, described from the moon's centre; then all this light is spread upon this surface; and consequently its density will be less in the reciprocal proportions of these surfaces, or reciprocally as the squares of the diameters. That is, the density of the light at the moon (which is supposed the same with daylight) is to the density at the earth (reflected from the moon;) as the square of 219 to 1 . But since in reality, there is not so much light falls on the moon, being no more than what falls on her disk, and her disk being but half her hemisphere, the density of light at her surface, upon each hemisphere will be but half as much. Therefore it will be, as day-light, to moon-light; so is 47961 to $\frac{1}{2}$, or as 95922 to 1 , or in round numbers as 96000 to 1 . Hence,

1. Moon-light is to day-light, as half the square of the moon's radius, to the square of the moon's distance, when she is full. And in the quadratures, as $\frac{1}{2}$ the square of the moon's radius, to the square of the moon's distance.—After the same manner may be found the light of any other celestial body, compared with daylight; let it be Venus. Put d = sun's distance from the earth, v = Venus distance from the sun, a = her distance from the earth, r = her radius. Now if Venus and the earth were equally illuminated by the sun, her light to day-light would be as $\frac{1}{2} rr : aa$. But Venus being nearer the sun, is more enlightened in the ratio of

$\frac{dd}{vv}$ to 1 ; therefore her light is to day light : $\frac{1}{2} rr \times \frac{dd}{vv} : aa :: \frac{1}{2} rrrd : vva$. But since in her quadratures, $d = a$ nearly, therefore, Venus's light is to day-light; as $\frac{1}{2} rr$ to vv . And that is as 1 to 804.000000 , nearly.

2. The light of Venus in her quadratures, is to day-light, as 1 to 800 millions.—This is supposing the radius of Venus, to her distance from the sun, to be as 1 to 14200 .

3. The light of the moon is 8000 times as great as the light of Venus. Supposing both of them to reflect all the light that falls on them.

PART II.

CATOPTRICS, OR REFLECTED VISION.

DEFIN. Catoptrics is that part of optics which treats of the pictures of objects formed by light reflected from a mirror.

SECT. I. ELEMENTARY PROPOSITIONS.

PROP. I. All rays of light falling on a reflecting surface, in the same angle; are reflected in equal angles.

EXPER. Let F (fig. 10.) be a hole in the window shut, G a reflecting surface placed horizontally. Let a beam of light from the sun FG, come through the hole F, and fall upon the reflecting surface G, and then be reflected to H on the opposite wall; the figure of the reflected light at H will be circular like the hole F. And therefore there is no separation of the rays as in refraction. And no colours are brought by reflection. Also if the paper be held any way between G and H parallel to the wall at H; the image received upon the paper will always be similar to the image at H, and of a circular form. And therefore the rays that had the same incidence, will run parallel to one another after reflection; and consequently are reflected at equal angles. Indeed the beam FG grows wider as it is further from F, and GH grows bigger as it is further from G; but this is only owing to the apparent magnitude of the sun's diameter. For from any one point of the sun's disk, the rays which fall parallel on G, will be reflected parallel to H. Hence the separation of the rays of light by reflection, is trifling compared with that by refraction.

PROP. II. If a ray of light be reflected from a plain surface; the angle of reflection will be equal to the angle of incidence.

Let AB (fig. 11.) be the incident ray, CD the reflected one.

RS

OPTICS.

RS the reflecting surface, PQRS the infinitely thin space, within which the repulsive force of the body is contained, AB ∞ CD the progress of the ray. Draw an infinite number of lines parallel to PQ or RS, such as nt, oq . Then since the repulsive force begins at B, it will continually bend or inflect the ray, into the curve Bom, till it comes to its lowest point m , where it will be parallel to the reflecting surface. Afterwards it will recede from the plane SR, describing the curve mqC . And since the forces are equal at the equal distances o and q, n and t , &c. therefore the particle of the curve mq , will be equal and similar to the particle om , and qt to on . And for the same reason all the particles of the curve mqC will be equal and similar to the corresponding particles of the curve moB ; and therefore the whole mqC will be equal and similar to the whole moB . And consequently the angle at C and B will be equal; and the angle of reflection equal to the angle of incidence.

Hence, 1. If a ray of light be reflected from any point of a curve surface; the angle of reflection is equal to the angle of incidence.

2. The ray of incidence and reflection are both in a plane, perpendicular to the reflecting surface, in the point of incidence.

3. A ray of light falling perpendicular to any surface, is reflected back in the same perpendicular. But moving parallel to it, will continue so.

4. If the reflected ray at O, return back through OS, it will be reflected to R.

PROP. III. If rays proceeding from a radiant point R (fig. 12.) fall upon a reflecting plane surface PL; the focus of the reflected rays, will be at F, in the line RF perpendicular to the reflecting surface; and as far on the other side of it. That is $PF = PR$.

For since RPF is perpendicular to PL; let RS be any incident ray; and SO the reflected ray. Produce OS backward to F. Then (Prop. 2.) $\angle PSR = \angle LSO = PSF$. Therefore in the right angled triangles PSR, PSF; all the angles are respectively equal, and PS common; therefore RF equal PF. Therefore the reflected ray SO proceeds from F, in the perpendicular RF, so that $PF = PR$. And by the same reasoning, if RN be any other incident ray, its reflected ray NH will proceed from F. And consequently F is the virtual focus of the reflected rays, which therefore all diverge from F.

Hence, 1. The distance of the focus F from the eye at O, is equal to the incident and reflected rays taken together, that is $OF = OS + SR$.

2. Rays converging to F, and reflected by the plane PL, converge to R.

3. If rays proceeding from an object at R be reflected by the plane PL to an eye at O; the object will appear to be placed at F, the focus of the reflected rays, where they last diverged from.

PROP. IV. If rays proceeding from a radiant point R, (fig. 13 and 14.) fall upon any point S of a reflecting spherical surface VS, and F be the focus of the reflected rays; it will be, $SR : CR :: SF : CF$. C being the centre of the sphere.

For (fig. 13.) the angle of reflection CSF being equal to the angle of incidence CSR (Prop. III.); therefore the angle RSF is bisected, and consequently $SR : SF :: CR : CF$. And (fig. 14.) draw FA parallel to RS, and produce CS to B; and if FSD be the reflected ray, then the angle $FSA = BSD = (\text{Prop. II.}) BSR = SAF$; therefore $SF = AF$. Then by the similar triangles CRS and CFA, $SR : CR :: AF : CF$. From the above are deduced these inferences.

1. When the radiating point R, and the focus F, are both on one side of the reflecting surface, if the rays diverge from one, they converge to the other.

2. When the radiating point R, and focus F, are on different sides of the reflecting surface; if the rays diverge from one, they diverge from the other. But if they converge to one, they converge to the other, by reflection.

3. If R is at an infinite distance, then $SF = CF$.

4. If R is the radiant point; make the $\angle RSC = CSF$, or $RSB = BSD$, and draw SF, or DSF, and F is the focus of the reflected rays.

5. The focus of rays proceeding from any radiant point R; is in the line RCV, joining the point R and the centre. For taking $Vs = VS$, the focus is in the place where the rays meet, which are reflected from all points of the arch Sr. Let RS, R ∞ F, be two correspondent ones, then the angles SRF, ∞ RF, being equal, and also RSF and R ∞ F; therefore SF, ∞ F will meet some where in the line RCV, at F.

6. A small object placed in the centre, cannot be seen by reflection. Or the eye placed in the centre, can see nothing by reflection. For all the reflected rays go also to the centre.

PROP. V. If VA (fig. 15.) be a reflecting spherical surface, whose centre is C. And if a ray of light RA (or GA) parallel to CV, fall upon A, and be reflected to F. Draw the tangent AT; then will $TF = FC$.

For CAT being a right angle, and $\angle CAF$ being (by Prop. II.) = angle CAR; we shall have $CAT = \frac{RAF + FAG}{2}$, and CAF

$= \frac{RAF}{2}$ then by subtraction $FAT = \frac{FAG}{2} = TAG = \frac{1}{2}ATP$.

therefore $TF = AF = FC$, because $\angle CAF = CAR = ACF$.

Hence 1. FC, FA, FT, are all equal to one another.

2. The tangent AT bisects the angle FAG.

3. If $CQ = QV$, then Q is the focus of the rays falling on V, or the principal focus.

4. And QF (=half TV) is the space on which all the rays fall that come from the whole surface AV.

5. If AV (fig. 16.) be any curve, and a ray of light RA (or GA) be reflected into the line AH. If VL be drawn parallel to AR, and AL perpendicular to the curve at A. Then $AH = HL$. For produce AL to C, that AC may be the radius of curvature in A; draw CF parallel to VL, and produce AH to intersect it in F. Then F is the focus of the rays reflected by the circle, passing through A, and therefore of the portion of the curve at A that coincides with it. Wherefore (by the 1st inference) $CF = AF$, and consequently (by similar triangles) $LH = AH$.

6. When parallel rays fall on the surface of a sphere, those nearest the vertex, have their focus nearest the centre.

PROP. VI. If aVA (fig. 17. and 18.) be a small portion of a reflecting spherical surface, C its centre, V its vertex; R the radiant point, from or towards which the rays flow; F the focus after reflection at A. Then it will be $VR : VF :: CR : CF$, nearly.

For by (Prop. IV.) If A be the point of incidence, it is $AR : AF :: CR : CF$. But the arch VA being extremely small, $AR = VR$, and $AF = VF$, very near. Therefore $VR : VF :: CR : CF$.

The points R, F, are conjugate foci to one another; that is, if R be the radiant point, F will be the focus; or if F be the radiant point, R will be the focus. Where I use radiant points in a general sense, for the point, which the rays either diverge from, or converge to, before reflection.

PROP. VII. If a VA (fig. 19.) be a small portion of a reflecting spherical surface, whose centre is C, and V its vertex. And if parallel rays, or those from an infinite distance as RA or GA, fall upon it, and F be the focus of the reflected rays; then F is in the middle of the radius VC, or $VF = FC$.

For (by the last Prop.) $VR : CR :: VF : CF$. But because R is infinitely distant, $VR = CR$, therefore $VF = CF$.

Hence 1. Rays diverging from F, the middle point of the radius, or converging to F, and reflected by the spherical surface VA, will after reflection go parallel to one another.

2. A luminous body placed in F, the middle point of the radius, will cast a light to a great distance, by reflection from the concave surface.

3. The principal focus of a reflecting spherical surface, is in the middle point of the radius at F. And the principal focal distance FV, is half the radius.

PROP. VIII. Let Aa (fig. 20 and 21.) be a small part of a reflecting spherical surface; C the centre, V the vertex, P the principal focus, R the radiating point (or that which the rays diverge from, or converge to, before reflection). And if F be the focus after reflection, then will PR, PC or PV, and PF, be in continual proportion.

For (fig. 20.) since $VF - PF = PF + FC$, therefore $VF - FC = 2PF$. But (Prop. VI.) $VR : VF :: CR : CF$; by division $VR : VF :: VR - CR (VC) : VF - (2PF) :: 2VP : 2PF :: VP : PF$. And again, by division $VR : VF :: VR - VP (PR) : VF - PF (VP)$. Therefore $PR : VP :: VP : PF$.

And (fig. 21.) $VR : VF :: CR - VR (CV \text{ or } 2VP) : CF - VF (2PF) :: VP : PF$. And by addition, $VR : VF :: VR + FP (PR) : VF + PF (VP)$. Therefore $PR : VP :: VP : PF$.

Hence 1. F and R are conjugate foci to one another, and lie always the same way from P.

2. The rectangle of the distances of the radiant point, and of the focus, from the principal focus, is equal to $\frac{1}{4}$ the square of the radius of the sphere. $PR \times PF = \frac{1}{4} VC^2$.

3. The principal focal distance is equal to the rectangle of the distances, of the focus, and of the radiant point, from the vertex, divided by the sum or difference of these distances; according as F and R are on the same or different sides of V; that is, $VP = \frac{VR \times VF}{VR + VF}$.

4. If R be the radiant point, F its correspondent focus; or R and F, conjugate foci; the distance of that focus F from the principal focus P, or $PF = \frac{VF^2}{VR + VF}$; according as F and R are on the same or different sides of V.

SCHOL. The three last propositions lay the foundation of all that is practicable in Optics, so far as reflected light is concerned. For no curve is made use of to reflect the rays of light, but the sphere; as it is scarcely practicable to grind glasses accurately in the form of any other curve. In using spherical surfaces, a small segment only is to be taken; because the parts of the surface remote from the vertex, reflect the rays to different foci; which are so much further from the principal focus, as the reflecting part is further from the vertex. And therefore if a large segment was used, the rays from

O P T I C S.

from any single point of an object, could not be brought to a single point in the focus, which would be attended with a deal of confusion.

The following proposition gives a general rule for determining the foci of all glasses universally, whether convex or concave; and whether the rays diverge or converge, and from whatever distances, finite or infinite, they proceed.

PROP. IX. Let *Aa* (fig. 22. be a small portion of a reflecting spherical surface, *C* its centre, *R* the radiating point. To find *F* the focus of the rays after reflection.

Put the distance $VR=d$, radius of the sphere $CV=r$, and focal distance $VF=f$.

Then $f = \frac{dr}{2d+r}$, very near. Where, if the rays converge, or *AV* be concave, *d* or *r* will be negative.

For $CR = d + r$, and $CF = r - f$. And (by Prop. VI.) $VR:VF::CR:CF$; that is, $d:f::d+r:r-f$. Whence $dr-df=df+rf$, which being reduced, $f = \frac{dr}{2d+r}$.

Hence, 1. If *d* is infinite, or *R* is at an infinite distance, then *r* vanishes, and $f = \frac{1}{2}r$.

2. If *R* is on the concave side, *d* is negative, and $f = \frac{-dr}{-2d+r}$,

that is, $f = \frac{dr}{2d-r}$. And moreover, if *r* is infinite, as in a plane surface, $f = -d$.

3. If *r* is negative, or the reflecting surface concave towards *R*, then $f = \frac{-dr}{2-d-r}$, that is, $f = \frac{dr}{r-2d}$.

4. If *AV* is concave towards *R*, and *d* infinite, then *r* is negative, and $f = \frac{-dr}{2d}$, that is, $f = -\frac{1}{2}r$.

5. If it is a plane surface, then *r* is infinite, and $f = d$.

From this general solution it is plain, that when the focal distance comes out affirmative, it is to be taken right forward; but if negative, it must be taken backward from the vertex. Also from this proposition several other problems may be resolved. As if it be required to know what must be the radius of a sphere, to represent the given object *R* at the given focus *F*, we have $r = \frac{2df}{d-f}$ the radius of the sphere. From this equation, it is plain, that if *d* be greater than *f*, the reflector will be convex towards the object. But if *f* be greater than *d*, *r* will come out negative, and the reflector will be concave to the object. If *d* be equal to *f*, *r* comes out infinite, and in this case, the speculum must be a plane surface.

Again, if it be required to find the distance of an object *R* from the given speculum *AV*, to have the focus at the given place *F*, we shall have $d = \frac{rf}{r-2f}$, the distance from a convex speculum. But

if the speculum be concave to the object, then $d = \frac{rf}{r+2f}$.

Hence, in a convex speculum, if *r* be greater than $2f$, the object will be on the convex side. But if $2f$ be greater than *r*, it will be on the concave side. And if $r = 2f$, the distance of the object will be infinite; and *f* will be the focal distance of parallel rays. The principal focus of a reflecting spherical surface may also be found by experiments, as follow:

1. For a concave reflector. Hold it directly before the sun, and hold a bit of paper before it to receive the reflected light. Move this paper back and forward till the white spot of light be the least possible, and that is the focus.

2. For a convex reflector. Cover it with paper, having two pin-holes made in it on contrary sides. Then expose it to the sun beams, and hold another paper before it, having a hole made in it as big as to let the sun's rays pass through to the two pin-holes. Then you will see two white spots of reflected light on each side the hole. Move the paper back and forwards, till the distance of the spots be twice the distance of the holes in the cover, first marked upon the paper. Then the distance of the paper from the lens is the principal focal distance.

PROP. X. If rays flow from one focus, *R* (fig. 23.) of a spheroid or hyperboloid *BA*; they will be reflected by the curve surface into the other focus *F*.

For from the properties of the conic sections, the lines *AR*, *AF* drawn to the foci of an ellipsis, make equal angles with the curve; and therefore the angle of incidence is equal to the angle of reflection. And the same is true of the hyperbola; therefore if *RA* be the incident ray, *AF* will be the reflected one. Hence *F* is the real focus in the ellipsis, and only a virtual focus in the hyperbola.

PROP. XI. If rays *RA* (fig. 24) parallel to the axis of a paraboloid *BA*, be reflected by the surface thereof; they will all be reflected into *F*, the focus of it.

For from conic sections, the line *FA* drawn to the focus, and *RA* parallel to the axis, make equal angles with the curve at *A*. Therefore, if *RA* be the incident ray, *AF* will be the reflected one.

No. 120.

Hence, rays proceeding from the focus *F* will be reflected by the surface of the paraboloid, parallel to the axis.

PROP. XII. The image of a right line made by a reflecting plane surface, is also a right line.

Let *AB* (fig. 25) be a reflecting plane, *PR* a right line, *Q* the middle point of it. Draw *Pp*, *Qq*, *Rr*, perpendicular to the plane *AB*, cutting it in *D*, *I*, *L*. And make $Dp = DP$, $Iq = IQ$, and $Lr = LR$, then (Prop. III.) *p*, *q*, *r*, will be the foci of *P*, *Q*, *R*; and *pr* the image of *PR*. Whence the figure *DPQRL* is similar and equal to the figure *DpqrL*, by construction. And therefore, since *PQR* is a right line, *pqr* is also a right line.

Hence 1. The image of a plain figure, seen in a reflecting plain surface is also a plain figure, equal and similar to the figure itself.

2. The image of any object, made by an upright reflecting plane, has its parts in a contrary position, the left side being to the right, and the right to the left hand; the difference being the same as the seal, and its print on the wax. But in a horizontal reflector, the object will appear upside down; the parts lying to either hand remaining the same as in the object.

PROP. XIII. If *AV* a (fig. 26 and 27) be a spherical reflector, the object *PQR* an arch of a circle, having the same centre *C*, its image *pqr*, by reflexion, will also be an arch of a circle, having the same centre *C*. And its image will be direct or inverted, according as it is on the same or different side of the centre *C*, with the object.

Here *p* is the focus of *P*, *q* of *Q*, and *r* of *R*. Let *e*, *f*, *g*, be the principal foci of the points *A*, *V*, *a* of the reflecting surface. Then (by Prop. VII.) we have $fQ:fC:fV:fq$, in continual proportion, and $gR:gC:gr$; also $eP:eC:ep$, also in continual proportion. But the two first terms are the same in all, and therefore the last; that is, $fQ = gr = ep$. And since $fC = gC = eC$, the sums or remainders will be equal, $qC = rC = pC$, therefore *rpq* is the arch of a circle whose centre is *C*. And since the rays cross at the centre *C*, if the image be on the same side of *C* as the object, it will be in the same position; but on different sides, in a different position. Hence,

1. The length of the object *PR* is to the length of the image *pr*; as *CP*, the object's distance from the centre, is to *CP*, the distance of the image from the centre.

2. On the contrary, if *pqr* be a circular object, its image *PQR* will also be a circular arch concentric with the object.

3. The image of a spherical surface, seen by reflexion in a spherical reflector parallel to it, will appear a spherical surface, also parallel to it.

4. If a right line be placed directly before a concave reflector, its image will appear concave; but in a convex reflector, the image will appear convex.

PROP. XIV. The object and its image, subtend equal angles at the vertex of the reflector; that is, $PVR = pVr$.

Let *PR* (fig. 28 and 29), be an object, *pr* its image. Through the centre *C*, draw *QCV* perp. to *PR*. Draw *VP*, *VR*, *Vp*, *Vr*, and *PpA*, *Rra*, passing through *C*. Then (Prop. VI.) $VQ:Vq::QC:qC::(\text{similar triangles}) PQ:pq$. And since the angles at *Q* and *q* are right, the angle $PVQ = pVq$. In like manner $RVQ = rVq$; whence $PVR = pVr$.

Hence the object and its image are equal to one another, where they meet together.

PROP. XV. The linear magnitude or diameter of the object *PR*, (fig. 28 and 29) is to the magnitude of the image *pr*; as the distance of the object from the vertex of the glass *VQ*, to the distance of the image from it *Vq*.

For (by last Prop.) the angles *PVR*, and *pVr* being equal, and the triangles *PVR* and *pVr* similar, we have $PR:pr::VQ:Vq$.

Therefore, 1. The diameters or linear magnitudes of the object and image are as their distances from the centre of the reflector. $PR:pr::CQ:Cq$. For $PR:pr::VQ:Vq::(\text{by Prop. VI.}) CQ:Cq$.

2. If *f* be the principal focus, then the diameter or linear magnitude of the object, so that of the image, is as the principal focal distance to the distance of the image from the principal focus; or as the distance of the object from the principal focus to the principal focal distance.

For we had $PR:pr::VQ:Vq::CQ:Cq::VQ-CQ:(\text{or } CQ-VQ):Vq-Cq(\text{or } Cq-Vq)::CV:2fq::fV:fq::fQ:fV$.

3. Hence also it follows, that a convex reflector lessens an object.

4. Also a concave reflector lessens an object, when it is farther from the glass than the radius of the reflector.

5. But a concave reflector magnifies an object, when it is nearer to it than the radius of the reflector; and then only.

6. The image *pr* is always terminated at *p*, by the extreme ray *PA*, which passes through the centre *C* of the reflector. And if the object be an immense distance, it is terminated by the radius *CA*, drawn parallel to the extreme ray *PV*, at the vertex. For when the object is infinitely distant, *PV* and *PCA* are parallel.

*

T

PROP.

OPTICS.

PROP. XVI. *As the distance of the object from the principal focus of a reflector, is to its distance from the reflector; so is the principal focal distance, to the distance of the image from the reflector; that is, $fQ : VQ :: fC : Vq$. See fig. 28 & 29.*

For f being the principal focus, we have (by Prop. XV.) $VQ : Vq :: PR : pr$. And (by Cor. 2. Prop. XV.) $PR : pr :: fQ : fV$; therefore $fQ : fV$ or $fC : VQ : Vq$.

Hence, If the object and image be equidistant from the reflector, they will coincide either in the centre or vertex of the reflector, and become equal.

For if $VQ = Vq$, then $fQ = fC$ or fV , and Q falls upon C , or else upon V ; and then $pr = PR$.

PROP. XVII. *In a convex speculum, the image always appears erect and on the other side of the glass, as in a plain speculum. And so it does in a concave, when the object is between the glass and the principal focus. But in a concave speculum, when the object is further from it than the principal focus, the image is on the same side of the glass, and inverted in every respect.*

For fig. 29, let RP be placed where it will before the convex AA ; its image rp will be on the contrary side. And if rp be an object, its image RP will be on the contrary side, till rp comes to f , and then RP will be infinitely distant. But when it is between f and C (fig. 28.) as at q , the image RP is on the same side. Or if RP be the object, then the image rp is on the same side, but inverted; because the object and image are on different sides of the centre, where the rays cross. And if the object PR be moved to an infinite distance, the image pr will be moved to f , still on the same side of the glass. Hence,

1. If the centre is between the object and image, they either both approach to it, or both fly from it. And if the speculum be between them, they either both approach the speculum, or both fly from it. For (fig. 28.) when C is between Q and q , the greater CQ is, the greater is Cq . And (fig. 29.) when V is between them, the greater VQ is, the greater is Vq .

2. As an object moves from the glass on the convex side to an infinite distance, its image moves from the glass to the principal focus. And as the object moves from an infinite distance on the concave side, to the centre, the image moves from the principal focus to the centre also, where they meet. And further, if the object moves from the centre to the principal focus; the image moves from the centre, the contrary way, to an infinite distance. And as the object moves from the principal focus to the vertex, the image moves from an infinite distance on the convex side to the vertex also, where they meet again. For (fig. 29.) whilst the object moves through VQ , the image moves through Vq to f . And (fig. 28.) whilst the object moves through QC , the image moves through fC . Also whilst the object moves through Cf , the image moves through CQ to an infinite distance; and (fig. 29.) whilst the object moves through fV , the image moves from an infinite distance through QV .

3. The image is upright or inverted, according as the image and object are on the same or different sides of the centre.

PROP. XVIII. *To see the image of an object made by any spherical speculum; the eye must be placed in the diverging rays, at a proper distance for distinct vision and facing the image.*

For to see the image, one must look at it as one would do at any visible object. And therefore, in order to be seen, the rays must diverge from it to the eye placed at a proper distance. Thus to see the image pr (fig. 28.) reflected from the concave speculum AA , the eye must be placed somewhere in the line qCQ . But if PR was the image (of the object pr), the eye must be placed beyond Q . Again, (fig. 29.) to see the image rq reflected by the convex speculum AA , the eye must be placed without the glass in the line VQ . But if rp is an object, and RP its image, then the eye must be placed in the line VC , on the concave side. The focus Q being only a virtual focus, to which the rays only tend but never reach. Hence,

1. If the eye be placed near the speculum, in the converging rays, before they reach the image; it will perceive the image (of the object) beyond the glass, at the same distance nearly as the object is before it, and of the same magnitude.

2. If an image be looked at, with both eyes placed very near it and in the diverging rays; (or else it cannot be seen at all); it will appear double. For the axes of the eyes cannot both be directed to an object extremely near, and the case is the same in all objects near hand, as well as this image.

PROP. XIX. *If an object rp (fig. 28.) be placed in the principal focus of a concave reflector; its apparent magnitude to the eye, at any place whatever, as O , will be invariably the same; and equal to the apparent magnitude to the naked eye, when seen from C the centre of the speculum.*

Here RP the image will be at an infinite distance. And (by Inference 1 and 3 Prop. VII. all the rays of the pencil RBV will be reflected parallel to one another, and to the axis AC passing through the centre of the speculum; and therefore the angle VOB , which is the apparent magnitude of the image to the eye at O , is equal to the angle VCA or VCr which is the apparent magnitude

of rq to an eye at C . And this is so, wherever O is, or the place of the eye.

PROP. XX. *The brightness of the image pr formed by the reflecting concave AB (fig. 28.) from the luminous object PR is as $\frac{AB^2}{Vq^2}$ or as the area of the lens directly, and the square of the distance of the image reciprocally.*

For if the brightness of the object be given, the quantity of light reflected from the speculum to the image, will be as the magnitude of the object and of the reflector directly, and the square of the distance reciprocally. Whence the light falling on the image is as $\frac{PR^2 \times AB^2}{QV^2}$; also the density of the light, or the brightness of

the image is as the quantity of light directly, and the area of the image reciprocally, or as $\frac{PR^2 \times AB^2}{QV^2 \times pr^2}$. But since PR , pr , are parallel, and (Prop. XIV.) the angle $PVR = pVr$, &c. $PR : pr :: QV : qV$, and $\frac{PR^2}{QV^2} = \frac{pr^2}{qV^2}$. Therefore the brightness of the image is as $\frac{pr^2 \times AB^2}{qV^2 \times pr^2}$ or $\frac{AB^2}{qV^2}$. Hence these Inferences.

1. If the brightness of the object be increased in any ratio, which call B ; the brightness of the image will then be as $\frac{AB^2}{qV^2}$.

2. In very remote objects, if f be the principal focal distance, then the brightness of the image will be as $\frac{AB^2}{f^2}$.

For then Vq becomes equal to f .

3. The brightness of the image increases as the area of the glass increases; but its distinctness decreases upon that account.

PROP. XXI. *If a concave speculum Aa (fig. 28.) be held directly to the rays of the sun; and any combustible body be held in the principal focus f , it will be fired by the heat thereof.*

For all the rays of the sun are reflected into the focus, forming there, by reflection, the image of the sun; which image must be of an intense heat, because all the rays that fall upon the speculum, are brought thither. And the broader the speculum is, the more rays are contained in that small space; and may be so increased by the breadth of the glass, as to burn or melt all sorts of bodies placed there, as is plain from numerous experiments.

1. The heat generated in the focus of the glass, is to the sun's direct heat; as the area of the glass, is to the area of the image in the focus. For the rays that fall upon the glass, are all brought into that space, where their density is reciprocally as the areas they are contained in.

2. The degrees of heat in different reflectors, are as the squares of the diameters directly, and the squares of the focal distances reciprocally. For the density of the rays in each, are in that proportion.

PROP. XXII. *If parallel rays, RA , CV , (fig. 30.) are reflected from a concave (or convex) spherical surface Aa , of a small height VP . Let F be the focus of the extreme ray AF , Q the principal focus. Then the aberration of the rays, in the length of the axis VC , is equal to half the height of the segment; $QF = \frac{1}{2}VP$, nearly.*

For draw the tangent AT . Then by the nature of the circle $CP : CV :: CV : CT$. And dividing, $CP : CV :: CV - CP (VP) : CT - CV (TV)$. But VP being very small, $CP = CV$ nearly, therefore $VP = VT$. But (Prop. V.) $TF = FC$, or $CF = \frac{1}{2}CT$. And (Prop. VII.) $QV = QC$, or $CQ = \frac{1}{2}CV$. Therefore $CF - CQ$ or $FQ = \frac{CT - CV}{2} = \frac{TV}{2} = \frac{VP}{2}$. But

(Inference 4. Prop. V.) QF is the space on which all the rays fall that come from the whole surface Aa , that is QF is the aberration of the rays in length; therefore $\frac{1}{2}VP$ is equal to that aberration.

Hence, 1. The aberration $QF = \frac{1}{2}TV$ exactly, or $\frac{AV^2}{4VC}$, nearly

2. The lateral aberrations at the principal focus is $= \frac{VA^3}{4VC}$, nearly

3. The radius of the sphere being given; the aberrations in length, are as the squares of the diameters; and the lateral aberrations, as the cubes of the diameters of the reflectors.

PART III.

DIOPTRICS, OR REFRACTED VISION.

DEFINITIONS.

1. *Dioptrics* is that part of Optics which treats of light refracted through different mediums, and the pictures of objects made by refraction.

2. A *Lens* is a solid transparent body as AB (fig. 31.) generally of glass, being of such a shape, that the sides of it are either flat, or the segments of spherical surfaces. Of these there are several sorts, as, 1. *Plane* on both sides. 2. *Plano convex*, being plain on one side and convex on the other. 3. *Plano concave*, or plain on one side

OPTICS.

side and concave on the other. 4. *Double convex*, being convex on both sides. 5. *Double concave*, being concave on both sides. 6. A *Meniscus*, being convex on one side, and concave on the other.
3. The *Axis* of a lens, is a right line perpendicular to both the surfaces, or passing through both their centres.
4. The *Vertex* is the point where the axis cuts the surface of the lens.

SECT. I. ELEMENTARY PROPOSITIONS.

PROP. I. If a ray of light AC (fig. 32.) pass into a refracting medium, the sine of incidence ACD, is to the sine of refraction ECF, in a constant ratio.

Let the ray BC falling obliquely on the refracting medium MS, be refracted in the line CN. And the ray ACI be refracted into the line CE. Draw AP perpendicular to MS, and make CH=CP, and CL=CM. And draw HIE and LN perpendicular to CS. And let the equal lines BC, AC, represent the equal motions of the rays B and A. Then supposing BC parallel or nearly coinciding with the refracting plane; let the motion AC be resolved into the two motions, AP, PC; AP being perpendicular, and PC parallel to the refracting surface. Now bodies act upon light by the forces of attraction and repulsion; and these forces are directed in lines perpendicular to the surface of the refracting body MS. Therefore the motions of the rays BC, PC, which are parallel to MS, suffer no alteration by the refraction of the medium. Consequently in the very same time that the rays A and B move to C, they would move to I and L without refraction, where CL=CB=CA=CI. But by the refraction of the medium, that from B goes to N, and that from A goes to E, in the perpendiculars LN, HE, because the parallel motion is the same as before. But (from the principles of Mechanics) the velocities of the rays A, B, which were equal before refraction, will also be equal after; and therefore CN=CE.

Now in the right angled triangle CLN, we have S. CLN (MC D):: S. CNL (NCF):: CN:CL::CE:CI:: (in the triangle CEI) S. CIH (ACD):: S. CEH (ECF). That is S. ACD the angle of incidence: S. ECF the angle of refraction:: rad: S. NCF, or in a given ratio, from which we gather these inferences.

1. If the refracted ray EC be turned directly back to the point of incidence; it will be refracted into the line CA, before described by the incident ray.

2. The angles of incidence and refraction lie both in one plane, which is perpendicular to the refracting surface at the point of incidence.

3. Heterogeneous rays of light have different degrees of refraction; but in any one considered by itself, the sine of incidence is in a given ratio to the sine of refraction.

4. If AC be the incident ray, and CE the refracted ray; and if AC produced cut the perpendicular HE in I. Then CE:CI:: sine of the angle of incidence: to the sine of the angle of refraction.

5. The velocity of light in the first medium ADC, is to its velocity in the second medium CFN; as the sine of the angle of refraction, to the sine of the angle of incidence.

6. If parallel rays pass out of one medium into another, they will also be parallel after refraction: the refracting surface being a plane.
PROP. II. If heterogeneous light be refracted out of glass into air, the sine of incidence, is to the sine of refraction of the least, and most refrangible rays; as 50 to 77 and 78.

This is proved by experiment thus; take a glass prism BCD, (fig. 33.) with a very acute angle C, and place it so that a ray of the sun AF coming through a small hole in the window shutter, near the prism, may fall perpendicularly upon the side DC, and be refracted by the opposite side at Y, the most refrangible rays to P, and the least refrangible to T. Then if EYG be perpendicular to the side CB, by measuring the angles AYE, TYG and PYG, the sines of these angles will become known.

For example, if the angle of the prism BCD be $31^{\circ} 36'$; then since the triangles CFY and CYE are both of them right angled, the angle BCD=FYE the angle of incidence at Y= $31^{\circ} 36'$, whose sine is .524. And the angles TYG and PYG will be $53^{\circ} 36'$, and $54^{\circ} 44'$; whose sines are .805 and .8165. But .524 and .805 and .8165 are nearly to one another as 50, 77 and 78.

Hence 1. The angle PYT, which the coloured image subtends, is about $1^{\circ} 8'$, or $1^{\circ} 9'$, subtracting the sun's diameter.

2. In the coloured image PT, the lengths of the several colours, red, orange, yellow, green, blue, purple, violet, are found to be $\frac{1}{10}$, $\frac{1}{10}$, $\frac{1}{10}$, $\frac{1}{10}$, $\frac{1}{10}$, $\frac{1}{10}$, $\frac{1}{10}$, it is easy to divide the angle PYT in that proportion; and then there will be had the sines of refraction at the confines of all the colours; that is, 77° , $77\frac{1}{2}^{\circ}$, $77\frac{1}{2}^{\circ}$, $77\frac{1}{2}^{\circ}$, $77\frac{1}{2}^{\circ}$, $77\frac{1}{2}^{\circ}$, $77\frac{1}{2}^{\circ}$, 78. For the image is divided after the manner of a musical cord, as Sir Isaac Newton has found. And in small arches, the differences of the sines are nearly as the differences of the arches.

3. If light pass out of glass into air, the sine of incidence, is to the sine of refraction of the mean rays, as 11 to 17, or as 20 to 31, which is a greater refraction than as 2 to 3. For the mean refrangible rays are those at the confines of the blue and green, or nearer the green, whose refraction is $77\frac{1}{2}^{\circ}$, or $77\frac{1}{2}^{\circ}$. By a like experiment, the sine of incidence and refraction of the least refrangible rays out of water into air is as 3 to 4, or as 81 to 108; and of the most refrangible, as 81 to 109.

PROP. III. If A, B, C, (fig. 34.) be three refracting mediums, contained between parallel surfaces; and if a ray of light DE passing through them be refracted at E and F, and pass through the third in direction FG. It will suffer the same refraction by passing through A, B, C, as if it went immediately out of A into C.

For let the medium C approach the medium A in direction FE, and the medium B grow thinner and thinner, till F fall upon E, and the medium B be vanished; yet this will make no difference in the position of the line FG. And therefore the refraction into the medium C will be the same whether the ray pass through B, or goes immediately from A to C, without coming into B at all. And the same likewise appears from experiments.

Hence 1. If there be never so many refracting mediums contained between parallel surfaces; the whole refraction of a ray is the same at last, in passing through all of them; as it would be in passing immediately out of the first into the last.

2. If several mediums A, B, C, terminated by parallel planes, be encompassed on all sides by some other medium; any ray RD moving out of this other medium, and passing through all the rest, will emerge parallel to itself, at coming into this other medium again; that is GS will be parallel to RD. For the refraction is the same as if all the mediums A, B, C, were away; and GS has the same direction as RD.

PROP. IV. If A, B, C, (fig. 35.) be three mediums, and the sines of incidence and refraction out of A into B, be a and b; and out of A into C, be a and c; then those out of B into C, will be b and c.

Let the mediums B and C be encompassed by the medium A; and let RD be a ray refracted at D, F, and G, and proceeding to K. Then (by Inference 2, Prop. 3) GK will be parallel to RD. At D, F, G, let fall the perpendiculars LDO, NFP, IGH. Then by reason of the parallels GK, RD, and GH, DL, the angle HGK=LDR. Whence $a = S.RDL$, $b = S.ODF = S.DFN = S.$ incidence of the ray DF, on the medium C. Also $a = S.HGK$, and consequently $c = S.FGI = S.GEP = S.$ refraction of the ray into the medium C. Therefore the sines of incidence and refraction out of B into C, are b and c.

EXAMP. Let A be air, B water, and C glass. And let the sines of incidence and refraction out of air into water be as 4 to 3; and out of air into glass as 17 to 11, or as 4 to $\frac{4 \times 11}{17}$; then $a = 4$,

$b = 3$, $c = \frac{4 \times 11}{17}$. Therefore the sine of incidence and refraction out of water into glass will be 3 and $\frac{4 \times 11}{17}$, or as 3×17 to 4×11 , or as 51 to 44.

Hence, If the sine of incidence and refraction out of B into C, be as b to c; and out of C into D as r to s. Then those out of B into D will be as br to cs.

For by this Proposition the sines of incidence and refraction out of C into B are as c and b; and out of C into D, as r to s, or as c to $\frac{cs}{r}$. Therefore those out of B into D, will be as b to $\frac{cs}{r}$, or as br to cs.

EXAMP. If the sines of incidence and refraction out of glass into air, be as 20 to 31; and out of air into water, as 4 to 3. Then the sines of incidence and refraction out of glass into water, will be as 20×4 to 31×3 , or as 80 to 93.

PROP. V. The forces of bodies to refract light, are nearly as their densities, excepting that unctuous and sulphureous bodies refract more than others of the same density.

By the laws of uniformly accelerated motion, if the body is given, the velocity is as the force and time; and the square of the velocity, as force $\times$ time $\times$ velocity; that is, as the force $\times$ space described, and that is (when the space is given) as the force. Let AF (fig. 36.) be the refracting surface, and let it be divided into an infinite number of equal parts terminated by parallel planes passing through A, B, C, D, &c. Put $a=AB$ or BC , &c. f, g, b , &c. for the forces acting in AB, BC, CD, &c. which may be esteemed uniform. Then the velocities acquired in falling from rest, through AB, BC, CD, will be as $\sqrt{f}$, $\sqrt{g}$, $\sqrt{b}$; and their squares as f , g , b . But the square of the velocity at B being f , the square of the velocity at C is=square of the velocity at B+the square of the velocity in passing through BC from rest= $f+g$. And the square of the velocity at D=square of the velocity at C+the square of the velocity in passing through CD= $f+g+b$. And so on, therefore the velocity at F= $\sqrt{f+g+b}$, &c.=square root of the force.

Let AB (fig. 37.) be the refracting surface, IC the incident ray, infinitely near AC, and CR the refracted ray. Let CB=CA, and BR perpendicular to CB. Then CB (=CI=1) is the parallel motion of the ray. And BR the perpendicular motion, which is generated by the refraction: and therefore BR is as the square root of the refracting force, as was shewn before; and the refracting force is as the density, therefore the square of BR is as the density of the medium.

Let the sines of incidence and refraction be as m to n; then we have $m:n::CR:CB=1$, and $CR=\frac{m}{n}$, and $BR^2=CR^2-CB^2=\frac{mm}{nn}-1$.

—I. Therefore in the following table, against the names of the bodies

OPTICS.

bodies in the first column, you have the sines of incidence and refraction in the second, the square of BR or the refracting power in the third, their density or specific gravity in the fourth, and their ratio in the fifth column.

Bodies	Refraction m	n	Refracting power	Density	the Ra- tio
Pseudo topaz	23	14	1.599	4.27	0.39
Air	3201	3200	0.000625	0.0012	.52
Glass of } Antimony }	17	9	2.568	5.28	.48
A Selenitis	61	41	1.213	2.252	.54
Glass	31	20	1.4025	2.58	.54
Rock Crystal	25	16	1.445	2.65	.54
Island Crystal	5	3	1.778	2.72	.65
Sal Gemmae	17	11	1.388	2.143	.64
Alum	35	24	1.1267	1.714	.65
Borax	22	15	1.1511	1.714	.67
Nitre	32	21	1.345	1.9	.70
Vitriol	303	200	1.295	1.715	.75
Oil Vitriol	10	7	1.041	1.7	.61
Rain Water	529	396	0.7845	1.	.78
Gum Arabic	31	21	1.179	1.375	.85
Spirit Wine	100	73	0.8765	0.866	1.01
Camphire	3	2	1.25	0.996	1.25
Oil Olive	22	15	1.1511	0.913	1.26
Linseed Oil	40	27	1.1948	0.932	1.28
Spt. turpentine	25	17	1.1626	0.874	1.32
Amber	14	9	1.42	1.04	1.36
Diamond	100	41	4.949	3.4	1.45

This table of Sir Isaac Newton's made from a great many experiments, shews that these bodies that differ from a constant ratio, are such as abound more or less with oily sulphureous particles; and that such oily sulphureous substances have a greater refractive power than others, in proportion as they are of a more sulphureous nature.

Therefore, 1. The square of BR is as the density of the medium.

2. Refraction out of a thinner medium into a thicker, is made towards the perpendicular; and the contrary.

PROP. VI. Let AGFO (fig. 38.) be any dense medium, AE perp. to AO, HO in incident ray, making the angle HOF infinitely small, OB, OC the refracted rays, being the least and most refrangible. Draw Bc parallel to AO, cutting OC in c; through c draw a c parallel to AE; then in any other dense medium AGH, if the least refrangible rays (of the incident ray HO) pass to D; then drawing De parallel to AO to cut ac in e, the most refrangible rays will pass through e.

Let the ray OE cut De in r, and if HO or OA be the velocity of the incident ray, then (Prop. I. Inference 5. (OB, OC, OD, OE will be the velocity of the rays going to B, C, D, E; and AB²: AD²: : density of the first medium: density of the second: : AC²: AE². And AB: AC:: AD: AE; whence AC: CB:: AE: ED. And by similar triangles, Bc: AO:: (CB: CA:: ED: EA::) Dr: AO; whence Dr=Bc=De, and r falls upon e in the line ac. Therefore in all mediums, where the angle of incidence is a right angle, the extreme refracted rays will cut the parallels AE, ac, in the points B, c, and D, e, making Bc, De also parallel to one another, and to the refracting surface OA. But this does not hold good when the angle of incidence is not a right angle.

Hence, if the medium is such, that the mean refrangible rays are refracted at an angle of 45° with OA, then the rays will be the most dispersed by refraction. For the angle DOE will be greater when AO makes 45 degrees with a line drawn from O, bisecting De.

PROP. VII. If R be the radiant point, (fig. 39) RP perpendicular to the refracting plane surface PA. Then if RA be the incident ray, AH the refracted ray, cutting RP in F; then F will be the focus, so that FA: RA:: S. incidence: S. refraction.

For the angle PRA = angle of incidence, and PFA = angle of refraction, and in the triangle ARF, FA: RA:: S.FRA: S.PFA:: S. angle of incidence: S. angle of refraction.

Hence 1. As the sine of refraction: to the sine of incidence:: the incident ray: the refracted ray.

2. If rays diverging from R, diverge from F, after refraction; then rays converging to F will converge to R after refraction.

3. Parallel rays falling on a refracting plane, are refracted into parallel lines. For R and F being at an infinite distance; all rays proceeding from R will be parallel to one another, and all rays proceeding from F will also be parallel.

4. If rays diverging from R, diverge from F, after refraction; then changing the mediums, the rays diverging from F will diverge from R, after refraction.

5. If rays RA, Ra, (fig. 40) falling near P, be refracted from the focus F; then FP: RP:: S. incidence: S. refraction. For then FA=FP, and RA=RP, nearly.

6. If R (fig. 41) is an object under water, and the eye moves from C to D, and then to H, &c. the object will seem to rise in the perp. RP, till at last it vanishes in P. Hence water looks deepest when looked at perpendicularly; but it appears not then to be so deep as it is, by a fourth part. For when the angle of incidence

ARP is 48: 40, the angle of refraction AFP becomes 90. And at C, the apparent place of R will be at F, so that FP: RP:: 3: 4, or PF = $\frac{3}{4}$ PR.

PROP. VIII. If AV be any refracting spherical surface, C the centre, R the radiant point, F the focus after refraction; then RA x sine of incidence: CR x sine of refraction:: AF: CF. See fig. 42, 43, 44 and 45.

Let RA be the incident ray, AG the refracted one. Draw FH parallel to CA, cutting RA in H. Then $\angle RHF = \angle RAC =$ angle of incidence, and $\angle AFH = \angle FAC =$ angle of refraction. Put m, n, for the sines of incidence and refraction. Then in the triangle AFH, S.RHF or AHF (m): S.AFH (n):: AF: AH. And by similar triangles, AR: CR:: AH: CF, and ex aequo, m x AR: n x CR:: AF: CF.

Hence 1. On the contrary, if the rays go the contrary way in the line GA or FA, they will be refracted to R; and R and F will be conjugate foci.

2. If rays diverging from R, converge to F; then changing the mediums, rays converging to R will diverge from F. Or if rays diverging from R diverge from F, then changing the mediums, rays converging to R will converge to F, after refraction. Which saves the labour of drawing more figures.

PROP. IX. If AV be a very small part of a refracting spherical surface, C the centre, R the radiating point or object, F the focus after refraction; then the distance of the object and vertex RV x sine of incidence: Distance of the object and centre RC x sine of refraction:: Distance of the vertex and focus VF: Distance of the centre and focus CF, nearly. (See the Figures mentioned in the last Proposition.)

Let RA be the incident ray, AG or AF the refracted ray; then since A is very near the vertex, V, RA=RV, and AF=VF nearly. And putting m, n, for the sines of incidence and refraction, m x AR: n x CR:: AF: CF; that is, m x RV: n x CR:: VF: CF. Hence,

1. If m, n, be the sines of incidence and refraction, then m x V R + n x CR: m x VR:: CV: VF.

PROP. X. If parallel rays RA, RV, fall upon any refracting spherical surface AV, (fig. 46 and 47) whose centre is C; F will be the focus of the refracted rays, so that the sine of incidence: sine of refraction:: AF: CF.

Draw the radius CA, then RAC or ACF is the angle of incidence (or its supplement), and FAC the angle of refraction. Let m, n, be the sines of incidence and refraction. Then in the triangle ACF, S.ACF (m): S.CAF (n):: AF: CF. Hence,

1. If the rays be turned back in the line GA, and refracted at A, they will emerge parallel.

2. If AV be any refracting curve, AC perp. to the curve in A; and CF parallel to RA: and if RA be the incident ray, AF the refracted ray: then AF: FC: S.incidence: S.refraction.

PROP. XI. If parallel rays, RA, RV, fall on a very small part of a refracting spherical surface, Aa, whose centre is C; and if F be the focus, then sine of incidence: sine of refraction:: VF: CF: nearly. See fig. 46 and 47.

For as AV is a very small arch, AF=VF nearly, therefore (Prop. XII) S.incidence: S.refraction:: AF (VF): CF. Hence,

1. If m, n, be the sines of incidence and refraction: then m-n: m:: radius CV: FV the principal focal distance from the vertex. For m: n:: VF (VC + CF): CF, and by division, m-n: m:: VC: VF.

2. The focus of parallel rays refracted by a convex spherical surface of glass is distant from the vertex near three times the radius. For m is to n nearly as 3 to 2, and m-n to m as 1 to 3.

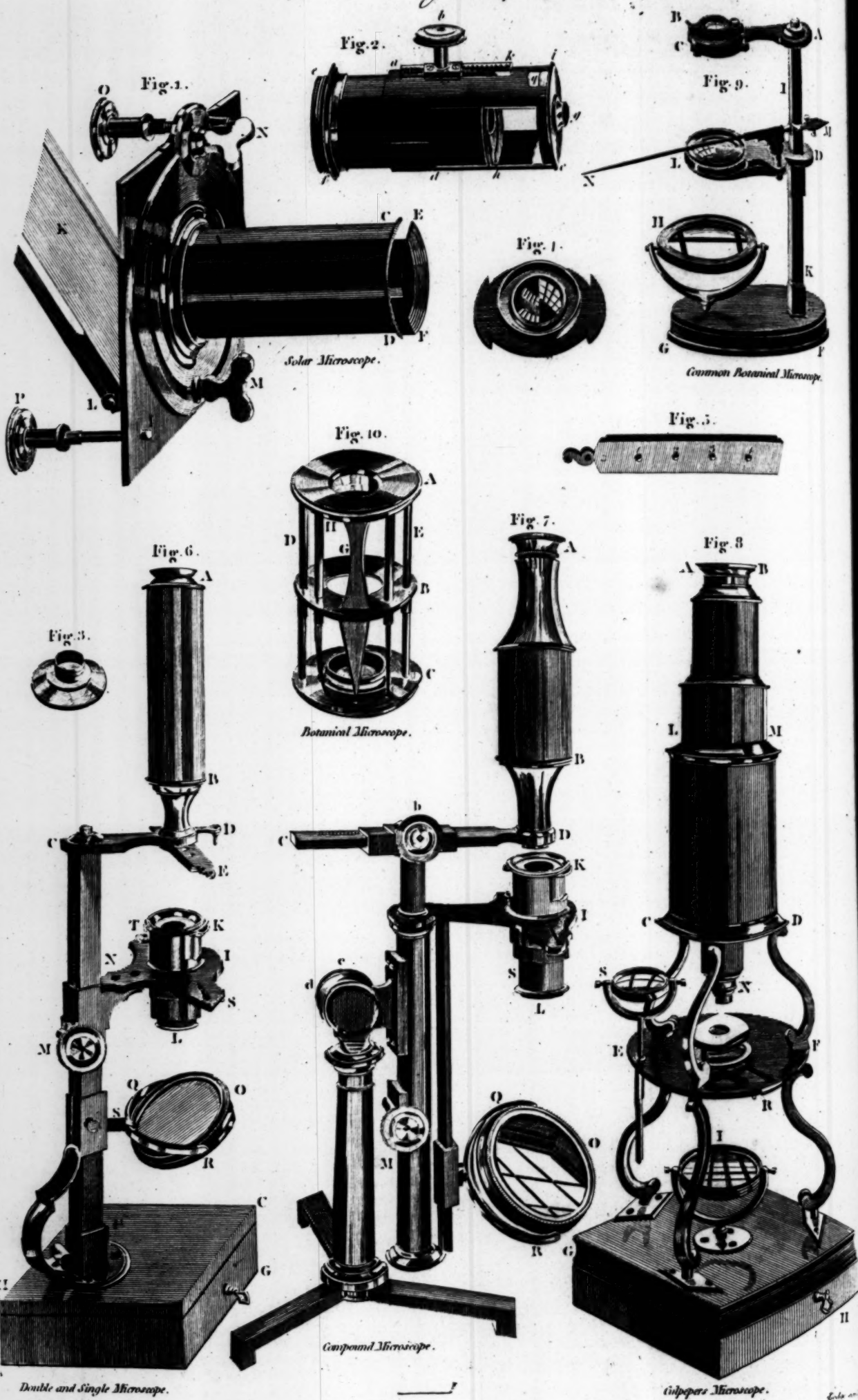
3. As m-n the difference of the sines: to n the lesser:: as CV the radius: to VF-VC, or CF the distance of the focus from the centre.

PROP. XII. If AV be a small portion of a refracting spherical surface; (fig. 48) C the centre, R the radiating point or the focus of the incident rays, F the focus of the refracted rays. And if m = S. incidence, n = S. refraction, RV = d, CV = r, VF = f; then $f = \frac{m \cdot r}{m - n \times d - nr}$; where, if the rays converge, or AV be concave, d or r will be negative.

For since the arch AV is very small, RA=RV=d, AF=V=f. Draw FH parallel to CA, cutting RA in H. Then by similar triangles RC (d+r): CF (f-r):: RA or RF (d): AH = $\frac{df-dr}{d+r}$. Then in the triangle AFH, S.AHF or CAH (m): S.AFH or CAF (n):: AF or VF (f): AH ($\frac{df-dr}{d+r}$). Whence

$n f = \frac{df-dr}{d+r} m$, and $ndf + nrf = dmf - dnr$, or $mdf - ndf - nrf = mdr$, therefore $f = \frac{mdr}{md - n \cdot d - nr}$. Hence,

1. $f = \frac{m \cdot r}{m - n \cdot d - nr} = \frac{m \cdot r}{md - n \times d + r}$
2. If rays fall on a concave refractor, $f = \frac{-m \cdot r}{m - n \cdot d + nr}$.



OPTICS.

3. If the rays converge to R, $f = \frac{m d r}{m - n \cdot d + n r}$

4. If it be a plain surface, $f = \frac{m d}{n}$

5. If the rays be parallel, $f = \frac{m}{m - n} r$

SCHOL. From this solution it follows, that when f the focal distance comes out affirmative, it must be taken directly forward from V, but when it is negative, it must be taken backward towards R. In the same manner that f is found from having d and r given; either d , or r , may be found from having the rest given.

In all cases where the rays converge to F, (fig. 49.) if a circle BD be described with any radius from the centre F, to cut the refracted rays AF; these rays passing through the meniscus AVDB, will go to the same focus F. For these rays passing perpendicularly through the refracting surface BD go right forward. And for the same reason, rays diverging from F, will go to R as before.

PROP. XIII. If parallel rays RA, &c fall upon a small portion of a sphere, and be refracted by the first surface to T; they will be refracted by the second surface to F, to the middle of DT. See fig. 50.

Let the rays RA, FG meet in H; then since the cord AG cuts the curve at A, G in equal angles, the refractions will be equal at A and G; whence the triangle AHG is equiangular, and equilateral. But FT being parallel to AH, the triangle GFT is similar to AHG; whence $GF = FT$. But GF being $= DF$ very near, therefore $DF = FT$. Hence, if parallel rays fall upon any part of a sphere, and T be the focus after the first refraction, F will be the focus after the second, so that $GF = FT$.

PROP. XIV. If any lens BH, if two radii CA, can be drawn parallel to one another, from the centres C, c, of the two surfaces, and Aa be drawn cutting the axis in D. Then every ray that passes through D, shall have its incident and emergent rays parallel. See fig. 51 and 52.

By reason of the parallels CA, and ca, the triangles CAD, and cad, are similar; therefore CD is to cD, as CA to ca, that is in a given ratio; and therefore the point D is invariable. And further the angles at A and a being equal, the line Aa cuts the two surfaces in the same angle, and therefore if the ray Aa be supposed to go both ways, the refractions will be equal and contrary; that is, they will make equal angles with Aa, and lie contrary ways, and therefore are parallel.

Hence, 1. In double convex and double concave lenses, the point D lies within the lens; in a plano convex or plano concave, it is at the convex or concave surface; but in a meniscus, it lies out of the lens, nearer to the greatest curvity. And in a sphere, it is at the centre.

2. The course of a ray, passing through D, very near the axis, may be taken for a straight line, without sensible error.

3. The point D is so placed, that $CG : cF :: DG : DF$.

4. As the sum of the radii (or the difference in a meniscus) : to the lesser radius :: so the thickness of the lens : to the distance of D from the vertex of greater curvature.

5. If Aa be any ray passing through D; then the tangents to the lens at A and a, will be parallel.

6. For every point A of the lens, there is some ray or other Aa, whose incident and refracted rays will be parallel; and that is the ray passing through D.

N.B. The point D is by optic writers called the *Centre* of the lens.

PROP. XV. Having the lens aV, and the radiant point R given; to find the focus F, after the refraction of both the surfaces. See fig. 53 and 54.

Let m, n be the sines of incidence and refraction, and make $m \times Rv - n \times Rc :: m \times Rv ::$ the radius $vc :: vf$, and f is the focus after the first refraction at av. Again $vf - vV = Vf$; then make $m \times Cf - n \times Vf :: n \times Vf ::$ radius $CV :: VF$, and F is the focus after the second refraction at AV: And thus you may proceed to find the focus after refraction by a third or fourth surface, &c.

PROP. XVI. An oblique pencil of rays SAGC, (fig. 55.) has its focus G a little nearer the lens, than a direct pencil RAFC.

For if $DS = DR$, then the angle CSA will be something less than the angle CRA, and upon that account the rays SA, SC, will be sooner brought to intersect at G, than the rays RA, RC, do at F. But further, the rays RA, RC, falling very nearly perpendicular to the sides of the lens AC, HN, are less bent than the rays SA, SC, which fall obliquely on both sides the lens. For the more oblique they are, the more they are bent, and turned out of their direct way. And consequently the oblique rays SA, SC will sooner intersect in G, than those at F. But since the angle RDS is generally very small, the difference between DF and DG will likewise be very small.

PROP. XVII. To find the principal focus of any lens.

1. Hold a convex lens perp. against the rays of the sun, hold a white paper behind it; to receive the refracted light, which will make a round white spot upon the paper. Move the paper No. 120.

back and forward till this spot, which is the sun's image, be the least possible; there fix it. Then the distance of the paper from the lens is the focal distance required, or the burning point.

2. Cover one side of a convex lens with paper, having several holes made in it with a pin, and placing the glass directly against the sun-beams, the light passing through the holes, will make so many white spots upon a paper held behind it. Move the paper back and forward till all these spots coincide in one; there is the focus. And the distance of the paper from the glass being measured, will give the focal distance.

PROP. XVIII. To find the vertex or centre of a lens.

Hold the lens at a proper distance from the eye, and observe the two reflected images of a candle, made from the two surfaces. Move the lens till the two images coincide, and that point is the vertex. And if this be in the middle of its surface, the lens is truly centered, otherwise not.

PROP. XIX. Wherever the rays, which come from all the points of an object, meet again in so many other points, to which they converge by refraction; there they will make the picture of the object upon any white body on which they fall.

Let PR (fig. 56.) be any object, AB a lens. The rays that diverge from any point Q falls upon the lens, and are refracted to their focus q, where they all meet, and make the image of Q upon a paper held there. In like manner the rays which diverge from P, are refracted to their focus p, and there give the image of P; and the rays diverging from R, are refracted to r, and make the image of R. And thus from all the intermediate points of the object, the rays proceeding to the lens, are refracted to as many corresponding points in the focus, and will altogether make there the image pqr of the object PQR, in its proper shape and colours. But the picture is inverted or turned upside down, and the right side to the left.

Hence, 1. Rays flowing from all the points of an object, paint the image thereof, in the real focus, and may be seen there upon a white paper; or without the paper it may be seen there hanging in the air, by an eye at O, placed at a proper distance, as 6 or 8 inches, &c. behind the focus.

2. An object seen by refraction, appears in that place, from whence the rays after their last refraction, diverge to the spectator's eye.

PROP. XX. The object and its image made by a lens, subtend equal angles at the lens.

For let D be the centre of the lens (fig. 57 and 58.) AB, PQR the object, pqr its image. Then PDq is nearly a straight line, and likewise RDr is also a straight line; consequently the angle PDR subtended by the object, is equal to the angle pDr subtended by the image, the angular point being at the centre of the lens D.

Hence, 1. The object and image are equal, when they meet together.

2. The object and image made by a single refraction, subtend equal angles at the centre of the refracting surface. For the unrefracted rays flowing from the extremes of the object, pass through the centre, and the object and image are contained between these.

In addition to the foregoing Propositions, the following Properties are demonstrated by Mr. Emerson.

1. The length of an object, is to the length of the image, made by a lens, as the distance of the object from the centre of the lens to the distance of the image from it.

2. A convex magnifies an object, when it is nearer than twice the principal focal distance; but if further off, it lessens it.

3. In all cases a concave lens diminishes an object, or the image is less than the object.

4. The length of the object, and the length of its image made by a single refraction, are as their distances from the centre of the refracting surface.

5. The apparent magnitude of a body, is as the angle which the image appears under to the eye in any place.

6. If the object and its image be both on the same side of the lens, the image will be erect; if they be on different sides, the image will be inverted.

7. When the object and image are on different sides the lens, as the object approaches the lens the image recedes from it; or if the object recedes, the image approaches it.

8. If the object and image be both on one side of the lens, if the object moves towards the lens, the image also moves towards the lens. And if the object moves from it, the image moves from it.

9. In a convex lens, if the object be beyond the principal focus, its image will be on the other side of the glass inverted. But if the object is nearer than the principal focus, the image will be on the same side of the glass erect.

10. In a concave lens the object and image are always on one side of the lens.

11. If a convex lens be fixed in the window shutter, and the room made dark, the pictures of external objects will be painted upon a paper held in the focus of the glass.

12. If an object be placed in the principal focus of a lens, its apparent magnitude at any place whatever, beyond the lens, will be invariably

*

U

invariably

OPTICS.

invariably the same; and equal to the apparent magnitude when seen from the centre of the lens with the naked eye.

13. The apparent magnitude of a body placed in the principal focus will always continue the same, however the eye is moved backward and forward from the lens.

14. The nearer the eye is to the lens, the more of the object appears; and the further off, the less of it is seen.

15. If the object be nearer than the principal focus, its apparent magnitude becomes less in going from the glass. But if the object be further, the apparent magnitude will increase in going from it.

16. If the eye be fixed in the principal focus, the apparent magnitude of an object will be invariably the same, wherever the object is placed before the glass.

17. If the eye is fixed at a less distance than the principal focus, the apparent magnitude of an object is diminished, as it is further removed from the glass, but by slow degrees.

18. If the eye be fixed at a greater distance than the principal focus, the apparent magnitude of an object is increased, as it is removed from the glass, till it comes to the conjugate focus, in respect to the eye; and then it becomes infinite, and infinitely confused, and begins to be inverted; and going further off, it is diminished again.

19. If the eye and object be fixed, and a convex lens be moved from the object to the eye, the apparent magnitude of the object increases to the middle, and then decreases to the eye. When it comes into such a position, that the eye and object are conjugate foci, the object is infinitely confused.

20. If the eye and object be fixed, and a concave lens be moved from either of them to the other, the apparent magnitude of the object will decrease to the middle, and then increase again. The apparent distance is reciprocally as the apparent magnitude; and in general we judge the apparent distance of an object to be the very same as we suppose the distance of a real object to be, from which the rays come to our eyes with the same degree of confusion.

21. The brightness of the image pr , formed by the lens AB from the luminous object PR ; will be as $\frac{AB^2}{Dq^2}$ the area of the

lens directly, and the square of the distance of the image reciprocally. Also the brightness of the image increases with the area of the glass, but the distinctness of it decreases. See (fig. 57.)

22. Converging rays are made more converging, by a convex lens; and diverging rays are made more diverging by a concave.

23. Parallel rays falling on one side of a convex lens A , (fig. 59.) will be refracted to P or p on the other side.

24. Parallel rays falling on one side of a concave lens A , will, by refraction, diverge from P or p on the same side.

25. In a convex lens A , rays diverging from P or p , will emerge parallel on the other side.

26. In a concave lens A , rays converging to P or p , will emerge parallel, going out of the lens on the same side.

27. In convex lenses, rays diverging from R (fig. 60.) beyond P , will converge to F beyond p . And the contrary.

28. In convex lenses, rays diverging from R , (fig. 61.) which is nearer than P , will diverge from F on the same side with R .

29. In convex lenses, rays converging to F , (fig. 62.) will, by refraction, converge to R , nearer than P or p .

30. In concave lenses, rays converging to R , (fig. 63.) beyond P , will diverge from F , beyond p , and the contrary.

31. In concave lenses, rays converging to F , (fig. 64.) nearer than p , will by refraction, converge to R , beyond F .

32. In concave lenses, rays diverging from R , (fig. 65.) beyond p , will, after refraction, diverge from F , nearer than p .

33. In concave lenses, rays diverging from R , (fig. 66.) nearer than p , will diverge from F , nearer still than p .

34. Let parallel rays Sa , Rv , (fig. 53 and 54.) be refracted by the lens Av , suppose the sines of incidence and refraction as m to n ; and put the radius of the segment towards the object $av=r$, the radius of the segment from the object $CV=R$, the thickness of the lens $vV=t$, the principal focal distance $VF=f$. And

$p = \frac{n}{m-n}$, $q = \frac{m}{m-n}$; therefore $mp = nq$. Then $f = \frac{Rn \times qr - t}{m \times R + r - t \times m - n}$; wherein if av , or AV be convex the contrary way, then r or R is negative.

35. If $t = 0$, or inconsiderable, then $f = \frac{pRr}{R+r}$, and is the same on either side of the lens.

36. If $t = 0$, and av be a plane surface, then $f = \frac{n}{m-n} R$.

37. If $t = 0$, and AV a plane surface, $f = \frac{n}{m-n} r$.

38. If $t = 0$, and $R=r$, then $f = \frac{n}{m-n} \times \frac{1}{2} r$.

39. The principal focal distance made by one refraction, is $\frac{mr}{m-n}$.

40. If a luminous body be placed in the principal focus of a

lens, it will cast a light to a great distance. For the rays emerging nearly parallel, will not unite till at a great distance.

41. In a double convex glass of equal radii, the principal focus is distant, the radius of the sphere; or the focal distance is equal to the radius.

42. In a sphere, the principal focus is distant half the radius, of an hemisphere $\frac{1}{2}$ the radius, when the convex side is exposed to the rays; and twice the radius, when the plane side is exposed.

43. In a plano convex, the distance of the principal focus is equal to the diameter, when the plane side is exposed to the rays; but to the diameter $-\frac{1}{2}$ the thickness, when the convex side is exposed.

44. In a double concave glass of different spheres, the distance of the principal focus is $\frac{2Rr}{R+r}$.

45. In double concaves of equal radii, the principal focus is distant the radius of the sphere, and is virtual.

46. In a plano concave, the principal focus is distant twice the radius, and is virtual.

47. In a double concave glass of different spheres, the distance of the principal focus is $-\frac{2Rr}{R+r}$, and is virtual.

48. In a meniscus, the distance of the principal focus is $\frac{2Rr}{R-r}$, the concave side being exposed to the rays.

49. If rays issuing from the radiant point R , (fig. 53 and 54.) be refracted by the lens Av ; let m , n = sines of incidence and refraction, $d = Rv$, the distance of the radiant point, $r = av$, the radius of the nearer surface. $R = CV$ the radius of the further surface. $t = vV$ the thickness of the lens. $f = VF$ the focal distance. $p = \frac{n}{m-n}$, $q = \frac{m}{m-n}$, $pm = qn$; then $f = \frac{mpdrR - ndrR + nprRt}{md \times r + R - mprR - dt \times m - n + nrt}$ wherein, if the rays converge, or if av , AV , be concave the contrary way, then d , r , or R is negative. Hence,

50. If t be nothing or inconsiderable, then $f = \frac{pdrR}{d \times r + R - Rpr}$ and is the same on both sides the lens, whilst the distance d continues the same.

And if the lens be of glass, then $f = \frac{6dRr - 2dRt + 4rRt}{3d \times r + R - 6rR - dt + 2rt}$

or when $t = 0$, $f = \frac{2dRr}{d \times r + R - 2rR}$

Also in a plano convex, if $t = 0$, and AV a plane surface, then $f = \frac{ndr}{m-n-d-nr}$.

51. If $t = 0$, and the lens has equal convexities, then $f = \frac{ndr}{m-n \times 2d-nr}$. And in glass, $f = \frac{dr}{a-r}$.

52. When $t = 0$, in a double concave, $f = \frac{pdrR}{-a \times r + R - prR}$.

And when the radii are equal, $f = -\frac{dr}{a+r}$.

53. In a plano concave, exposed with the concave side to the rays, $f = -\frac{pdrR}{a+prR}$.

54. In a meniscus, the convex side turned to the rays, $f = \frac{-sdrR}{d \times r - R + prR}$.

55. The focal distance made by a single refraction is $\frac{mR}{m-n-d-nr}$.

56. If the radiant point and the focus be equidistant from a lens, they will each of them be distant twice the principal focal distance.

57. If the radiant point be nearer the lens than the principal focus; the rays after refraction will diverge, if it is in the principal focus, they will emerge parallel; and if it is further off, they will converge.

58. If P , p , (fig. 67 and 68.) be the principal foci of a sphere or lens Av , R the radiant point, F the focus by refraction, D the centre of the sphere or lens; then RP , RD , RF , are continual proportionals, where P and F must lie the same way from R .

59. If Av be a lens or sphere (fig. 69 and 70.) F the focus of the refracted rays which flow from the radiant point R , p the principal focus. Then $RF : RD :: DF : Dp$, the principal focal distance. For $RF : RD :: RD : RP$, and by division, $RF : RF - RD (DF) :: RD : RD - RP (PD \text{ or } pD)$.

60. In a convex, the principal focal distance $Dp = \frac{RD \times DF}{RD + DF}$.

61. $RF : DF :: DF : pF$, or $pF = \frac{DF^2}{RF} = \frac{DF}{KF} \times DF$.

For since $RF : RD :: DF : Dp$, by division $RF : RF - RD (DF) :: DF : DF - Dp (pF)$.

62. Hence,

OPTICS.

62. Hence, the focus F may be found geometrically thus: Let P be the principal focus, with the centre D and radius DP, describe the arch PG, cutting any incident ray RA, in G. Joint DG, and draw AF parallel to it, cutting the axis RD in F, then F is the focus.

63. The distance of the radiating point and its focus made by a convex lens, is the least possible, when they are equidistant from the lens.

64. The radiating point and its focus is at the least distance from each other, when each of them is distant from the lens, twice the principal focal distance.

65. If a convex lens be held directly to the rays of the sun, and a combustible body be held in the principal focus, the heat of the rays will set it on fire.

66. The heat in the focus of the lens, is to the sun's direct heat, as the area of the glass, to the area of the image in the focus.

67. The degrees of heat in the foci of different lenses, are as the squares of the diameters directly, and the squares of the focal distances reciprocally.

68. If AB be a plane convex lens, (fig. 71.) exposed with the plane side to the parallel homogeneous rays NA, CV. And if P be the principal focus, or that of rays falling near V, and F the focus of the ray AF; m, n the sines of incidence and refraction out of a rare into a dense medium, $x = DV$, the versed sine of the arch AV. Then the aberration $PF = \frac{mm}{n \times m - n} x$.

69. Putting $AD = y$, the aberration by the figure of the lens, that is, $PF = \frac{mmyy}{2an.m-n}$.

70. The aberration of the sphericity of the figure, is as the versed sine, or as the square of the cord of half the arch AV.

71. The aberration in length PF, of a plane convex lens, is $\frac{1}{2}$ times its thickness nearly.

72. The lateral aberration FG corresponding to PF, is $= \frac{mm}{nd} \times \frac{y^3}{2aa}$.

73. The aberration $PF = \frac{mm}{m-n^2} \times \frac{AD^3}{2VF}$, and the correspondent lateral aberration $FG = \frac{mm}{m-n^2} \times \frac{AD^3}{2VF^2}$.

74. In a double convex lens, of the same focal distance, the aberrations will be nearly the same as in the plano convex.

75. If the rays do not come parallel, but diverging, the aberration will be something greater, and converging something less; but may be taken for the same.

76. If parallel rays (or any others nearly) fall upon the plane side of a plano convex lens, the diameter of the least circle of aberration is $\frac{1}{2}$ the aberration made at the principal focus, or $2QI = \frac{1}{2}FG = \frac{mm}{na} \times \frac{y^3}{4aa} = \frac{mm}{m-n^2} \times \frac{AD^3}{4VF^2}$.

77. The circle, whose diameter is $2QI$, contains all the rays refracted by the lens, between A and B.

78. Hence if the principal focal distance is given, the lateral aberrations are as the cubes of the breadths of the lens. And if the breadths of the lens be given, the lateral aberration is reciprocally as the square of the focal distance.

79. Having given AF, the least distance that a long-sighted person can see distinctly, or the greatest distance a short-sighted person can see distinctly; and AQ the distance he wants to see distinctly, then AC the radius of a double convex, or double concave, for that purpose will be $= \frac{AF \times AQ}{AF - AQ}$ when it is the radius of a convex lens, it will suited the long-sighted person, and when it is the radius of a concave lens, it is for the short-sighted, (see fig. 72 and 73.)

80. A long-sighted person that cannot see distinctly nearer than F, (fig. 72.) cannot see distinctly nearer than Q, by help of the glass, BD. But from Q to C, or further, he can see distinctly.

81. If the long-sighted person can only see objects distinctly, which are very remote; then he must have a convex lens whose focal distance is AQ, to see objects distinctly at the distance AQ.

82. A short-sighted person that cannot see distinctly further than F, (fig. 73.) cannot see distinctly further than Q, by help of the concave glass BD. But can see distinctly from Q to F, or nearer.

83. If AF be the greatest distance a short-sighted person can see distinctly, then by help of a concave, whose radius or focal distance is AF, he will be able to see all remote objects to infinity.

SECT. II. OF THE MAGNITUDE, POSITION, AND COLOURS, OF THE RAINBOW.

The rainbow never appears but when it rains in the sun-shine; and is caused by the refraction and reflection of the sun's light passing through the drops of falling rain. And it may be made artificially, by spouting up water, and causing it to fall down in drops in the sun's rays; in these drops the colours will appear to a spectator standing in a due position. Also it may be shewn in globes of glass filled with water, and placed in the sun in a proper position. To understand how the bow is made; let BNFG (fig. 74.) be a drop

of rain of a spherical figure, C its centre, and let AN be one of the sun's rays incident upon it at N, and then refracted to F, where let it either go out of the drop by refraction to V, or be reflected to G; and at G let it either go out by refraction to R, or be reflected to H; and at H let it either go out by refraction to S, or be reflected to I, &c. On the incident ray AX, and the refracted one NF, let fall the perpendiculars CD, CE. Draw the diameter BQ parallel to the incident ray AN. And let m, n , be the sines of incidence and refraction out of air into water. Draw NC, CF. Now in the progress of the ray AN, through the points N, F, G, H, &c. it is continually changing its direction, the same way about the circle, till at last it emerges out of the drop, making the angle of refraction, equal to that at its incidence, for all the lines NF, FG, GH, &c. are equal. Then to find the direction in which it at last emerges, produce NF to W, FG to T, GH to Y, &c. and then we must find the sum of the angles XNW, WFT, TGY, &c. and YHS, which makes the whole change of direction, or the revolution of the ray in its progress. Draw CZ perpendicular to FG. Then in the quadrilateral CEFZ, the angles at E and Z are right; therefore the angle ECZ + EFZ, = two right angles = EFZ + ZFW, therefore ECZ = ZFW, or ZFW = NCF = 2NCE. Put t = number of reflections, F, G, H, &c. Then since all the external angles at F, G, H, are equal, the sum of them all is $= t \times ZFW = 2t \times NCE$, to which add XNF + YHS or 2XNF, and the sum is $2t \times NCE + 2XNF$, for the whole change of direction of the ray. But XNF = XNC - ENC, and NCE = R - CNE (putting R = a right angle), therefore the whole change of direction is $= 2tR - 2t + 2 \times CNE + 2CNX$, or twice the quantity $tR - t + 1 \times CNE + CNX$. And this being known, it is easy to find the angle the emerging ray makes with the incident ray AN or BQ. This is true of any ray whatsoever, but to our purpose there is but one position of the ray AN, which will bring the colours, and this is next to be found.

Let AN be an incident ray of any colour, and let it emerge at H, describing the tract ANFGHS. Now that the rays of any colour emerging at H, may affect the sense strongly, they ought to emerge parallel, for if they emerge and fall upon the eye, in different directions, they mix with other rays of a different colour, and cannot appear sensible. And there will be so few rays of that colour in any one direction, that they cannot excite any sensation. And since to excite so strong a sensation, the rays of any one colour ought to emerge parallel, and as they are also parallel at their incidence: therefore we must find what position, or what angle of incidence, the ray AN must have, that all the rays of that colour, emerging at a small distance from H, may be all parallel to HS. Now this can only be when the sum of all the angles $2tR - 2t + 2 \times CNE + 2CNX$ is a maximum or minimum. For by the nature of a maximum or minimum, such a quantity remains the same for a small variation of the arch BN. Now we may observe, that when the arch BN is very small, the arch FQ is very small; and as BN grows greater, FQ grows greater, and BF lesser; and when BN approaches a quadrant, QF grows less again, and BF bigger. So that BF first decreases to a certain limit, and then increases again, and at that limit it is at its minimum. But the quantity $2tR - 2t + 2 \times CNE + 2CNX$ depends much upon the situation of F, and therefore will be at its minimum when the rays at H emerge parallel. Now since $2tR$ is given, $2tR - 2t + 2 \times CNE + 2CNX$, will be at its minimum when $2t + 2 \times CNE - 2CNX$ is a maximum, or when $t + 1 \times CNE - CNX$ is a maximum. But $t + 1 \times CNE - CNX$ is a maximum, when $t + 1 \times$ increment of CNE = increment of CNX. Let $y = CD$ or NM the sine of incidence; $CN = 1$; m, n , the sines of incidence and refraction, and take Nn a very small increment or decrement of BN, and drawing no parallel to AN, No will be the increment or decrement of MN; then $\frac{m}{n}y = CE$ the sine of refraction, and its increment $= \frac{n}{m} \times No$. And by the nature of the circle, confine

$(\sqrt{1-y})$: radius (1) :: No : $Nn = \frac{No}{\sqrt{1-y}}$, the increment of BN or $\angle CND$ Also confine $(\sqrt{1 - \frac{nnyy}{mm}})$: radius

(1) :: increment of the sine of refraction $(\frac{n}{m} \times No)$: $\frac{n \times No}{m\sqrt{1 - \frac{nnyy}{mm}}}$

the increment of the arch or angle of refraction CNE. Therefore $\frac{t+1}{t+1} \frac{n \times No}{m\sqrt{1 - \frac{nnyy}{mm}}} = \frac{No}{\sqrt{1-y}}$. Put $p = t + 1$, then

$\frac{pn}{\sqrt{mm - nnyy}} = \frac{1}{\sqrt{1-y}}$, and $pn \times \sqrt{1-y} = \sqrt{mm - nnyy}$; and squaring, $ppnn - ppnnnyy = mm - nnyy$; and reducing, $ppnnnyy - nnyy = ppnn - mm$; and $y = \frac{ppnn - mm}{pp - 1.nn}$. And y being known, the angles CND and CNE, are known, and consequently the

OPTICS.

the quantity of the angle of deviation of the ray, $2iR - p \times CNE + 2CNX$. And the angle in which HS cuts the incident ray AN or BQ, will be known; for if the deviation be 180 degrees, the incident and emergent rays will coincide, and the emergent ray will return back to the sun.

Since y depends upon the quantities of m and n , it is evident that the rays of different colours, having a different degree of refrangibility, will have different limits of BN, and will emerge parallel in different points H, and will cut BQ at different angles. And these several sorts of rays being separated from one another, will appear each in their proper colours.

For the first rainbow: if light passes out of air into water, m and n will be 108 and 81 for the least refrangible rays, or the red; and 109 and 81 for the most refrangible rays, or the violet. And therefore in this bow, where $m=108$, $p=2$, y comes out $=86036 = S$, 59, 22, $=CNX$, and $CNE=40$, 11. And $2R-4CNE + 2CNX=137$, 58, and this or its supplement 42, 2, is the angle the emergent ray makes with the incident ray for the red. And in like manner when $m=109$, the angle which the emergent ray makes with the incident ray, will be found 40, 17, for the violet. Again, in the second bow, where $p=3$, $m=108$, we shall find $y=95015 = S$, 71, 50, $=CNX$, and $CNE=45$, 27; and $4R - 6CNF + 2CNX=230$, 57, which exceeds 180 by 50, 57, the angle made with the incident ray, for the red. And when $m=109$, the angle the violet emergent ray makes with the incident ray will be 54, 7.

Now suppose O to be the eye of the spectator, and OP a line drawn thro' the sun and the eye (fig. 75.) And let the angles POE $=40$ 17, POF $=42$, 2, POG $=50$, 57, and POH $=54$, 7. And let these angles be turned about their common side OP; then shall the other sides OE, OF, OG, OH, describe the extreme arches of two rainbows AFBE, and CHDG. For if E, F, G, H, be drops of water placed any where in the conical surfaces described by OE, OF, OG, OH, and be illuminated by the sun's rays SE, SF, SG, SH; the angle SEO or POE of 40, 17, will be the greatest angle in which the violet rays will, after one reflection, be refracted to the eye, and therefore all the drops in the line OE, shall send the most refrangible rays most copiously to the eye, and thereby strike the senses with the deepest violet colour. And in like manner the angle SEO or POF of 42, 2, will be the greatest angle under which the red rays can emerge out of the drops, and therefore will come most copiously to the eye and strike the senses with that colour. And the rays that have intermediate degrees of refrangibility shall come most copiously from drops between E and F, and strike the senses with the intermediate colours; that is, from the inside to the outside of the bow, the colours will appear in the order, violet, indigo, blue, green, yellow, orange, red.

Again in the second bow, the angle SGO or POG of 50, 57, shall be the least angle under which the red rays, after two reflections can emerge out of the drops, and come most copiously in the line OG, and strike the sense with that colour. And the angle SHO or POH of 54, 7, shall be the least angle in which the violet rays after two reflections can emerge out of the drops, and therefore they will come most copiously to the eye, and strike the sense with that colour. And by the same argument the drops between G and H, shall strike the sense with the intermediate colours; therefore from the inside to the outside of the bow, the colours will appear in this order, red, orange, yellow, green, blue, indigo, violet. And since these four lines OE, OF, OG, OH, may be situated any where in the conical superficies, what is said of the drops and colours in these lines, is to be understood of the drops and colours every where in those surfaces. But the second bow, by reason of the light lost by two reflections does not always appear, and is always fainter than the first. These would be the angles if the sun was but a point, but from his apparent diameter, the breadth of the bows will be increased half a degree, whence the breadth of the inner bow will be 2, 15, and of the outer one 3, 40; and their distance 8, 25; the radii of the inner bow 40, 2, and 42, 17, of the outer one 50, 42, and 54, 22; and this appears to be so by observation, when their colours are strong and lively. It may be observed that all the rays but the violet in the line SE, will emerge from E in a greater angle than SEO made by the violet, and will therefore all pass below the eye; and all the rays but the red, in the line SF, will emerge from F in a lesser angle than SFO made by the red, and will therefore pass above the eye; by which means only red will appear in the line OF, and only violet in the line OE. They that have a mind to measure the bow, may observe that its radius is equal to the height of the bow and the height of the sun together, and therefore is easily measured with a quadrant. And if the sun's altitude be greater than 42, 17, the inner bow cannot be seen, nor the exterior one, if his altitude exceed 54, 22. In the third and fourth rainbows y is .97373 and .98366 respectively, and $CNX=76$, 50, and 79, 38. Whence $2iR + 2CNX - 2p \times CNE=318$, 20, and 400, 31, respectively, putting m and n as 4 to 3 for the red rays. And therefore in the third rainbow, the emergent ray cuts the incident ray at an angle of 41, 40; and in the 4th, at an angle of 40, 31, both moving from the sun. And therefore looking towards the sun, the red rays in these rainbows would appear at the distance from him of 41, 40 and 40, 31 respectively, and nearly coinciding. And in the 3d the violet would

be towards the sun; but in the fourth the violet is from the sun. But their light is weakened so by reflections, that they never appear. When the angle of revolution (or change of direction) of the emerging ray differs not much from a semicircle or any odd number of semicircles; one must look for the bow towards the sun's opposition. But when it differs not much from a circle or any number of circles, one must look towards the sun for the bow. Thus the first and second bows are seen opposite to the sun, and the third and fourth towards it.

If the angle of revolution falls short of a semicircle or any number of semicircles, the violet colour will be on the inside the bow. But if it exceed them, the violet will be on the outside. Thus in the first and third bows, the violet is within; and in the second and fourth, without.

PART IV. OF OPTICAL INSTRUMENTS.

ART. I. *Doctor Whithering's Botanical Microscope, as constructed by Mr. George Adams.*

This little instrument is represented at fig. 10. Plate III. It consists of three brass plates A, B, C, which are parallel to each other, the wires D and E are rivetted into the upper and lower plate which are by this means united to each other; the middle plate or stage is moveable on the aforesaid wires by two little sockets which are fixed to it. The two upper plates each contain a magnifying lens, but of different powers: one of these confines and keeps in their places, the fine point F, the forceps G, and the small knife H.

To use this Instrument. Unscrew the upper lens, and take out the point of the knife and the forceps, then screw the lens on again, place the object on the stage, and then move it up and down till you have gained a distinct view of the object, as one lens is made of a shorter focus than the other, and spare lenses, of a still deeper focus, may be had if required.

ART. II. *Common botanical Microscope.* This little instrument is represented at fig. 9. Plate III. It appears preferable to Doctor Whithering's being equally simple and more extensive in its application, and the stage unincumbered. A B, a small arm carrying the two magnifiers, one fixed to the upper part as at B, the other to the lower part of the arm at C, these may be used separately or combined together. The arm at B is supported by the square pillar IK, the lower end of which fits into the socket E, of the foot FG, the stage DL is made to slide up and down the square pillar; H a concave mirror, for reflecting light on the object.

To use this Microscope. Place the object on the stage, reflect the light on it from the concave mirror, and regulate it to the focus by moving the stage nearer to, or further from, the lens at B. The ivory sliders pass through the stage. Other objects may be fixed in the nippers L, M, and then brought under the eye glasses; or they may be laid on one of the glasses which fit the stage.

ART. III. *The Solar Microscope, as constructed by Mr. ADAMS.*

This instrument is represented in Plate III. at the figures 1, 2, 3, 4, 5. A B C D, (fig. 1.) represents the body of the microscope consisting of two brass tubes, EF, is the top of the inner moveable tube; the end ef of the single-tooth and pinion microscope (fig. 2.) screws into the top of the inner tube; at the end AB, of the external tube there is a lens to receive the light of the sun from the mirror KL, and to collect and condense it on the object; the end AB, screws into the circular plate GHI. KL, a long frame fixed to the circular plate; in this frame there is a plain mirror to reflect the rays of the sun on the lens at AB. An endless worm or screw, which is cut on the lower part of the nut M, works in a small wheel which is fixed to the frame KL, so that by turning the nut, the frame KL is moved up or down; the nut N moves the mirror to the right or left. O, P, two screws to fasten the square plate to the window shutter.

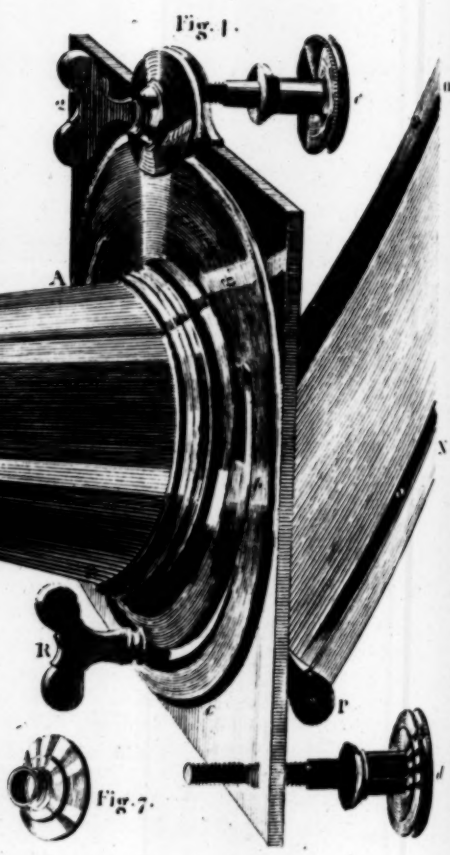
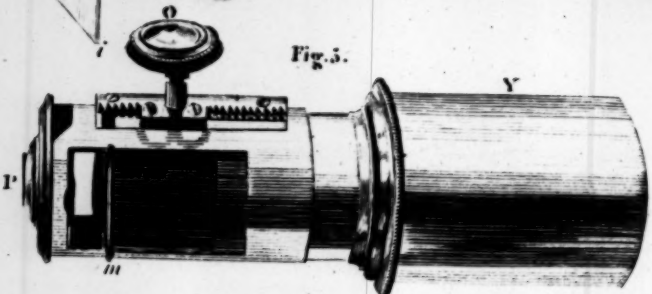
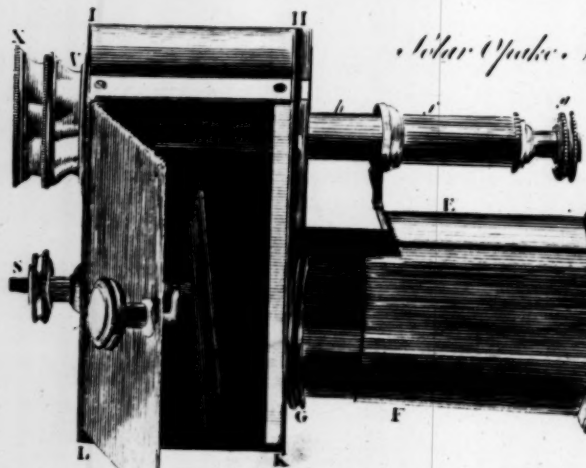
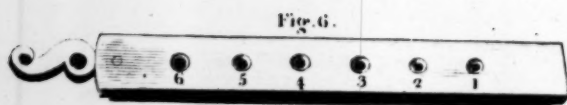
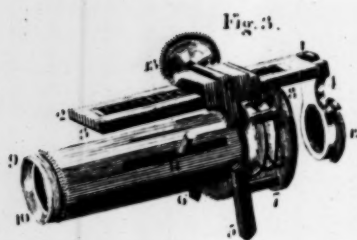
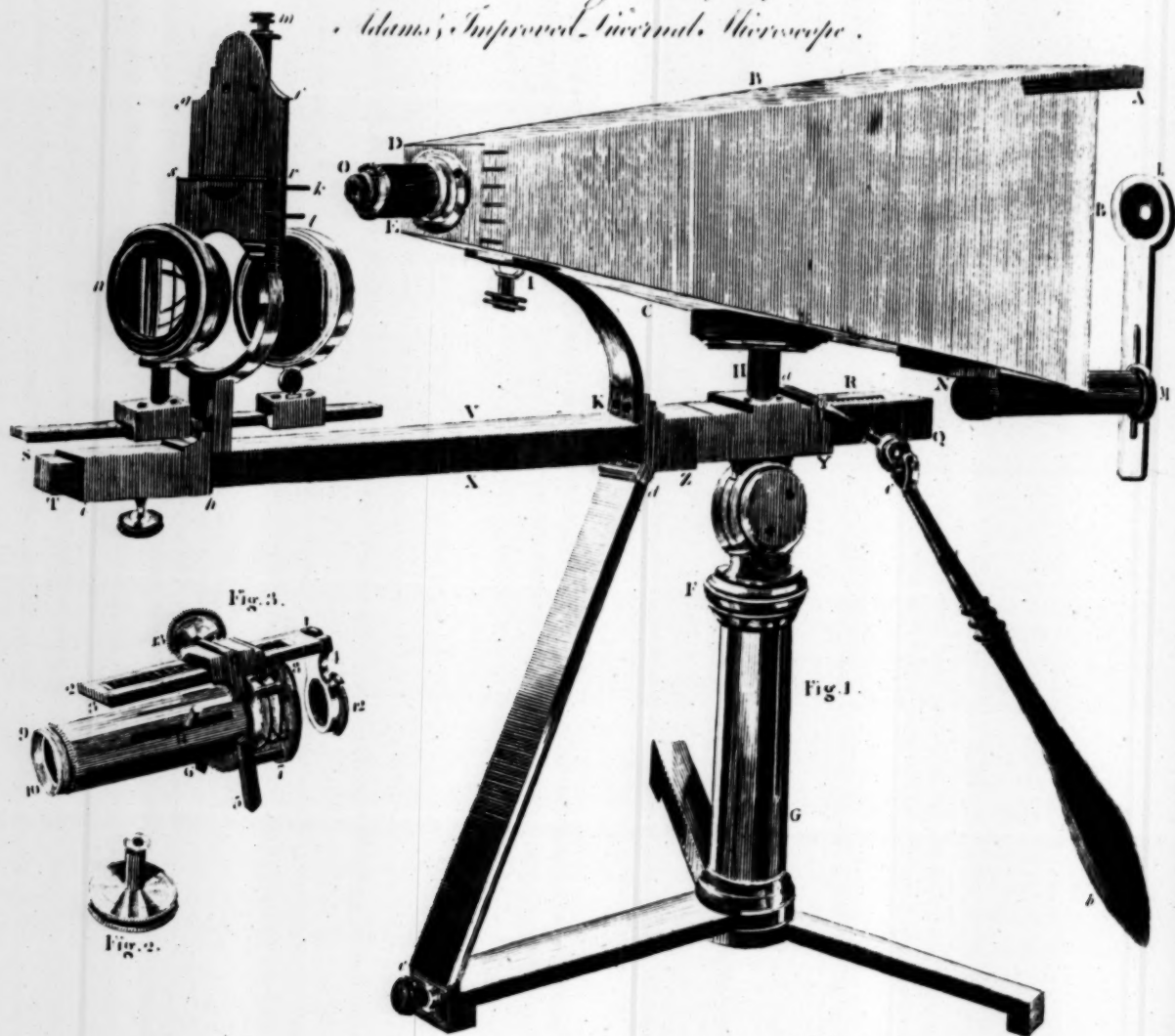
Fig. 2. Plate III. is the single microscope, ef the end which screws on to the upper part E (fig. 1.) of the internal tube of the body; q fig. 2. is the dovetailed slit for receiving the slider (fig. 5.) g the hole in which the megaloscope magnifier (fig. 3.) is to be screwed when the slider (fig. 5.) is removed. At bare the moveable plates, between which are the sliders placed; under the lowermost of these the lens, represented at fig. 4. is to be placed, when the magnifiers No. 1, 2, 3, and 4, fig. 5. are to be used. α is a small piece of rack work, which is moved backwards and forwards, by the pinion that is fixed to the lower end of the milled nut b; by the gradual motion of this rack: the objects are adjusted to the foci of the different lenses. Fig. 5. is a brass slider with four or six lenses, or magnifying glasses; it is to be inserted into the hole at q, fig. 2. Plate I. either of the magnifiers may be placed before the object, by sliding it one way or the other, you may perceive when the glass is in the centre of the eye hole, by a small spring falling into a notch which is made on the side of the slider opposite to each lens.

To use the solar Microscope.

Fasten the square (Plate III. fig. 1.) against the inside of a window shutter by the two screws O, P, which are to go from the outside of the window shutter through it, and then be screwed into their respective holes in the square plates G, H, I. The mirror is to be on the outside of the shutter passing through a hole made for that purpose. Darken the room, then place a screw on a convenient distance from the window; the further it is from it, the larger is the image; move the mirror KL by the two nuts M, N, till the sun's

h
s
e
r
t
l
e
r
t
r
g
r
or
e
ot
;
ie
y
ie
ed
or
2,
o-
er
o-
B,
an
t;
ng
r-
els
ks
n-
res
are
ws
y;
the
ved
es,
efe
ers
e of
ion
ual
dif-
or
2.
ect,
lals
otch
vin-
out-
into
is to
e for
ient
er is
l the
sun's

Microscopes.—See System of Optics. Part 4.
Wheeler's Improved Diurnal Microscope.



Copied by Permission from W. Wheeler's Essays on the Microscope.

OPTICS.

Sun's rays come through the instrument in an horizontal direction to the screen, forming a round spot thereon. Screw the microscope (fig. 2.) into it place EF; (fig. 1.) put the slider with the lens (fig. 5.) in its proper situation, and the object slider between the plates at b (fig. 2.) adjust the object to the focus of the magnifying lens by the screw b, till the object appears distinct and clear on the screen by moving the internal tube of the body, the object may be placed at different distances from the lens which is fixed at AB, so as to be sufficiently illuminated, and yet not scorched by the solar rays. *Apparatus belonging to the common Solar Microscope, Square Plate, and Mirror.*

The body of which consisting of two tubes, one within the other, the single microscope, the megalascope lens (fig. 3.), the slider (fig. 5.) with lenses; the two screws O, P, (fig. 1.) fix ivory sliders, a tale box, and some glass tubes; also, a slider or brass case containing a plane piece of glass and a brass slider with holes, into which are cemented small concave glasses designed for confining small insects between the plane and concave glass, which are thus preserved from being crushed, and prevented from wandering out of view.

ART. IV. Culpeper's, or the three-pillared Microscope.

Fig. 8. Plate III. represents this microscope, which consists of a large exterior body ABCD, supported on three small scrolls, which are fixed to the stage EF; the stage is supported by three larger scrolls that are screwed to the mahogany pedestal GH. There is a drawer in the pedestal which holds the apparatus. The concave mirror is fitted to a socket in the centre of the pedestal. The lower part LMCD of the body, forms an exterior tube, into which the upper part of the body ABLM slides, and may be moved up or down so as to bring the magnifiers, which are screwed on at N, nearer to, or further from, the object.

To use this Microscope. Screw one of the buttons which contains a magnifying lens to the end N of the body, place the slider with the objects between the plates of the slider-holder. Then to attain distinct vision and a pleasing view of the objects, adjust the body to the focus of the lens you are using, by moving the upper part gently up and down, and regulate the light by the concave mirror.

For opaque objects two additional pieces must be used, the first is a cylindrical tube of brass, represented at fig. 21. Plate III. which fits on the cylindrical part of N on the body, the second piece is the concave speculum (fig. 8.) Plate I. this is to be screwed to the lower end of the aforesaid tube: the upper edge of this tube should be made to coincide with the line, which has the same number affixed to it as to the magnifier you are using.

ART. V. ADAMS'S improved double and single Microscope.

AB, Fig. 6. Plate III. represents the body of the microscope, containing a double eye-glass and a body-glass; it is here shewn as screwed to the arm CD, from whence it may be occasionally removed either for the convenience of packing, or, when the instrument is to be used as a single microscope. The eye-glasses and body-glasses are contained in a tube which fits into the exterior tube AB; by cutting out a little thin tube when the microscope is in use, the magnifying power of each lens is increased. The body AB, of the microscope, is supported by the arm CD; this arm is fixed to the main pillar CF, which is screwed firmly to the mahogany pedestal. GH; there is a drawer to this pedestal which holds the apparatus. NIS, is the plate or stage which carries the slider-holder KL; this stage is moved up or down the pillar CF, by turning the milled nut M; this nut is fixed to a pinion, that works in a toothed rack, cut on one side of the pillars. By means of this pinion the stage may be gradually raised or depressed, and the object adjusted to the focus of the different lenses. KL is the slider-holder, which fits into a hole that is in the middle of the stage NIS. It is used to confine and guide either the motion of the sliders which contain the objects, or the glass tubes that are designed to confine small fishes for viewing the circulation of the blood. The sliders are to be passed between the two upper plates, the tubes through the bent plates. L is a brass tube, to the upper part of which is fixed the condensing lens before spoken of, it fits into the under parts of the slider-holders N, I; and may be set at different distances from the object, according to its distance from the mirror or the candle. This tube is seen the further drawn out in fig. 7. Plate III.

Fig. 6, is the frame which holds the two mirrors, one is plane, the other concave. These mirrors may be moved in various directions in order to reflect the light properly by means of the pivots on which they move in the semicircle QSR, and the motion of the semicircle itself on the pin S; the concave mirror generally answers best in the day time; the plane mirror combines better with the condensing lens, and a lamp or candle. At D there is a socket for receiving the pin of the arm (fig. 11. Plate of Microscopic Apparatus) to which the concave speculum for reflecting light on opaque objects is fixed. At S is a hole and slit for receiving either the nippers (fig. 12.) or the fish-pan (fig. 15.) when these are used, the slider-holder must be removed. T, a hole to receive the pin of the convex lens, fig. 19.

To use the improved double Microscope. Take the microscope out of the box, screw the body into the round end of the upper part of the arm CD. Place the brass sliders which contain the magnifiers into the dovetailed slit, which is on the under side of the aforesaid arm, as seen at E, fig. 6. Plate III.) and slide it forwards until the magnifier you mean to use is under the center of the bodies: oppo-

site to each magnifier in this slide there is a notch, and in the dovetailed part of the arm CD, there is a spring which falls into the above-mentioned notch, and thus makes each magnifier coincide with the centre of the body. Pass the ivory slider you intend to use between the upper plates of the slide-holder KL, and then reflect as strong a light as you can on the object, by means of one of the mirrors; after this, adjust the object to the focus of the magnifier, and your eye by turning the milled screw, the motion of this raises and depresses the stage NIS.

ART. VI. ADAMS'S Improved Compound Microscope.

Fig. 7. Plate III. represents this microscope.—Its advantages of this over the preceding microscope, consists first in the motion which may be given to the body, the stage, and the mirrors, by means of the joint CD, which has both a vertical and horizontal motion; so that the microscope may be placed either in an horizontal or inclined situation; and thus be adapted to the ease of the observer, and be used when he is sitting down. If the mirror QOR is taken off, the light will be conveyed in a direct line to the object, without any reflection. Secondly, that the body may be removed over any part of the stage, and thus over the object. The arm which carries the body, moves to the right or left on a central pin, and may also be moved backwards or forwards by the milled nut b. Thirdly, the concave or flat mirrors are much larger than those of fig. 6. In every other respect, the microscope is similar to the foregoing, and may be managed by the descriptions thereof, for which purpose, similar letters are affixed to the same parts.

ART. VII. The improved Solar Microscope, which is constructed to exhibit transparent and opaque Objects.

Fig. 4. Plate IV. represents the solar microscope, generally supposed to afford the most entertainment, on account of the wonderful extent of its magnifying power, and the ease with which several persons may view each single object at the same time. The use of it was, however, confined for many years only to transparent objects. About the year 1774, M. B. Martin so far improved this instrument, as to render it applicable to opaque as well as to transparent objects, exhibiting the magnified image of either kind on a large screen; speaking of it himself, he says, "with this instrument all opaque objects, whether of the animal, vegetable, or mineral kingdom, may be exhibited in great perfection in all their native beauty; the lights and shades, the prominences and cavities, and all the varieties of different hues, tints and colours, heightened by the reflection of the solar rays, condensed upon them." Transparent objects are also shewn with greater perfection than in the common solar microscope. Fig. 4. represents this instrument mounted, for exhibiting opaque objects. Fig. 5. are the single tooth and pinion microscope, which is used for shewing transparent objects; the cylindrical tube Y, being made to fit into the tube FE, fig. 4.—Fig. 6, the slider which contains the magnifiers; it fits into a dovetail, which is at the upper part of the microscope, fig. 5. ABCD EF, fig. 4. represents the body of the solar microscope; one part thereof, ABCD, is conical, the other CDEF, is cylindrical. The cylindrical part receives the tube G of the opaque box, or the tube Y of the single microscope, fig. 5. At the large end AB of the conical part, there is a lens to receive the rays from the mirror, and to refract them towards the box HIKL. NOP, is a brass frame, which is fixed to the moveable circular plate abc; in this frame there is a plane mirror to reflect the solar rays on the aforesaid lens. This mirror may be moved into the most convenient position for reflecting the light by means of the nuts Q and R. By the nut Q, it may be moved from east to west; it may be elevated or depressed by the nut R. d, e, two screws to fasten the microscope to a window shutter. The box for opaque objects is represented at HIKL; it contains a plane mirror M, for reflecting the light that it receives from the large lens to the object, and thereby illuminating it; S is a screw to adjust this mirror, or place it in a proper angle for reflecting the light. V, X, two tubes of brass, one sliding within the other, the exterior one in the box HIKL; these carry the magnifying lenses; the interior tube is sometimes taken out, and the exterior one is then used by itself. Part of this tube may be seen in the plate within the box HIKL. At H there is a brass plate, the back part of which is fixed to the hollow tube b, in which there is a spiral wire, which keeps the plate always bearing against the side H, of the brass box, HIKL, the sliders with the opaque objects, pass between this plate and the side of the box; to put them there, the plate is to be drawn back by means of the nut g.—it, a door to one side of the opaque box. The foregoing pieces constitute the several parts necessary for viewing opaque objects. We shall now proceed to describe the *Single Microscope*, which is used for transparent objects: but in order to examine these, the box HIKL, must be first removed, and in its place we must insert the tube Y of the single microscope, that we are now going to describe. Fig. 5. represents a large tooth and pinion microscope; at m within the body of this microscope are two thin plates that are to be separated, in order to let the ivory sliders pass between them; they are pressed together by a spiral spring, which bears up the under plate, and forces it against the upper one. The slider, (fig. 6.) that contains the magnifier, fits into the hole n; any of the magnifiers may be placed before the object by moving the aforesaid slider: when the magnifier is at the center of the hole P, a small spring falls into one of the notches, which is on the side of the slider, (fig. 6.)

*

X

Under

OPTICS.

Under the plate *m* are placed two lenses for enlarging the field of view on the screen, the smaller of the two is fixed on a piece of brass, and is nearest the plate *m*; this is to be taken out when the magnifiers, number 4, 5, or 6, are used, or when the megalascope lens (fig. 7.) is used; but is to be replaced for number 1, 2, 3 (fig. 6.). This microscope is adjusted to the focus by turning the nut *O*.

To use the Solar Microscope. (fig. 4.) Make a round hole in the window shutter, a little larger than the circle *abe*; pass the mirror *CNP*, through this hole, and apply the square plate to the shutter; then mark with a pencil the places which correspond to the two holes through which the screw is to pass; take away the microscope, and bore two holes at the marked places sufficiently large to let the milled screws pass through them. These screws are to pass from the outside of the shutter, to go through it; and being then screwed into their respective holes in the square plate, they will, when screwed home, hold it fast against the inside of the shutter, and thus support the microscope. Screw the conical tube *ABCD*, to the circle *abe*, and then slide the tube *G* of the opaque box into the cylindrical part *CDEF*, of the body, if opaque objects are to be examined; but if they be transparent objects you mean to shew, then place the tube *Y*, (fig. 5.) within the tube *CDEF*. (fig. 4.) The room is to be darkened as much as possible, that no light may enter but what passes through the body of the microscope, for on this circumstance, together with the brightness of the sun-shine, the perfection and distinctness of the image in a great measure depend. We shall first consider the microscope as going to be used for opaque objects. 1. Adjust the mirror *NOP*, so as to receive the solar rays by means of the two finger screws or nuts. *Q, R*; the first, *Q*, turns the mirror to the right or left; the second, *R*, raises or depresses it; this you are to do till you have reflected the sun's light through the lens, at *AB*, strongly upon a screen of white paper, placed at some distance from the window, and formed thereon a round spot of light. An unexperienced observer will find it more convenient to obtain the light, by forming this spot before he puts on either the opaque box, or the tooth and pinion microscope. Now put in the opaque box, and place the object between the plates at *H*; open the door *ik*, and adjust the mirror *M*, till you have illuminated the object strongly. If you cannot affect this by the screw *S*, you must move the screws *Q, R*, in order to get the light reflected strongly from the mirror *NOP*, or the mirror *M*, without which the latter cannot illuminate the object. The object being strongly illuminated, shut the door *ik*, and a distinct view of the object will soon be obtained on your screen by adjusting the tubes *VX*, which is effected by moving them backwards or forwards. A round spot of light cannot always be procured in northern latitudes, the altitude of the sun being often too low; neither can it be obtained when the sun is directly perpendicular to the front of the room. As the sun is continually changing its place, it will be necessary, in order to keep his rays full upon the object, to keep them continually directed through the axis of the instrument by the two screws *Q* and *R*.

To view transparent objects. Remove the opaque box, and insert the tube *Y*, of fig. 5, Plate IV. in its place; put the slider (fig. 6.) into its place at *n*, and the slider, with the object, between the plates at *m*; then adjust the mirror *NOP*, as before directed, by the screws *Q, R*, so that the light may pass through the object; regulate the focus of the magnifier by the screw *O*. The most pleasing magnifiers are the fourth and fifth. The size of the object may be increased or diminished by altering the distance of the screen from the microscope: five or six feet is a good distance.

To examine transparent objects of a larger size, or to render the instrument what is usually called a megalascope. Take out the slider (fig. 6.) from its place in fig. 5, and screw the button (fig. 7.) into the hole at *P* (fig. 5.) and remove the glass which is under the plate at *m*, and regulate the focus by the foregoing directions.

N. B. At the end of the tube *G*, there is a lens for increasing the density of the rays, for the purpose of burning or melting any combustible or fusible substance. This lens must be removed in most cases, lest the objects should be burnt; the intensity of the light is also varied by moving this tube backwards or forwards.

ART. VIII. The Improved Lucernal Microscope.

Fig. 1. Plate IV. represents this instrument to view opaque objects; *ABCDE*, is a large mahogany pyramidal box, which forms the body of the microscope; it is supported firmly on the brass pillar *FG*, by the means of the socket *H*, and the curved piece *IK*. *LMN*, is a guide for the eye, in order to direct it in the axis of the lenses; it consists of two brass tubes, one sliding within the other; and a vertical flat piece, at the top of which is the hole for the eye. The outer tube is seen at *MN*; the vertical piece is represented at *LM*; the inner tube may be pulled out, or pushed in, to adjust it to the focus of the glasses. The vertical piece may be raised, or depressed, that the hole, through which the object is to be viewed, may coincide with the center of the field of view; it is fixed by a milled screw at *M*, which could not be shewn in this figure. At *N* is a dovetailed piece of brass, made to receive the dovetail at the end of the tubes *MN*, by which it is affixed to the wooden box *ABCDE*, the tubes *MN*, may be removed from this box occasionally, for the convenience of packing it up in a leather compass. *OP*, a small tube which carries the magnifiers.—One of the magnifiers; it is screwed into the end of a tube, which slides within the tube *P*; the tube *P* may be unscrewed occasionally from the

wooden body *B. QRSTVX*, a long square bar, which passes through the sockets *Y, Z*, and carries the stage or frame that holds the objects; this bar may be moved backward or forward, in order to adjust it to the focus, by means of the pinion which is at *a. b. c.* is a handle furnished with an universal joint, for more conveniently turning the pinion; when the handle is removed, the nut (fig. 2.) may be used in its stead. *de* fig. 1. is a brass bar, to support the curved piece *KI*, and keep the body *AB* firm and steady. *FGHI*, is the stage for opaque objects; it fits upon the bar *QRST*, by means of the socket *hi*, and is brought nearer to or removed further from the magnifying lens, by turning the pinion *a*; the objects are placed in the front side of the stage, (which cannot be seen in this figure) between four small brass plates; the edges of two of these are seen at *KL*; the two upper pieces of brass are moveable; they are fixed to a plate, which is acted on by a spiral spring that presses them down, and confines the slider with the objects; this plate, and the two upper pieces of brass, are lifted up by the small nut *m*. At the lower part of the stage there is a semicircular lamp of glass *n*, which is designed to receive the light from the lamp, and to collect and throw it on the concave mirror *O*; from whence it is to be reflected on the object. The upper part *FGRS* of the opaque stage takes out, that the stage for transparent objects may be inserted in its place.

Fig. 3. represents the stage for transparent objects; the two legs number 5 and 6, fit into the top of the under part *rs hi*, fig. 1. of the stage for opaque objects; 7 is the part which confines or holds the sliders; and through which they are to be moved; 9 and 10, a brass tube, which contains the lenses, for condensing the light, and throwing it upon the object; there is a second tube within, that marked 9 and 10, which may be placed at different distances from the object, by the pin 11. When this stage is used as a single microscope without any reference to the lucernal, the magnifiers, or object lenses, are to be screwed into the hole 12, and are to be adjusted to a proper focus by the nut 13. *N. B.* At the end *AB* of the wooden body, there is a slider which is represented as partly drawn out at *A*; when quite taken out, three grooves will be perceived, one of which contains a board that forms the end of the box. The next contains a frame with a grey glass; the third, or that furthest from the end *AB*, two large convex lenses.

To examine opaque objects with the Lucernal Microscope.

The microscope is represented as mounted, and entirely ready for this purpose, in (fig. 1.) To render the use of this instrument easy, it is usually packed with as many of the parts together as possible. It occupies on this account, rather more room, but is much less embarrassing to the observer, who has only three parts to put on, after it is taken out of its box; namely, the guide for the eye, the stage, and the tube, with its magnifier. But to be more particular, take out the wooden slider *A*, then lift out the cover and the grey glass from their respective grooves under the slider *A*.

Put the end *N*, of the guide for the eye *LMN*, into its place, so that it may stand in the position which is represented in this figure. Place the socket, which is at the bottom of the opaque stage, on the bar *QXT*, so that the concave mirror *o* may be next the end *DE*, of the wooden body. Screw the tubes *P, O*, into the end *DE*; the magnifier you intend to use, is to be screwed on the end of these tubes. The handle *b*, or milled nut (fig. 2.) must be placed on the square end of the pinion *a*. Place the lamp lighted before the glass lamp *n*, and the object you intend to examine between the spring plates of the stage, and the instrument is ready for use.

To use the Lucernal Microscope in the Examination of transparent Objects. The microscope is to remain as before; the upper part *fg s*, of the opaque stage, must be removed, and the stage for transparent objects, represented at fig. 3, put in its place; the end number 9, and number 10, to be next the lamp. Place the grey glass in its groove at the end *AB*, and the objects in the slider-holder at the front of the stage; then transmit as strong a light as you are able on the object, which you will easily do by raising or lowering the lamp. The object will be beautifully depicted on the grey glass; it must be regulated to the focus of the magnifier, by turning the pinion *a*. The object may be viewed either with or without the guide for the eye; an observer will see an object to the greatest advantage, by using this guide, which is to be adjusted as we have described before. Take the large lens out of the groove, and receive the image on the grey glass; in this case the guide for the eye is of no use; if the grey glass is taken away, the image of the object may be received on a paper screen. Some transparent objects appear to the greatest advantage, when the lens at 9 and 10 is taken away; as by giving too great a quantity of light, it renders the edges less sharp. For a further account of *Microscopic Apparatus*, see it under that head in the Alphabet.

In digesting this System, I have had recourse to the best authors I could procure, as Newton, Gregory, Smith, Martin, and others; particularly Mr. Emerson, whose Treatise is judicious, both as to method and science. I have also been favoured with the liberty of copying extracts, descriptive of the most modern and improved Microscopes and their Apparatus, from a valuable work of Mr. George Adams, entitled *ESSAYS ON THE MICROSCOPE*, &c.

ROBERT MOODY.

EXCISE OFFICE, BROAD STREET.

TREATISE

TREATISE ON ORATORY;

Or, the Art of Speaking well upon any Subject, in order to persuade.

INTRODUCTION.

SECT. I. OF THE RISE AND PROGRESS OF ORATORY.

THE invention of Oratory is, by the Egyptians, and the fables of the poets, ascribed to Mercury. And it is well known, that the Greeks made their deities the authors, likewise, of other arts, and supposed that they presided over them. Hence they gave Mercury the titles of *Λογιστής* and *Ερμης*, from both which names come words that signify "to speak." And Aristides calls eloquence *the gift of Mercury*; and, for the same reason, anciently, the tongue was consecrated to him. He was likewise said to be the interpreter or messenger of the gods; which office very well suited him, as he excelled in eloquence. Hence we read in the sacred writings, that, when the people of Lystra took Barnabas and Paul for gods in human shape, because of that sudden and surprising cure which was wrought upon the lame man, they called Barnabas *Jupiter*, and Paul *Mercury*; for this reason, as the inspired writer tells us, "because he was the chief speaker," that is (as the spectators then thought) the interpreter or spokesman of Barnabas.

But, to pass over these fictions of the Heathen deities, let us hear what Quintilian says of the *origin* of this art, who seems to give a very probable account of it in the following passage: "The faculty of speech (says he) we derive from nature; but the art from observation. For, as in physic, men, by seeing that some things promote health, and others destroy it, formed the art upon those observations; in like manner, by perceiving that some things in discourse are said to advantage, and others not, they accordingly marked those things; in order to imitate the one, and avoid the other. They also added somethings from their own reason and judgment, which, being confirmed by use, they began to teach others what they knew themselves." But no certain account can be given when, or by whom, this method of observation first began to take place. Aristotle supposes, not without reason, that the first lineaments of the art were very rude and imperfect. Pausanias, indeed, in his *Description of Greece*, tells us, that Pittheus, the uncle of Theseus, taught it at Trezene, a city of Peloponnesus, and wrote a book concerning it; which he read himself, as it was published by one of Epidaurus. But, as Pittheus lived above 1000 years before Pausanias, who flourished in the time of the emperor Adrian, some are of opinion he might be imposed upon by the Epidaurian, who published this book under the name of *Pittheus*. It is very reasonable to believe that the Greeks had the principles of the art so early as the time of Pittheus; for Theseus, his nephew, lived not long before the taking of Troy, which, according to Sir Isaac Newton, happened 904 years before the birth of Christ; at which time, Cicero thought it was in much esteem among them. "Homer (says he) would never have given Ulysses and Nestor, in the Trojan wars, so great commendations on account of their speeches (to one of whom he attributes force, and to the other sweetness, of expression) if eloquence had not, in those times, been in great repute." And, lest any one should imagine that, in those days, they made use only of such helps as nature and practice could afford them, the same poet informs us, that Peleus sent Phoenix, with his son Achilles, to the Trojan war, to instruct him, not only in the art of war, but likewise of eloquence. But, who were the professors of this art, for some ages following, is not known; for Quintilian says, that, afterwards, Empedocles is the first upon record, who attempted any thing concerning it; and he, by Sir Isaac Newton's account, flourished about 500 years after Troy was taken. At which time, as Cicero observes, men, being now sensible of the powerful charms of oratory, and the influence it had upon the mind, there immediately arose several masters of it; the chief of whom are mentioned by Quintilian. But Gorgias seems to have excelled all the rest in fame and reputation; for he was so highly applauded by all Greece, that a golden statue was erected to him at Delphos, which was a distinguishing honour conferred upon him only. And he is said to have been so great a master of oratory, that, in a public assembly, he would undertake to declaim immediately upon any subject proposed to him. He wrote, as Cicero informs us, in the demonstrative or laudatory way; which requires most of the sublime, and makes what Diodorus Siculus says of him the more probable, that "he first introduced the strongest figures, members of periods opposite in sense, of an equal length, or ending with a like sound, and other ornaments of that nature." And hence those figures, which give the greatest force and lustre to a discourse, were anciently called by his name. Cicero tells us further, that Thrasy-machus and Gorgias were the first who introduced numbers into prose, which Iliocrates afterwards brought to perfection. Quintilian likewise mentions Protagoras, Gorgias, Prodicus, and Thrasy-machus, as the first who treated of common-places, and shewed the use of them for the invention of arguments. Nor must we omit Plato, whose elegant dialogue upon this subject is still extant, which he entitles *Gorgias*. For though he does not lay down the common rules of the art, yet he very well explains the nature of it, and maintains its true end and use, against the generality of its professors, who had greatly perverted the original design of it. Thus, by the study and industry of so many ingenious and great men, the art of

oratory was then carried to a considerable height among the Grecians. Nor have there been wanting some eminent writers of this kind among the Greeks, since the time of Quintilian; two of whom we cannot omit to mention, Hermogenes, and Longinus, the author of the incomparable treatise *Of the Sublime*, a book which can scarce be too much commended, or too often read.

It was long before Rome received this art, and not without difficulty at first. The reason was, because the Romans were, for several ages, wholly addicted to military affairs, and to enlarge their territories; so that they not only neglected to cultivate learning, but thought the pursuit of it a thing of ill tendency, by diverting the minds of their youth from the cares and toils of war, to a more soft and indolent kind of life. Therefore, so late as the year of their city 592, when, by the industry of some Grecians, the liberal arts began to flourish in Italy, a decree passed the senate, by which all philosophers and rhetoricians were ordered to depart out of Rome. But in a few years after, when Carneades, Critolaus, and Diogenes, who were not only philosophers, but orators, came ambassadors from Athens to Rome, the Roman youths were so charmed with the eloquence of their harangues, that they could no longer be stopped from pursuing the study of oratory. And, by a further acquaintance with the Greeks, it soon gained such esteem, that persons of the first quality employed their time and pains to acquire it. And a young gentleman, who was ambitious to advance himself in the service of his country, could have little hopes of success, unless he had laid the foundation of his future prospects in that study.

Seneca tells us, that Lucius Plotius, a Gaul, was the first who taught the art of oratory at Rome, in Latin; which, Cicero says, was while he was a boy; and when the most studious persons went to hear him, he lamented that he could not go with them; being prevented by the regard he paid to the opinion of some of his friends, who thought that greater improvements were made by exercises in the Greek language, under Grecian masters. Seneca adds, that this profession continued for some time in the hands of freed-men; and that the first Roman who engaged in it was Blandus, of the equestrian order, who was succeeded by others; some of whose lives are yet extant, written by Suetonius, as many of the Grecians are, by Philostratus and Eunapius. Quintilian likewise gives us the names of those among the Romans who wrote upon the art. "The first (says he) as far as I can learn, who composed any thing upon this argument was M. Cato the Censor. After him, Antony the orator began upon the subject, which is the only work he has left, and that imperfect. Then followed some of less note. But he who carried eloquence to its highest pitch among us, was Cicero; who has likewise, by his rules, given the best plan both to practise and teach the art. After him, modestly would require us to mention no more, had he not told us himself, that his books of rhetoric slipped out of his hands, while he was but a youth. And these lesser things, which many persons want, he has purposely omitted in his discourses of oratory. Cornificius wrote largely upon the same subject; Stertinius, and Gallio, the father, each of them something. But Celsus and Lenas were more accurate than Gallio; and, in our times, Virginius, Pliny, and Rutilius. And there are, at this day, some celebrated authors of the same kind, who, if they had taken in every thing, might have saved much pains." Time has since deprived us of most of the writers mentioned here by Quintilian. But we have the less reason to regret this loss, since it has preserved to us Cicero's Treatises upon this subject; which we may well suppose to have been chiefly owing to their own excellency, and the great esteem they have always had in the world. Besides his *Two books of Invention*, which Quintilian here calls his *Books of Rhetoric*, there are extant of his, *Three books of an Orator*; one *Of famous Orators*; and another, which is called *The Orator*; as also his *Topics*; a *Preface Concerning the best sort of Orators*; and a *Treatise Of the parts of Oratory*. Each of which Treatises, whether we regard the justness and delicacy of the thought, the usefulness of the rules, or the elegance and beauty of the style, deserves to be frequently perused by all who are lovers of eloquence. For, who can be thought so well qualified to give the rules of any art, as he who excelled all mankind in the practice of them? But those *Four books to Herennius*, which are published among Cicero's works, seem, with good reason, to be attributed to Cornificius, whom Quintilian here mentions. Celsus also is, by some, affirmed to have taught oratory, whom he also places among the rhetoricians, and whose *Eight books of Medicine* are yet extant, written in so beautiful a style, as plainly shews him to be a master of eloquence. But Quintilian himself exceeded all who went before him in diligence and accuracy, as a writer. His *Institutions* are so comprehensive, and written with such great exactness and judgment, that they are generally allowed to be the most perfect work of the kind. With this excellent author, we shall finish the account of the Latin rhetoricians.

There were, indeed, some others in the following ages, whose works are yet extant; but as they contain nothing of moment, which is not to be found in those already mentioned, we shall forbear to name them. Much less shall we descend to that nume-

ORATORY.

rous body of writers, who, since the revival of learning, have treated upon this subject, for the same reason. A very good judge, the Archbishop of Cambray, has given it as his opinion, that the method of forming the best system of oratory is to collect it from the finest precepts of Aristotle, Cicero, Quintilian, Longinus, and other celebrated authors; with proper examples, taken from the choicest parts of the purest antiquity. And this is the method attempted to be pursued in the following treatise.

SECT. II. OF THE NATURE OF ORATORY.

The terms *rhetoric* and *oratory* having no other difference but that one is taken from the Greek language, and the other from the Latin, they may be used promiscuously; but the case is not the same with respect to the words *rhetorician* and *orator*. For, although the Grecians used the former, both to express those who taught the art, and those who practised it; yet the Romans afterwards, when they took that word into their language, confined it to the teachers of the art, and called the rest *orators*. And there seems to have been a sufficient reason for this distinction, since the art was the same in both, and might, therefore, go by either name; but the different province of rhetoricians and orators rendered it proper they should be called by different names.

It is not necessary to use many words to prove that oratory is an art. For it is comprised under certain rules, agreeably to reason, delivered in a regular method, and suited to attain the end it proposes; which are characters sufficient to denominate it an art. Indeed the case is the same here as in most other things, that a good genius of itself is more serviceable than the most exact acquaintance with all the rules of art, where that is wanting. But it is sufficient that art help nature, and carry it farther than it can otherwise advance without it. And he who is desirous to gain the reputation of a good orator, will find the assistance of both very necessary. Some persons have thought that many of the common systems written upon the subject of oratory have been attended with this inconvenience, that, by burdening the mind with too great a number of rules about things of less importance, they have oftentimes rather discouraged than promoted the study of eloquence. This undoubtedly is an extreme which should be always carefully avoided. But, however, an indifferent guide in a strange road is better than none at all. It may be worth while to hear Quintilian's opinion upon this head. "I would not (says he) have young persons think they are sufficiently instructed, if they have learned one of these compends which are commonly handed about, and fancy themselves safe in the decrees, as it were, of these technical writers. The art of speaking requires much labour, constant study, a variety of exercise, many trials, the greatest prudence, and readiness of thought. However, these Treatises are useful, when they set you in a plain and open way, and do not confine you to one narrow tract, from which he who thinks it a crime to depart, must move as slowly as any one that walks upon a rope." We see he is not for having us confine ourselves too closely to systems, though he thinks they are of service at first, till use and experience render them less necessary.

The business of oratory is to teach us to speak well; which, as Cicero explains it, is to speak *justly, methodically, floridly, and copiously*. Now, in order to speak *justly*, or pertinently, a person must be master of his subject, that he may be able to say all that is proper, and avoid whatever may appear foreign and trifling. And he must clothe his thoughts with such words and expressions as are most suited to the nature of the argument, and will give it the greatest force and evidence. And, as it teaches to speak *justly*, so likewise *methodically*. This requires, that all the parts of a discourse be placed in their proper order, and with such just connection, as to reflect a light upon each other, and thereby to render the whole both clear in itself, and easy to be retained. But the same method is not proper for all discourses. And very frequently a different manner is convenient in handling the same subject. For it is plain, that art, as well as nature, loves variety; and it discovers the speaker's judgment, when the disposition of his discourse is so framed as to appear easy and natural, rather than the effect of industry and labour.

To speak *floridly* is so peculiar a property of this art, that some have wholly confined to the pomp and ornaments of language. But that it extends farther, and respects things as well as words, we shall have occasion to shew hereafter. It contains, indeed, the whole subject of elocution, but does not wholly consist in it. True and solid eloquence requires not only the beauties and flowers of language; but likewise the best sense and clearest reasoning. Besides, rhetoric gives rules for the several sorts of style, and directs the use of them agreeably to the nature of the subject.

But the force of oratory appears in nothing more than a *copiousness* of expression, or a proper manner of enlargement, suited to the nature of the object; which is of great use in persuasion, and forms the last property, required by Cicero, of speaking well. A short and concise account of things is often attended with obscurity, from an omission of some necessary circumstances relating to them. Or, however, where that is not the case, yet, for want of proper embellishments to enliven the discourse, and thereby to excite and fix the hearers' attention, it is apt to slip through their minds, without leaving any impression. But where images of things are drawn in their full proportion, painted in their proper colours, set in a clear light, and represented in different views, with all the strength and

beauties of eloquence, they captivate the minds of the audience with the highest pleasure, engage their attention, and, by an irresistible force, move and bend them to the design of the speaker.

The principal end and design of oratory is to persuade. For which reason it is frequently called the *art of persuasion*. Indeed the orator has often other subordinate views; as when he endeavours either to delight his hearers with what is pleasant and agreeable, or to conciliate their good opinion by a smooth and artful address; but still both these are in order to persuade and excite them to action. And while the orator employs his art in pursuing only those ends for which it was at first designed, the persuading men to good and virtuous actions, and dissuading them from every thing that is ill and vicious; nothing can be more commendable in itself, or useful to human societies.

SECT. III. OF THE DIVISION OF ORATORY.

Oratory consists of four parts: *invention, disposition, elocution, and pronunciation*. This will appear by considering the nature of each of them, and what it contributes in forming an orator. Every one who aims to speak well and accurately upon any subject, does naturally, in the first place, enquire after and pursue such thoughts as may seem most proper to explain and illustrate the thing on which he designs to discourse. And if the nature of it requires that he should bring reasons to confirm what he says, he not only seeks the strongest, and such as are like to be the best received; but also prepares to answer any thing which may be offered to the contrary. This is *invention*. After this he deliberates with himself in what method to dispose of those things which have occurred to his mind, that they may appear in the plainest light, and not lose their force by disorder and confusion. This is the business of *disposition*. His next concern is to give his thoughts an agreeable dress; by making choice of the fittest words, clearest expressions, smooth and harmonious periods, with other ornaments of style, as may best suit the nature of his subject, brighten his discourse, and render it most entertaining to his hearers; and this is called *elocution*. The last thing he attends to, is to deliver what he has thus composed, with a just and agreeable *pronunciation*. And daily experience convinces us, how much this contributes both to engage the attention, and impress what is spoken upon the mind. This, then, is the method to which nature directs, in order to qualify ourselves for discoursing to the best advantage: though, by custom and habit, these things become so familiar to us, that we do not always attend to them separately, in their natural order. However, it is the business of art to follow nature, and to treat of things in that manner which she dictates.

PART. I.

OF INVENTION.

SECT. I. OF INVENTION IN GENERAL.

Invention, considered in general, is the discovery of such things as are proper to persuade. And, in order to attain this end, the orator proposes to himself three things: To prove or illustrate the subject upon which he treats; to conciliate the minds of his hearers; and to engage their passions in his favour. And as these require different kinds of arguments or motives, invention furnishes him with a supply for each of them. An argument, as defined by Cicero, is a reason, which induces us to believe, what before we doubted of. And as different kinds of discourses require different arguments, rhetoricians have considered them two ways; in general, under certain heads, as a common fund for all subjects; and, in a more particular manner, as they are suited to *demonstrative, deliberative, or judicial* discourses. At present we shall treat only upon the former of these.

A lively imagination, and readiness of thought, are undoubtedly a very great help to invention. Some persons are naturally endued with that quickness of fancy, and that penetration of mind, that they are seldom at a loss for arguments, either to defend their own opinions, or to attack their adversaries. However, these things being the gift of nature, and not to be gained by art, do not properly fall under our present consideration. It will be readily granted, that great learning, and an extensive knowledge, are a noble fund for invention. An orator, therefore, should be furnished with a stock of important truths, solid maxims of reason, and a variety of knowledge, collected and treasured up, both from observation, and a large acquaintance with the liberal arts; that he may not only be qualified to express himself in the most agreeable manner, but likewise to support what he says with the strongest and clearest arguments. But, because all are not born with a like happy genius, and have not the same opportunity to cultivate their minds with learning and knowledge; and because nothing is more difficult than to dwell long upon the consideration of one thing, in order to find out the strongest arguments which may be offered for and against it; upon these accounts, art has prescribed a method to lessen, in some measure, these difficulties, and help every one to a supply of arguments upon any subject. And this is done by the contrivance of *common places*, which Cicero calls the *seats or heads of arguments*, and, by a Greek name, *topics*. They are of two sorts: *internal* and *external*.

Internal topics comprehend three heads: *Definition, Enumeration, and Notation*.

Definition explains the nature of the thing defined, and shews what it is. And to whatsoever the definition agrees, the things defined

ORATORY.

defined does so likewise. If therefore Socrates be a rational creature, he is a man; because it is the definition of a man, that he is a rational creature.

Enumeration takes in all the parts of a thing. And from this we prove, that what agrees to all the parts, agrees to the whole: and what does not agree to any one or more parts, does not agree to the whole: As when Cicero proves to Piso that all the Roman state hated him, by enumerating the several ranks and orders of Roman citizens who all did so.

Notation, or etymology, explains the meaning or signification of a word. From which we reason thus: "If he cannot pay his debts, he is insolvent;" for this is the meaning of the term *insolvent*.

From this brief account of common places, it is easy to conceive what a large field of discourse they open to the mind upon every subject. The different considerations furnish out a great number and variety of arguments, sufficient to supply the most barren invention.

External Topics. When the orator reasons from such topics as do not arise from his subject, but from things of a different nature, these are called *external*. They are all taken from authorities, and are by one general name called *Testimonies*. Now a testimony may be expressed by writing, speech, or any other sign proper to declare a person's mind. And all testimonies may be distinguished into two sorts: divine and human. A divine testimony, when certainly known to be such, is incontestible, and admits of no debate, but should be acquiesced in without hesitation. Indeed the ancient Greeks and Romans esteemed the pretended oracles of their deities, the answers of their augurs, and the like fallacies, divine testimonies; but with us no one can be ignorant of their true notion, though they do not so directly come under our present consideration. Human testimonies, considered as furnishing the orator with arguments, may be reduced to three heads: *writings, witnesses, and contracts*.

By *Writings*, here, are to be understood written laws, wills, or other legal instruments; expressed and conveyed in that manner. And it is not so much the force and validity of such testimonies, considered in themselves, that is here intended, as the occasion of dispute which may at any time arise concerning their true design and import, when produced in proof upon either side of a controversy. A writing is said to be ambiguous, when it is capable of two or more senses, which makes the writer's meaning uncertain. Ambiguity may arise either from single words, or the construction of sentences. From single words; as when either the sense of a word, or the application of it, is doubtful. As, should it be questioned, whether ready money ought to be included under the appellation of chattels left by a will? or, if a testator bequeath a certain legacy to his nephew Thomas, and he has two nephews of that name. Ambiguity, is also sometimes occasioned from the construction of a sentence; as when several things or persons having been already mentioned, it is doubtful to which of them that which follows ought to be referred. For example, a person writes thus in his will: "Let my heir give as a legacy to Titius, a horse out of my stable, which he pleases." Here it may be questioned, whether the word *he* refers to the heir or to Titius; and consequently, whether the heir be allowed to give Titius which horse he please, or Titius may choose which he likes best?

A controversy may arise when two writings happen to clash with each other, or at least seem to do. Of this Hermogenes gives the following instance. One law enjoins: "He who continues alone in a ship during a tempest, shall have the property of the ship." Another law says, "A disinherited son shall enjoy no part of his father's estate." Now a son who had been disinherited by his father, happens to be in his father's ship in a tempest, and continues there alone, when every one else had deserted it. He claims the ship by the former of these laws, and his brother tries his right with him by the latter. In such cases, therefore, it may first be considered, whether the two laws can be reconciled? and if that cannot be done, then which of them appears more equitable?

Of interpretation, in which the dispute turns upon the true meaning and explication of the law in reference to that particular case. We have the following instance of this in the *Pandects*: "A man who had two sons, both under age, substitutes Titius as heir to him who should die last, provided both of them died in their minority. They both perish together at sea, before they come to age. Here arises a doubt whether the substitution can take place, or the inheritance devolve to the heir at law?" The latter pleads, That as neither of them can be said to have died last, the substitution cannot take place; which was suspended, upon condition that one died after the other. But to this it may be said, It was the intention of the testator, that if both died in their nonage, Titius should succeed to the inheritance; and therefore it makes no difference whether they died together, or one after the other; and so the law determines it.

The second head of external argument are *Witnesses*. These may either give their evidence, when absent, in writing subscribed with their name; or present, by word of mouth. And what both of them testify, may either be from hearsay, or what they saw themselves, and were present at the time it was done. As the weight of the evidence may be thought greater or less on each of these accounts, either party will make such use of it as he finds

for his advantage. The characters of the witnesses are also to be considered; and if any thing be found in their lives or behaviour that is justly exceptionable, to invalidate their evidence, it ought not to be omitted. And how they are affected to the contending parties, or either of them, may deserve consideration; for some allowances may be judged reasonable in case of friendship, or enmity, where there is no room for any other exception. But regard should chiefly be had to what they testify, and how far the cause is affected by it. And where witnesses are produced on one side only, as orators sometimes attempt to lessen the credit of this kind of proof, by pleading that witnesses are liable to be corrupted, or biased by some prevailing interest or passion, to which arguments taken from the nature and circumstances of things are not subject; it may be answered, on the other hand, that sophistical arguments and false colourings are not exposed to infamy or punishment, whereas witnesses are restrained by shame and penalties, nor would the law require them if they were not necessary.

The third and last head of external arguments are *Contracts*; which may be either public or private. By public are meant the transactions between different states, as leagues, alliances, and the like; which depend on the laws of nations, and come more properly under deliberative discourses, to which we shall refer them. Those are called *private* which relate to lesser bodies or societies of men, and single persons; and may be either written or verbal. And it is not so much the true meaning and purport of them that is here considered, as their force and obligation. And, as the Roman law declares, "Nothing can be more agreeable to human faith, than that persons should stand to their agreements." Therefore, in controversies of this kind, the party whose interest it is that the contract should be maintained, will plead that such covenants have the force of private laws, and ought religiously to be observed, since the common affairs of mankind are transacted in that manner; and therefore to violate them, is to destroy all commerce and society among men. On the other side, it may be said, that justice and equity are chiefly to be regarded, which are immutable; and besides that the public laws are the common rule to determine such differences, which are designed to redress those who are aggrieved. And, indeed, where a compact has been obtained by force or fraud, it is in itself void; and has no effect either in law or reason. But, on the other hand, the Roman lawyers seem to have very rightly determined, that all such obligations as are founded in natural equity, though not binding by national laws, and are therefore called *nuda pacta*, ought, however, in honour and conscience, to be performed.

By the state of a controversy, we are to understand the principal point in dispute between contending parties, upon the proof of which the whole cause or controversy depends. We find it expressed by several other names in ancient writers: as, the *constitution of the cause*, the *general head*, and the *chief question*. And as this is the principal thing to be attended to in every such discourse, so it is what first requires the consideration of the speaker, and should be well fixed and digested in his mind, before he proceeds to look for arguments proper to support it. Thus Antony, the Roman orator, speaking of his own method in his pleading, says: "When I understand the nature of the cause, and begin to consider it, the first thing I endeavour to do is, to settle with myself what that is to which all my discourse relating to the matter in dispute ought to be referred: then I diligently attend to these other two things: How to recommend myself, or those for whom I plead, to the good esteem of my hearers; and how to influence their minds, as may best suit my design." This way of proceeding appears very agreeable to reason and prudence. For what can be more absurd than for a person to attempt the proof of any thing, before he has well settled in his own mind a clear and distinct notion, what the thing is which he would endeavour to prove? Quintilian describes it to be, "That kind of question which arises from the first conflict of causes."

But besides the principal question, there are other subordinate questions, which follow upon it in the course of a dispute, and should be carefully distinguished from it. Particularly that which arises from the reason, or argument, which is brought in proof of the principal question. For the principal question itself proves nothing, but is the thing to be proved, and becomes at last the conclusion of the discourse. Thus, in the cause of Milo, Cicero's argument is: *I killed Clodius justly, because he assassinated me*. Unless the Clodian party be supposed to deny this, they give up their cause. From hence therefore this subordinate question follows: *Whether Clodius assassinated Milo?* Now Cicero spends much time in proof of this, as the hinge on which the first question, and consequently the whole cause depended. For if this was once made to appear, the lawfulness of Milo's killing Clodius, which was the grand question or thing to be proved, might be inferred as an allowed consequence from it.

Though all the examples we have hitherto brought to illustrate this subject have been taken from judicial cases; yet not only these, but very frequently discourses of the deliberative kind, and sometimes those of the demonstrative, are managed in a controversial way. All controversies have their state; and therefore Quintilian very justly observes, that "states belong both to general

ORATORY.

neral and particular questions; and to all sorts of causes, demonstrative, deliberative, and judicial." In Cicero's oration for the Manilian law, this is the main point in dispute between him and those who opposed that law: "Whether Pompey was the fittest person to be intrusted with the management of the war against Mithridates?" This is a subject of the deliberative kind. And of the same nature was that debate in the senate, concerning the demolition of Carthage. For the matter in dispute between Cato, who argued for it, and those who were of the contrary opinion, seems to have been this: "Whether it was for the interest of the Romans to demolish Carthage?" And so likewise in those two fine orations of Cato and Cæsar, given us by Sallust, relating to the conspirators with Cataline, who were then in custody, the controversy turns upon this: "Whether those prisoners should be punished with death, or perpetual imprisonment?" Examples of the demonstrative kind are not so common; but Cicero's oration concerning the "Answers of the soothsayers," may afford us an instance of it. Several prodigies had lately happened at Rome, upon which the soothsayers, being consulted, assigned this as the reason of them: Because some places, consecrated to the gods, had been afterwards converted to civil uses. Clodius charged this upon Cicero, whose house was rebuilt at the public expence, after it had been demolished by Clodius, and the ground consecrated to the goddess Liberty. Cicero, in this oration, retorts the charge; and shews, that the prodigies did not respect him, but Clodius. So that the question in dispute was: "To which of the two those prodigies related?" This oration does not appear to have been spoken in a judicial way, and must therefore belong to the demonstrative kind. His invective against Piso is also much of the same nature, wherein he compares his own behaviour and conduct with that of Piso.

Whoever engages in a controversy, ought, in the first place, to consider with himself the main question in dispute, to fix it well in his mind, and keep it constantly in his view; without which he will be very liable to ramble from the point, and bewilder both himself and his hearers. And it is no less the business of the hearers principally to attend to this; by which means they will be helped to distinguish and separate from the principal question what is only incidental, and to observe how far the principal question is affected by it; to perceive what is offered in proof, and what is only brought in for illustration; not to be misled by digressions, but to discern when the speaker goes off from his subject, and when he returns to it again; and, in a word, to accompany him through the whole discourse, and to carry with them the principal chain of reasoning upon which the cause depends, so as to judge upon the whole, whether he has made out his point; and the conclusion follows from the premises.

SECT. II. ARGUMENTS SUITED TO DEMONSTRATION.

These consist either in praise or dispraise: and agreeably to the nature of all contraries, one of them will serve to illustrate the other. Now we either praise persons or things: In praising or dispraising persons, rhetoricians prescribe two methods. One is, to follow the order in which every thing happened that is mentioned in the discourse; the other is, to reduce what is said under certain general heads, without a strict regard to the order of time. In pursuing the former method, the discourse may be very conveniently divided into three periods: the first of which will contain what preceded the person's birth; the second, the whole course of his life; and the third, what followed upon his death. Under the first of these may be comprehended what is proper to be said concerning his country or family. And therefore, if these were honourable, it may be said to his advantage, that he no way disgraced them, but acted suitably to such a descent. But if they were not so, they may be either wholly omitted, or it may be said, that instead of deriving thence any advantage to his character, he has conferred a lasting honour upon them; and that it is not so much moment where, or from whom, a person derives his birth, as how he lives. In the second period, which is that of his life, the qualities both of his mind and body, with his circumstances in the world, may be separately considered. Though, as Quintilian rightly observes: "All external advantages are not praises for themselves, but according to the use that is made of them. For riches, and power, and interest, as they have great influence, and may be applied either to good or bad purposes, are a proof of the temper of our minds; and therefore we are either made better or worse by them." But these things are a just ground for commendation, when they are the reward of virtue, or industry. Bodily endowments are health, strength, beauty, activity, and the like; which are more or less commendable, according as they are employed. And where these, or any of them, are wanting, it may be shewn that they are abundantly compensated by the more valuable endowments of the mind. Nay, sometimes a defect in these may give an advantageous turn to a person's character; for any virtue appears greater in proportion to the disadvantages the person laboured under in exerting it. But the chief topics of praise are taken from the virtues and qualifications of the mind. And here the orator may consider the disposition, education, learning, and several virtues, which shone through the whole course of the person's life. In doing which the preference should always be given to virtue, above knowledge or any

other accomplishment. And in actions, those are most considerable, and will be heard with greatest approbation, which a person either did alone, or first, or wherein he had fewest associates; as likewise those which exceeded expectation, or were done for the advantage of others, rather than his own. And further, as the last scene of a man's life generally commands the greatest regard, if any thing remarkable at that time was either said or done, it ought particularly to be mentioned. Nor should the manner of his death, or cause of it, if accompanied with any commendable circumstances, be omitted; as, if he died in the service of his country, or in the pursuit of any other laudable design.

The third and last period relates to what followed after the death of the person. And here the public loss, and public honours conferred upon the deceased, are proper to be mentioned. Sepulchres, statues and other monuments to perpetuate the memory of the dead, at the expence of the public, were in common use both among the Greeks and Romans. But in the earliest times, as these honours were more rare, so they were less costly. For as in one age it was thought a sufficient reward for him who died in the defence of his country, to have his name cut in a marble inscription, with the cause of his death; so, in others, it was very common to see the statues, of gladiators, and persons of the meanest rank, erected in public places. And therefore a judgment is to be formed of these things from the time, custom, and circumstances, of different nations; since the frequency of them renders them less honourable, and takes off from their evidence as the rewards of virtue. But, as Quintilian says, "Children are an honour to their parents, cities to their founders, laws to those who compiled them, arts to their inventors, and useful customs to the authors of them."

In praising of persons, care should always be taken to say nothing that may seem fictitious, or out of character, which may call the orator's judgment or integrity in question. Light and trivial things in commendations are likewise to be avoided, and nothing mentioned but what may carry in it the idea of something truly valuable, and with the hearers may be supposed to which for, and is proper to excite their emulation. These are the principal heads of praise with relation to men. In dispraise, the heads contrary to these are requisite; which being sufficiently clear from what has been said, need not particularly be insisted on. With respect to things, as distinguished from persons, we are to understand by them all beings inferior to man, whether animate or inanimate; as likewise the habits and dispositions of men, either good or bad, when considered separately and apart from their subject, as arts and sciences, virtues and vices, with whatever else may be a proper subject for praise or dispraise. Some writers, indeed, have, for their own amusement, and the diversion of others, displayed their eloquence in a jocular manner upon subjects of this kind. So Lucian has written in praise of a fly, and Synesius an elegant encomium upon baldness. Others, on the contrary, have done the like in a satirical way. Such is Seneca's apotheosis or consecration of the emperor Claudius; and the Mysopogon or beard-hater, written by Julian the Emperor. Not to mention several modern authors, who have imitated them in such ludicrous compositions. But as to these things, and all of the like nature, the observation of Antony, in Cicero, seems very just: "That it is not necessary to reduce every subject we discourse upon to rules of art." For many are so trivial as not to deserve it; and others so plain and evident of themselves, as not to require it.

A prudent orator will be cautious of opposing any settled and prevailing notions of those whom he addresses; unless it be necessary, and then he will do it in the softest and most gentle manner.

SECT. III. CHARACTER AND ADDRESS OF AN ORATOR.

Having considered the first part of invention, which furnishes the orator with such arguments as are necessary for the proof of his subject, we are next to shew what are the proper means to conciliate the minds of his hearers; to gain their affection; and to recommend both himself, and what he says, to their good opinion and esteem. For the parts of invention are commonly thus distinguished: that the first respects the *subject* of the discourse, the second the *speaker*, and the third the *hearers*. Now the second of these, which we have at present to explain, is by Quintilian called a *propriety of manners*. And in order to express this, it is necessary, as he tells us, "that every thing appear easy and natural, and the disposition of the speaker be discovered by his words." We may form an easy conception of this from the conduct of such persons who are most nearly concerned in each other's welfare.—As when relations or friends converse together upon any affairs of importance, the temper and disposition of the speaker plainly shews itself by his words and manner of address. And what nature here directs to, without colouring or disguise, the orator is to endeavour to perform by his art.

It is further necessary that the orator should know the world, and be well acquainted with the different tempers and dispositions of mankind. Nor indeed can any one reasonably hope to succeed in this province, without well considering the circumstances of time and place, with the sentiments and dispositions of those to whom he speaks; which, according to Aristotle, may be distinguished four ways: as they discover themselves by the several *affections, habits, ages, and fortunes* of mankind. And each of these requires a different conduct and manner of address.

ORATORY.

It is the orator's business, therefore, to consider these several characters and circumstances of life, with the different bias and way of thinking they give to the mind; that he may so conduct himself, in his behaviour and manner of speaking, as will render him most acceptable, and gain him the good esteem of those whom he addresses.

SECT. IV. OF THE PASSIONS.

As it is often highly necessary for the orator, so it requires his greatest skill, to engage the passions in his interest. Quintilian calls this the *soul and spirit of his art*. And, doubtless, nothing more discovers its empire over the minds of men, than this power to excite, appease, and sway their passions, agreeably to the design of the speaker. Hence we meet with the characters of *admirable, divine*, and other splendid titles, ascribed to eloquence by ancient writers. For the passions are to the mind what the wind is to a ship; they move, and carry it forward; and he who is without them, is in a manner without action, dull and lifeless. There is nothing great or noble to be performed in life, wherein the passions are not concerned. We shall here consider the passions, as they may be separately referred either to *demonstrative, deliberative, or judicial* discourses; though they are not wholly confined to any of them. To the *demonstrative* kind we may refer *joy and sorrow, love and hatred, emulation and contempt*.

Joy is an elation of the mind, arising from a sense of some present good. Such a reflection naturally creates a pleasant and agreeable sensation, which ends in a delightful calm and serenity. This is heightened by a description of former evils, and a comparison between them and the present felicity. Thus Cicero endeavours to excite in the minds of his fellow-citizens the highest sense of joy and delight at Cataline's departure from Rome, by representing to them the imminent danger which threatened both them and the city while he continued among them.

Sorrow, on the contrary, is an uneasiness of mind arising from a sense of some present evil. This passion has generally a place in funeral discourses. And it may be heightened, like the former, by comparison, when any past happiness is set in opposition to a present calamity. Hence Cicero aggravates the sorrow at Rome, occasioned by the death of Metellus, from his character and great services to the public, while living.

Love excites us to esteem one another for some excellency, and to do him all the good in our power. It is distinguished from *friendship*, which is mutual; and therefore love may continue where friendship is lost; that is, the affection may remain on one side. And when we assist a person from no other motive but to do him a kindness, Aristotle calls this *good-will*. Love takes its rise from a variety of causes. Generosity, benevolence, integrity, gratitude, courtesy, and other social virtues, are great incitements to love any one endued with such qualities; and persons generally love those who are of a like disposition with themselves, and pursue the same views. It is therefore the chief art of a flatterer to suit himself in every thing to the inclination of the person whose good graces he courts. When the orator would excite this affection towards any person, it is proper to shew that he is possessed of at least some, if not all, of these agreeable qualities. When the conspirators with Cataline were to be brought to justice, Cicero was very sensible of the envy he should contract on that account, and how necessary it was for him to secure the love of the Roman senate for his support and protection in that critical juncture. And this he endeavours to do in his fourth oration against Cataline, by representing to them, in the most pathetic manner, that all the labours he underwent, the difficulties he conflicted with, and the dangers to which he was exposed on that account, were not for his own sake, but for their safety, quiet, and happiness.

Hatred is opposed to love, and produced by the contrary dispositions: and therefore persons hate those who never did them any injury, from the ill opinion they have of their base and vicious inclinations. So that the way to excite this passion is, by shewing that any one has committed some heinous fact, with an ill intent: and the more nearly affected persons are by such actions, in what they account of the greatest concern, the higher in proportion their hatred rises. Since life therefore is esteemed the most valuable good, Cicero endeavours to render Mark Antony odious to the citizens of Rome, by describing his cruelty.

Emulation is a disquiet, occasioned by the felicity of another, not because he enjoys it, but because we desire the like for ourselves. So that this passion is in itself good and laudable, as it engages men to pursue those things which are so. For the proper objects of emulation are any advantages of mind, body, or fortune, acquired by study or labour. Emulation therefore is excited by a lively representation of any desirable advantages which appear to be attainable from the example of others who are or have been possessed of them. But where the felicity of another occasions an uneasiness, not from the want of it, but because he enjoys it, this passion is called *envy*, which the ancients describe as an hideous monster, feeding upon itself, and being its own tormentor.

Contempt is opposed to *emulation*, and arises from misconduct in things not of themselves vicious: As where a person either acts below his station and character, or affects to do that for which he is not qualified. Thus Cicero endeavours to expose Cæcilius and

bring him into contempt of the court, for pretending to rival him in the accusation of Verres, for which he was altogether unfit.

To *deliberative* discourses may be referred *fear, hope, and shame*.

Fear arises from the apprehension of some great and impending evil. For the greatest evils, while they appear at a distance, do not much affect us. Such persons occasion fear who are possessed of power, especially if they have been injured, or apprehend so; likewise those who are addicted to do injuries, or who bear us an ill will: and the example of others, who have suffered in a like case, or from the same persons, help to excite fear. From the circumstances, therefore, either of the thing or person, it will not be difficult for the orator to offer such arguments as may be proper to awaken his passion. So Demosthenes, when he would persuade the Athenians to put themselves in a condition of defence against king Philip, enumerates the several acts of hostility already committed by him against the neighbouring states. And because men's private concerns generally more affect them than what relates to the public, it is proper sometimes to shew the necessary connection these have with each other, and how the ruin of one draws the other after it. The contrary passion to *fear* is *hope*; which arises either from a prospect of some future good, or the apprehension of safety from those things which occasion our fear. Young persons are easily induced to hope the best, from the vigour of their spirits; and those who have escaped former dangers, are encouraged to hope for the like success for the future. The example of others, also, especially of wise and considerate men, have often the same good effect. To find them calm and sedate, when exposed to the like danger, naturally creates confidence and the hope of safety. But nothing gives persons that firmness and steadiness of mind, under the apprehension of any difficulties, as a consciousness of their own integrity and innocence. Let dangers come from what quarter they will, they are best prepared to receive them. They can calmly view an impending tempest, observe the way of its approach, and prepare themselves in the best manner to avoid it. In Cicero's oration for the Manilian law, he encourages the Roman citizens to hope for success against Mithridates, if they chose Pompey for their general, from the many instances of his former successes, which he there enumerates.

Shame arises from the apprehension of those things that hurt a person's character. *Modesty* has been wisely implanted in mankind by the great Author of nature, as a guardian of virtue, which ought for this reason to be cherished with the greatest care; because, as Seneca has well observed, "if it be once lost, it is scarce ever to be recovered." Therefore the true cause or foundation of shame is any thing base or vicious; for this wounds the character, and will not bear reflection; and he must arrive at no small degree of insensibility who can stand against such charge, if he be conscious to himself that it is just. Therefore, to deter persons from vicious actions, or to expose them for the commission of them, the orator endeavours to set them in such a light as may most awaken this passion, and give them the greatest uneasiness by the reflection. On the other hand, *immodesty*, or impudence, which consists in a contempt of such things as affect the reputation, can never be too much discouraged or exposed; and the way of doing this is, to make use of such arguments as are most proper to excite shame. We have a very remarkable instance of it in Cicero's second Philippic, wherein he affixes this character upon Mark Antony, through every scene of his life.

To *judicial* discourses may be referred *anger and lenity, pity and indignation*.

Anger is a resentment occasioned by some affront, or injury, done without any just reason. Now men are more inclined to resent such a conduct, as they think they less deserve it. Therefore, persons of distinction and figure, who expect a regard should be paid to their character, can the less bear any indications of contempt: and those who are eminent in any profession or faculty are apt to be offended, if reflections are cast either upon their reputation or art. Magistrates also, and persons in public stations, sometimes think it incumbent on them to resent indignities for the support of their office. But nothing sooner inflames this passion than if good services are rewarded with a slight and neglect. The instance of Narsites, the Roman general, is remarkable in this kind; who, after he had been successful in his wars with the Goths, falling under the displeasure of the emperor Justin, was removed from the government of Italy, and received by the empress with this taunt: *That he must be sent to weave among the girls*; which so provoked him, that he said he would weave such a web as they should never be able to unravel. And accordingly, he soon after brought down the Longobards, a people of Germany, into Italy; where they settled themselves in that part of the country which, from them, is now called *Lombardy*. The time and place in which an injury was done, and other circumstances that attended it, may likewise contribute very much to heighten the fact. Hence Demosthenes, in his oration against Midias, endeavours to aggravate the injury of being struck by him, both as he was then a magistrate, and because it was done at a public festival. From hence it appears, that the persons who most usually occasion this passion are such as neglect the rules of decency, contemn and insult others, or oppose their inclinations; as likewise the ungrateful, and those who violate the ties of friendship, or requite favours with injuries. But when the orator endeavours

ORATORY.

to excite anger, he should be careful not to exceed due bounds in aggravating the charge, lest what he says appear rather to proceed from prejudice than a strict regard to the demerit of the action.

Lenity is the remission of anger. The design of men's actions are principally to be regarded; and therefore what is done ignorantly, or through inadvertency, is sooner forgiven. Also to acknowledge a fault, submit, and ask pardon, are the ready means to take off resentment; for a generous mind is soon cooled by submission. Besides, he who repents of his fault does really give the injured party some satisfaction, by punishing himself; as all repentance is attended with grief and uneasiness of mind, and this is apt very much to abate the desire of revenge: as, on the contrary, nothing is more provoking than when the offender either audaciously justifies the fact, or confidently denies it. Men are likewise wont to lay aside their resentment, when their adversaries happen by some other means to suffer what they think a sufficient satisfaction. Lastly, easy circumstances, a lucky incident, or any thing which gives the mind a turn to mirth and pleasure, has a natural tendency to remove anger: for anger is accompanied with pain and uneasiness, which very ill suit joy and cheerfulness. The orator therefore, in order to alluage and pacify the minds of his auditors, will endeavour to lessen their opinion of the fault, and by that means to take off the edge of their resentment; and to this purpose, it will be proper either to represent that the thing was not designed, or that the party is sorry for it: or to mention his former services; as also to shew the credit and reputation which will be gained by a generous forgiveness. And this last topic is very artfully wrought up by Cicero, in his address to Cæsar, in favour of Ligarius.

Pity arises from the calamities of others, by reflecting that we ourselves are liable to the like misfortunes. So that evils, considered as the common lot of human nature, are principally the cause of pity; and this makes the difference between *pity* and *good-will*, which arises merely from a regard to the circumstances of those who want our assistance. But considering the uncertainty of every thing about us, he must seem in a manner divested of humanity who has no compassion for the calamities of others; since there is no affliction which appears to any man, but either that, or some other as great, may fall upon himself. But those persons are generally soonest touched with this passion who have met with misfortunes themselves; and by how much greater the distress is, or the person appears less deserving it, the higher pity does it excite: for which reason, persons are generally most moved at the misfortunes of their relations and friends, or those of the best figure and character. The orator therefore, in order to excite the greater pity, will endeavour to heighten the idea of the calamity, from the several circumstances both of the thing itself and the person who labours under it. A fine example of this may be seen in Cicero's defence of Muræna, cap. 40, &c.

Indignation, as opposed to *pity*, is an uneasiness at the felicity of another who does not seem to deserve it. But this respects only external advantages, such as riches, honours, and the like; for virtues cannot be the object of this passion. Aristotle therefore says "that pity and indignation are generally to be found in the same persons, and are both evidences of a good disposition." Now the orator excites this passion, by shewing the person to be unworthy of that felicity which he enjoys. And as, in order to move compassion, it is sometimes of use to compare the former happy state of the person with his present calamity: so here, the greater indignation is raised, by comparing his former mean circumstances with his present advancement: as Cicero does in the case Vatinus. These are the passions with which an orator is principally concerned. In addressing to which, not only the greatest warmth and force of expression are often necessary; but he must likewise first endeavour to impress his own mind with the same passion he would excite in others, agreeably to that of Horace:

My grief with others' just proportion bears;
To make me weep, you must be first in tears.

PART II. OF DISPOSITION.

As *Invention* supplies the orator with necessary materials, so *Disposition* directs him how to place them in the most proper and suitable order. Disposition therefore, considered as a part of oratory, naturally follows invention. And what is here chiefly intended by it is the placing the several parts of a discourse in a just method and dependance upon one another. Writers are not all agreed in determining the parts of an oration; though the difference is rather in the manner of considering them than in the things themselves. But Cicero, whom we shall here follow, mentions six, namely, *Introduction*, *Narration*, *Proposition*, *Confirmation*, *Confutation*, and *Conclusion*.

SECT. I. INTRODUCTION.

The design of this is to prepare the minds of the hearers for a suitable reception of the remaining parts that are to follow; and for this end three things are requisite: that the orator gain the *good opinion* of his hearers; that he secure their *attention*; and give them some *general notion* of his subject.

1. *Good opinion*. When the orator introduces his discourse with his own person, he will be careful to do it with modesty, and seem rather to extenuate his virtues and abilities than to magnify them. We have a very fine example of this in Cicero's oration for the

poet Aulus Licinius Archias, which begins thus: "If I have any natural genius, which I am sensible how small it is; or any ability in speaking, wherein I own I have been very conversant; or any skill acquired from the study and precepts of the best arts; to which my whole life has been devoted: this Aulus Licinius has, in a particular manner, a right to demand of me the fruit of all these things. For as far back as I can remember, and call to mind what passed in my youth, to the present time, he has been my chief adviser and encourager both to undertake and pursue this course of studies." When the orator sets out with the person of those to whom the discourse is made, it is not unusual to commend them for their virtues, and those especially which have a more immediate relation to the present subject. Thus Cicero begins his oration of thanks for the pardon of Marcellus, with an encomium upon the mildness, clemency, and wisdom of Cæsar, to whom it was addressed.

2. *Attention*. On this head, Cicero says, "We shall be heard attentively by one of these three things: if we propose what is great, necessary, or for the interest of those to whom the discourse is addressed." So that, according to him, the topics of attention are much the same with those of good opinion, when taken from the subject: and indeed, people are naturally led to attend either to those things or persons of which they have entertained a favourable opinion. But in order to gain this point, the orator sometimes thinks it proper to request the attention of his audience. Thus Cicero, in his defence of Cluentius, after having shewn the heinousness of the charge against him, concludes his introduction in the following manner, speaking to the judges: "Wherefore I intreat, that while I briefly and clearly reply to a charge of many years standing, you will, according to your usual custom, give me a kind and attentive hearing."

3. *Some general account of the subject of the discourse*. This is always necessary, which the two others are not; and therefore it must be left to the prudence of the orator when to use or omit them, as he shall judge proper, from the nature of his discourse, the circumstances of his hearers, and how he stands with them. But some account of the subject is what cannot be neglected; for every one expects to be soon informed of the design of the speaker, and what he proposes to treat of. Nor when they are all made use of, is it necessary they should always stand in the order we have here placed them. Cicero sometimes enters immediately upon his subject, and introduces the other heads afterwards; as in his third oration against Cataline, made to the body of the Roman people, which begins thus: "You see that the state, all your lives, estates, fortunes, wives, and children, and this seat of the greatest empire, the most flourishing and beautiful city, having, by the favour of heaven towards you, and my labours, counsels, and dangers, been this day rescued from fire and sword and the very jaws of destruction, are preserved and restored to you." And then he proceeds to recommend himself to their esteem and benevolence, from the consideration of these benefits. These are the heads which commonly furnish matter for this part of a discourse. But orators often take occasion from the time, place, largeness of the assembly, or some other proper circumstance, to compliment their hearers, recommend themselves, or introduce the subject upon which they are about to treat. Instances of each of these may be met with in several of Cicero's orations.

SECT. II. NARRATION.

The orator having prepared his hearers to receive his discourse with candour and attention, and acquainted them with his general design in the introduction, before he proceeds directly to his subject, often finds it necessary to give some account of what preceded, accompanied, or followed upon it; and this he does in order to enlarge the view of the particular point in dispute, and place it in a clearer light. This is called *narration*; which is a recital of something done, in the order and manner in which it was done. There are four properties required in a good narration: that it be short, clear, probable, and pleasant.

1. The brevity of a narration is not to be judged of barely from its length: for that may be too long which contains but a little, and that too short which comprehends a great deal. Wherefore this depends upon the nature of the subject, since some things require more words to give a just representation of them, and others fewer. That may properly therefore be called a *short narration* which contains nothing that could well have been omitted, nor omits any thing which was necessary to be said. Now, in order to avoid both these extremes, care should be taken not to go further back in the account of things, nor to trace them down lower, than the subject requires: to say that only in the general, which does not need a more particular explication; nor to assign the causes of things, when it is enough to shew they were done: and to omit such things as are sufficiently understood, from what either preceded, or was consequent upon them. But the orator should be careful, lest, while he endeavour to avoid prolixity, he run into obscurity. Horace was very sensible of this danger, when he said:

By striving to be short, I grew obscure.

2. *Perspicuity*. This may justly be esteemed the chief excellency of language. For as the design of speech is to communicate our thoughts to others, that must be its greatest excellence which contributes most to this end; and that, doubtless, is perspicuity. As perspicuity therefore is requisite in a discourse, so it is particularly serviceable

ORATORY.

serviceable in a narration, which contains the substance of all that is to be said afterwards. Wherefore if this be not sufficiently understood, much less can those things which receive their light from it. Now the following things render a narration clear and plain: proper and significant words, whose meaning is well known and determined; short sentences, though full and explicit, whose parts are not perplexed, but placed in their just order; proper particles to join the sentences, and shew their connection and dependance on each other; a due regard to the order of time, and other circumstances necessary to be expressed; and, lastly, suitable transitions.

3. *Probability.* Things appear probable, when the causes assigned for them appear natural; the manner in which they are described is easy to be conceived; the consequences are such as might be expected; the characters of the persons are justly represented; and the whole account is well attested, consistent with itself, and agreeable to the general opinion. Simplicity likewise in the manner of relating a fact, as well as in the style, without any reserve or appearance of art, contributes very much to its credibility. For truth loves to appear naked and open, stripped of all colouring or disguise. The conspiracy of Cataline was so daring and extravagant, that no one, but such a desperado, could ever have undertaken it with any hopes of success. However, Cicero's account of it to the senate was so full and exact, and so well suited to the character of the person, that it presently gained credit. And therefore, when, upon the conclusion of Cicero's speech, Cataline who was present, immediately stood up, and desired they would not entertain such hard thoughts of him, but consider how much his family had always been attached to the public interest, and the great services they had done to the state; their resentments rose so high, that he could not be heard: upon which he immediately left the city, and went to his associates.

4. The last thing required in a narration is that it be *pleasant and entertaining*. And this is more difficult, because it does not admit of that accurate composition, and pompous dress, which delights the ear, and recommends some other parts of a discourse. For it certainly requires no small skill in the speaker, while he endeavours to express every thing in the most natural, plain, and easy manner, not to grow flat and tiresome. For Quintilian's remark is very just, that, "the most experienced orators find nothing in eloquence more difficult than what all who hear it fancy they could have said themselves." And the reason of this seems very obvious; for as all art is an imitation of nature, the nearer it resembles that, the more perfect it is in its kind. Hence unexperienced persons often imagine that to be easiest which suits best with those natural ideas to which they have been accustomed; till, upon trial, they are convinced of their mistake. Wherefore, to render this part of the discourse pleasant and agreeable, recourse must be had to variety both in the choice of words, and turns of the expression: and therefore questions, admirations, interlocations, imagery, and other familiar figures, help very much to diversify and enliven a narration, and prevent it from becoming dull and tedious, especially when it is carried on to any considerable length.

SECT. III. PROPOSITION.

In every just and regular discourse, the speaker's intention is to prove or illustrate something. And when he lays down the subject upon which he designs to treat, in a distinct and express manner, this is called the *proposition*. Orators use several ways in laying down the subject of their discourses. Sometimes they do it in one general proposition: at other times, to give a clearer and more distinct view of their discourse, they subjoin to the proposition the general heads of argument by which they endeavour to support it. But when the subject relates to several different things, which requires each of them to be separately laid down in distinct propositions, it is called *partition*. There are three things requisite in a good partition; that it be *short, complete*, and consist but of a *few members*.

A good and just partition is attended with considerable advantages; for it gives both light and ornament to a discourse: and it is also a great relief to the hearers, who, by means of these stops and rests, are much better enabled to keep pace with the speaker without confusion, and, by casting their thoughts either way from what has been said, both know and are prepared for what is to follow. And, as persons, in travelling a road with which they are acquainted, go on with greater pleasure and less fatigue, because they know how far it is to their journey's end; so, to be apprised of the speaker's design, and the several parts of his discourse which he proposes to treat on, contributes very much to relieve the hearer, and keep up his attention. This must appear very evident to all who consider how difficult it is to attend long and closely to one thing, especially when we do not know how long it may be before we are likely to be released. Whereas, when we are before-hand acquainted with the scheme, and the speaker proceeds regularly from one thing to another, opportunity is given to ease the mind, by relaxing the attention, and recalling it again when necessary.

SECT. IV. CONFIRMATION.

The orator having acquainted his hearers, in the proposition, with the subject on which he designs to discourse, usually proceeds either to prove or illustrate what he has there laid down. For some discourses require nothing more than an enlargement or illustration, to set them in a proper light, and recommend them to the hearers;

for which reason, likewise, they have often no distinct proposition. But where arguments are brought in defence of the subject, this is properly *confirmation*. For, as Cicero defines it, "confirmation is that which gives proof, authority, and support, to a cause, by reasoning." And for this end, if any thing in the proposition seem obscure, or liable to be misunderstood, the orator first takes care to explain it; and then goes on to offer such arguments for the proof of it, and represent them in such a light as may be most proper to gain the assent of his hearers. But here it is proper to observe, that there are different ways of reasoning, suited to different arts. The mathematician treats his subject after another manner than the logician, and the orator in a method different from them both. The forms of reasoning used by orators are four; *Syllogism, Enthymem, Induction, and Example*.

1. By *Syllogism*. A syllogism is a form of reasoning which consists of three propositions; the last of which is deduced from the two former. The first of these is called the *major proposition*, or, for brevity, the *major*; the second the *minor proposition*, or *minor*; and the third, the *conclusion*. But as the last is opposed to the other two jointly, they are called the *premises*, and this the *conclusion*. So we may reduce Cicero's argument by which he endeavours to prove that Clodius assaulted Milo, and not Milo Clodius, to a syllogism in this manner:

He was the aggressor whose advantage it was to kill the other. But it was the advantage of Clodius to kill Milo, and not Milo's to kill him.

Therefore Clodius was the aggressor; or, he assaulted Milo.

2. By *Enthymem*. But orators do not often use complete syllogisms, but most commonly enthymems. An *enthymem* is an imperfect syllogism, consisting of two parts; the conclusion, and one of the premises. And in this kind of syllogism, that proposition is omitted, whether it be the major or minor, which is sufficiently manifest of itself, and may easily be supplied by the hearers. But the proposition that is expressed is usually called the *antecedent*, and the conclusion the *consequent*. So if the major of that syllogism be omitted, by which Cicero endeavours to prove that Clodius assaulted Milo, it will make this enthymem:

The death of Milo would have been an advantage to Clodius. Therefore Clodius was the aggressor; or, therefore he assaulted Milo.

3. By *Induction*. That is, when one thing is inferred from several others, by reason of the similitude between them. And this way of reason is often very useful in popular discourses. For many persons are sooner moved by examples and similitudes than by arguments taken from the nature of things. Every one either endeavours to think right, or at least would be esteemed so to do. But it is often no easy matter to take in the force of an argument, especially for those who have been accustomed to examine things closely, and weigh them duly in their minds. And therefore, when this cannot be done without some pain and uneasiness to the mind, till it become habitual by practice, it is not to be wondered at if such persons are best pleased with that way of reasoning by which they imagine they can form a judgment of things with the greatest ease and facility. But though inductions are made from all kinds of similitudes, yet those usually carry the greatest force with them which are drawn from like facts. Such is that of Cicero, in his oration for the Manilian law; for when some persons objected to Pompey's being intrusted with the Mithridatic war, as a thing not customary to put such an accession of power into the hands of one man; Cicero removes that objection, by producing several instances of the like nature, and particularly shews that more new honours had already been conferred on Pompey than upon any other Roman citizen before him, which had all been employed to the advantage of the state. "I will not (says he) take notice that two very great wars, the Punic and Carthaginian, were both managed by one general; and two very powerful cities, which threatened this empire most, Carthage and Numantia, both destroyed by the same Scipio. I will not observe, that both you and your fathers thought fit to place the safety of the government alone in Caius Marius; and that the same person shall carry on the war with Jugurtha, with the Cimbrians, and with the Teutones. You remember how many new powers have already been conferred on Pompey;" which he then proceeds to enumerate, and from thence infers, that the objection of novelty was no just reason against his being entrusted with the conduct of the important war. And as to other similitudes, it may thus be shewn by induction, that various habits are gained and improved by practice. Bodily strength is increased and confirmed by daily exercise: all manual arts are acquired by repeated trials and experiments: the liberal sciences are also attended by constant study and application: and, in like manner, the mind is formed to virtue, and improved in it, by the continual practice of right actions.

4. By *Example*. Rhetoricians use this word in a different sense from the common acceptation: for that is usually called an *example*, which is brought either to prove or illustrate some general assertion. As if any one should say, that *human bodies may be brought to sustain the greatest labours by use and exercise*; and in order to prove this, should relate what is said of Milo of Croton, that "by the constant practice of carrying a calf several furlongs every day, he could carry it as far after it was to its full size." But in oratory the

ORATORY.

the word *example* is used for any kind of similitude; or, as Vossius defines it, "When one thing is inferred from another, by reason of the likeness which appears between them." Hence it is called an *imperfect induction*, which infers something from several others of a like nature. But, as was observed before, in speaking of induction, so likewise in examples, those have the greatest force in reasoning, which are taken from facts. Now facts may be compared with respect to some agreement or similitude between them, which in themselves are either equal or unequal. Of the former kind this is an instance: "Cato acted as became a patriot, and a lover of his country's liberty, in opposing the arms of Cæsar; and, therefore, so did Cicero." The reason of the inference is founded in the parity of the case, which equally concerned all good subjects of the Roman government at that time. For all were alike obliged to oppose a common enemy, who endeavoured to subvert the constitution, and subject them to his own arbitrary power. Thus we have given a brief account of the principal ways of reasoning commonly made use of by orators.

SECT. V. CONFUTATION.

The forms of reasoning here are the same as have been already explained under *confirmation*. *Confutation*, however, is often the more difficult task; because, he who is to prove a thing comes usually prepared; but he who is to confute it, is frequently left to a sudden answer. For which reason, in *judicial* cases, Quintilian says, "It is much easier to accuse than defend, as it is to make a wound than to heal it." Therefore, not only a good judgment, but a readiness of thought also, seems necessary for this province. But, in all disputes, it is of the greatest consequence to observe where the stress of the controversy lies. For, without attending to this, persons may cavil about different matters without understanding each other, or deciding any thing. And, in confutation, what the adversary has advanced ought carefully to be considered, and in what manner he has expressed himself. As to the things themselves, whether they immediately relate to the matter in dispute, or are foreign to it. Those things that are foreign to the subject, may either be passed over in silence, or, in a very few words, shewn to be insignificant. And there ought likewise to be a distinction made between such things as relate to the subject, according to their importance. Those that appear to have no great weight should be slightly remarked; for, to insist largely upon such matters, is both tiresome to the hearers, and apt to bring the judgment of the speaker into question: and, therefore, things of that nature are generally better turned off with an air of neglect, a pungent question, or an agreeable jest, than confuted by a serious and laboured answer. But those things which relate to the merits of the cause may be confuted either by *contradicting* them, or by shewing some *mistake* in the reasoning, or their *invalidity* when granted.

Things may be *contradicted* several ways. What is apparently false may be expressly *denied*. We have an instance in Cicero, who first upbraids Mark Anthony as guilty of a breach not only of good-breeding but likewise of friendship, for reading publicly a private letter he had sent him. And then adds, "But what will you say now, if I should deny that I ever sent you that letter? How will you prove it? By the hand-writing? In which I confess you have a peculiar skill, and have found the benefit of it. But how can you make it out? for it is in my secretary's hand. I cannot but envy your master, who had so great a reward for teaching you to understand just nothing: for what can be more unbecoming, not only an orator, but even a man, than for any one to offer such things, which, if the adversary denies, he has nothing more to say?" It is a forcible manner of contradicting a thing, by shewing, that the adversary himself maintained the contrary. So, when Oppius was charged with defrauding the soldiers of their provisions, Cicero refutes it, by proving, that the same persons charged Oppius with a design to corrupt the army by his liberality. An adversary is never more effectually silenced than when you can fasten contradictions upon him; for this is stabbing him with his own weapon. There is likewise an ironical way of contradicting a thing, by retorting that, and other things of the like nature, upon the adverse party. Thus Cicero, in his oration against Vatinius, says, "You have objected to me, that I defended Cornelius, my old friend, and your acquaintance. But pray, why should I not have defended him? Has Cornelius carried any law contrary to the omens? Has he violated any law? Has he assaulted the consul? Did he take possession of a temple by force of arms? Did he drive away the tribune, who opposed the passing a law? Has he thrown contempt upon religion? Has he plundered the treasury? Has he pillaged the state? No; these, all these, are your doings." Such an unexpected return is sometimes of great service to abate the confidence of an adversary.

A second way of confutation is, by observing some *flaw* in the reasoning of the adverse party. We shall endeavour to illustrate this, from the several kinds of reasoning treated of before under *confirmation*. And first, as to syllogisms; they may be refuted, either by shewing some mistake in the premises, or, that the conclusion is not justly deduced from them. So, when the Clodian party contended, that Milo ought to suffer death for this reason, Because he had confessed that he had killed Clodius; that argument, reduced to a syllogism, would stand thus:

He who confesses he has killed another ought not to be allowed to see the light.

But Milo confesses this.

Therefore he ought not to live.

For a full definition of propositions, affirmative, negative, absolute, and conditional, with their division into self-evident and demonstrable; together with the several kinds of reasoning, and forms of syllogisms, the reader is referred to our *System of Logic*, Part II. Sect. II. III. and IV. and Part III. throughout.

The last method of *confutation* is, when the orator does, in some sense, *grant* the adversary his argument, and, at the same time, shews its *invalidity*. And this is done by a variety of ways, according to the different nature of the subject. Sometimes he allows what was said may be true; but pleads, that what he contends for is necessary. This was the method by which Hortensius proposed to bring off Verres, as we have already shewn from Cicero, whose words are these, addressing himself to the judges: "What shall I do? which way shall I bring in my accusation? where shall I turn myself? for the character of a brave general is placed like a wall against all the attacks I can make. I know the place, I perceive where Hortensius intends to display himself. He will recount the hazards of war, the necessities of the state, the scarcity of commanders; and then he will intreat you, and do his utmost to persuade you, not to suffer the Roman people to be deprived of such a commander upon the testimony of the Sicilians, nor the glory of his arms to be sullied by a charge of avarice." At other times the orator pleads, that, although the contrary opinion may seem to be attended with advantage, yet, that his own is more just or honourable. Such was the case of Regulus, when his friends endeavoured to prevail with him to continue at Rome, and not return to Carthage, where he knew he must undergo a cruel death. But, as this could not be done without violating his oath, he refused to hearken to their persuasions. Another way of confutation is, by retorting upon the adversary his own argument. Thus Cicero, in his defence of Ligarius, says: "You have, Tubero, that which is most desirable to an accuser, the confession of the accused party; but yet, such a confession, that he was on the same side that you, Tubero, chose yourself, and your father too, a man worthy of the highest praise. Wherefore, if there was any crime in this, you ought first to confess your own, before you attempt to fasten any upon Ligarius." The orator takes this advantage where an argument proves too much, that is, more than the person designed it for, who made use of it.

SECT. VI. CONCLUSION.

Rhetoricians make the *conclusion* of a discourse to consist of two parts: *recapitulation*, and an *address to the passions*. 1. *Recapitulation* is a summary account of what the speaker has before offered in maintenance of his subject; and is designed both to refresh the memory of the hearers, and to bring the principal arguments together into a narrow compass, that they may appear in a stronger light. We have a very exact and accurate example of repetition in Cicero's oration for Quintus. Cicero was then a young man, and seems to have kept more closely to the rules of art than afterwards, when, by use and practice, he had gained a greater freedom of speaking. The partition of his speech runs thus: "We deny, Sextus Nevius, that you was put into the possession of the estate of P. Quintus, by the prætor's edict. This is the dispute between us. I will therefore shew, first, that you had no just cause to apply to the prætor for possession of the estate of P. Quintus; then, that you could not possess it by the edict; and, lastly, that you did not possess it. When I have proved these three things, I will conclude." Now Cicero begins his conclusion with a repetition of those three heads, and a summary account of the several arguments he made use of under each of them. But they are too long to be here exhibited.

2. We now proceed to the other part of the conclusion, which consists in an *address to the passions*. Indeed the orator sometimes endeavours occasionally to work upon the passions of his hearers in other parts of his discourse, but more especially in the conclusion, where he is warmest himself, and labours to make them so. For the main design of the introduction is to conciliate the hearers, and gain their attention; of the narration, proposition, and confirmation, to inform them; and of the conclusion, to move them. And therefore, to use Quintilian's words, "Here all the springs of eloquence are to be opened. It is here we secure the minds of the hearers, if what went before was well managed. Now we are past the rocks and shallows, all the fails may be hoisted. And, as the greatest part of the conclusion consists in illustration, the most pompous language and strongest figures have place here." Now the passions to which the orator more particularly addresses differ according to the nature of the discourse. In demonstrative orations, when laudatory, love, admiration, and emulation are usually excited; but in invectives, hatred, envy, and contempt. In deliberative subjects, either the hope of gratifying some desire is set in view, or the fear of some impending evil. And, in judicial discourses, almost all the passions have place, but more especially resentment and pity; inasmuch, that most of the ancient rhetoricians mention only these two.—But, having treated upon the nature of the passions, and the methods suited both to excite and allay them, in Part I. Sect. IV. we shall, at present, only add a few general observations, which may

ORATORY.

may not be improper in this place, where the skill of the orator, in addressing to them, is more especially required.

The orator will observe what circumstances, either of things or persons, or both, will furnish him with motives proper to apply to those passions he desires to excite in the minds of his hearers. Thus Cicero, in his orations for Plancus and Sylla, moves his hearers from the circumstances of the men; but, in his accusation of Verres, very frequently from the barbarity and horrid nature of his crimes; and from both in his defence of Quintius. But the same passion may be excited by very different methods. This is plain from the writings of those Roman satyrists which are yet extant; for they have all the same design, and that is to engage men to a love of virtue, and hatred of vice: but their manner is very different, suited to the genius of each writer. Horace endeavours to recommend virtue, by laughing vice out of countenance; Persius moves us to an abhorrence and detestation of vice, with the gravity and severity of a philosopher; and Juvenal, by open and vehement invectives. So orators make use of all these methods in exciting the passions; as may be seen by their discourses, and particularly those of Cicero. But it is not convenient to dwell long upon the same passion; for the image, thus wrought up in the minds of the hearers, does not last a great while, but they soon return to reflection. When the emotion, therefore, is once carried as high as it well can be, they should be left under its influence, and the speaker proceed to some new matter, before it declines again. Moreover, orators sometimes endeavour to raise contrary passions to each other, as they are concerned for opposite parties. So the accuser excites anger and resentment, but the defendant pity and compassion. At other times, one thinks it sufficient to allay and take off that passion which the other has raised, and bring the hearers to a calm and sedate consideration of the matter before them. But this especially is to be regarded, that the orator expresses the same passion himself, with which he endeavours to affect others; and that not only in his action and voice, but likewise in his language: and, therefore, his words, and manner of expression, should be suited to that perturbation and disorder of mind which he designs to represent. However, a decency and propriety of character is always carefully to be observed; as Cicero very well remarks, "A neglect of this is not only very culpable in life, but likewise in discourse: nor do the same things equally become every speaker, or every audience; nor every time, and every place." And, therefore, he greatly commends that painter, who, designing to represent, in a picture, the sacrifice of Iphigenia, Agamemnon's daughter, drew Calchas, the priest, with a sad countenance; Ulysses, her father's great friend, more dejected; and her uncle, Menelaus, most disconsolate; but threw a veil over the face of Agamemnon himself, as being unable to express that excess of sorrow which he thought was proper to appear in his countenance.

As persons are commonly more affected with what they see than what they hear, orators sometimes call in the assistance of that sense in moving the passions. For this reason, it was usual among the Romans, in judicial cases, for accused persons to appear with a dejected air, and a fordid garb, attended by their parents, children, or other relations and friends, with the like dress and aspect; as likewise to show their scars, wounds, bloody garments, and other things of the like nature, in open court. So when, upon the death of Cæsar, Mark Antony harangued the populace, he, at the same time, exposed to their view the garment in which he was flabbed, fixed upon a pole; at which sight they were so enraged, that immediately they ran with lighted torches to set fire to the houses of the conspirators. But this custom at last became so common, and was sometimes so ill conducted, that the force of it was greatly abated, as we learn from Quintilian.

PART III. OF ELOCUTION.

Elocution directs us to suit both the words and expressions of a discourse to the nature of the subject, or, to speak with propriety and decency. This faculty is, in one word, called *eloquence*; and those persons who are possessed of it are therefore styled *eloquent*.

Elocution is twofold: general, and particular. The former treats of the several properties and ornaments of language in common; the latter considers them as they are made use of to form different sorts of style.

SECT. I. GENERAL ELOCUTION.

This, according to rhetoricians, consists of three parts: *Elegance*, *Composition*, and *Dignity*. A discourse which has all these properties suitably adjusted, must, with respect to the language, be perfect in its kind, and delightful to the hearers.

ART. I. ELEGANCE.—*Elegance* consists in two things: *Purity*, and *Perspicuity*: and both these as well with respect to single words, as their construction in sentences. These properties in language give it the name of *elegant*, for a like reason that we call other things so which are clean and neat in their kind. But, in the common use of our tongue, we are apt to confound *elegance* with *eloquence*; and say, a discourse is *elegant*, when we mean, by the expression, that it has all the properties of fine language.

By *purity*, we are to understand the choice of such words and phrases as are suited and agreeable to the use of the language in which we speak: and so grammarians reduce the faults they oppose to it to two sorts, which they call *barbarism*, and *solecism*; the

No. 121.

former of which respects single words, and the latter their construction. But we shall consider them jointly, and in a manner different from grammarians; for, with them, all words are esteemed pure which are once adopted into a language, and authorised by use: and as to phrases, or forms of expression, they allow them all the same claim, which are agreeable to the analogy of the tongue. But, in oratory, neither all words nor all expressions are so called, which occur in language; but such only as come recommended by the authority of those who speak or write with accuracy and politeness: indeed it is a common saying, *that we should think with the learned, and speak with the vulgar*; but the meaning of that expression is no more than that we should speak agreeably to the common usage of the tongue, that every one may understand us; and not choose such words or expressions as are either difficult to be understood, or may carry in them an appearance of affectation and singularity. But, in order to set this matter in a clear light, we shall here recount the principal things which vitiate the purity of language.

And, first, it often happens, that such words and forms of speaking as were introduced by the learned, are afterwards dropped by them, as mean and fordid, from a seeming baseness contracted by vulgar use; for polite and elegant speakers distinguish themselves by their discourse, as persons of figure do by their garb; one being the dress of the mind, as the other is of the body: and hence it comes to pass, that both have their different fashions, which are often changed; and, as the vulgar affect to imitate those above them in both, this frequently occasions an alteration when either becomes too trite and common. But, besides these fordid words and expressions, which are rendered so by the use of the vulgar, there is another sort, first introduced by them, which is carefully to be avoided by all those who are desirous to speak well: for the vulgar have their peculiar words and phrases, suited to their circumstances, and taken from such occurrences as usually occur in their way of life. Thus, in the old comedians, many things are spoken by servants, agreeable to their character, which would be very unbecoming from the mouth of a gentleman; and we cannot but daily observe the like instances among ourselves. Again, this is common to language with all other human productions, that it is, in its own nature, liable to a constant change and alteration: for, as Horace has justly observed,

All human works shall waste,
Then how can feeble words pretend to last?

Nothing could ever please all persons, or, at least for any length of time; and there is nothing from which this can less be expected than language: for, as the thoughts of men are exceedingly various, and words are the signs of their thoughts, they will be constantly inventing new signs to express them by, in order to convey their ideas with more clearness, or greater beauty. If we consider our own language, it will appear to have been in a manner entirely changed from what it was a few ages since. To mention no others, our celebrated Chaucer is to most persons now almost unintelligible, and wants an expostor. And even, since our own memory, we cannot but have observed that many words and expressions, which, a few years ago, were in common use, are now, in a manner, laid aside and antiquated; and that others have constantly succeeded, and daily do succeed, in their room. So true is the observation of the same poet:

Some words that have, or else will feel decay,
Shall be reitor'd, and come again in play:
And words, now fam'd, shall not be fancied long;
They shall not please the ear, nor move the tongue:
As use shall their approve, and those condemn;
Use, the sole rule of speech, and judge supreme.

We must, therefore, no less abstain from antiquated or obsolete words and phrases, than from fordid ones.

But farther: as, on the one hand, we must avoid obsolete words and phrases; so, on the other, we should refrain from new ones, or such whose use has not yet been sufficiently established, at least among those of the best taste. Words may be considered as new in two respects, either when they are first brought into a language, or when they are used in a new sense. As the former of these may sometimes leave us in the dark, by not being understood, so the latter are most apt to mislead us; for when we hear a word that has been familiar to us, we are presently led to fix that idea to it with which it has usually been attended; and, therefore, in both cases, some previous intimations may be necessary. Cicero, who, perhaps, enlarged the furniture of the Roman tongue more than any one person besides, appears always very cautious how he introduces any thing new, and generally gives notice of it when he attempts it, as appears in many instances scattered through his works.

But, besides those things already mentioned, any mistake in the sense of words, or their construction, is opposed to purity; for, to speak purely, is to speak correctly: and such is the nature of these faults in elocution, that they are often not so easy to be observed by hearing as by reading. Whence it is, that many persons are thought to speak better than they write; for, while they are speaking, many slips and inaccuracies escape disregarded, which, in reading, would presently appear: and this is more especially the case of persons unacquainted with arts and literature, who, by the assistance of a lively fancy, and flow of words, often speak with great ease and freedom, and, by that means, please the ear;

A a

when

ORATORY.

when, at the same time, what they say would not so well bear reading. We shall only add, that a distinction ought likewise to be made between a poetic diction and that of prose writers; for poets in all languages have a sort of peculiar dialect, and take greater liberties, not only in their figures, but also in their choice and disposition of words; so that what is a beauty in them, would often appear unnatural and affected in prose.

Periphrasis, as well as *purity*, consists partly in *single words*, and partly in their *construction*.

As to *single words*, those are generally clearest, and best understood, which are used in their proper sense. But it requires no small attention and skill to be well acquainted with the force and propriety of words; which ought to be duly regarded, since the perspicuity of a discourse depends so much upon it. Cæsar seems plainly to have been of this mind, when he tells us, "The foundation of eloquence consists in the choice of words." It may not be amiss, therefore, to lay down some few observations, by which the distinct notions of words, and their peculiar force, may more easily be perceived. All words may be divided into *proper words* and *tropes*. Those are called *proper words* which are expressed in their proper and usual sense; and *tropes* are such words as are applied to some other thing than what they properly denote, by reason of some similitude, relation, or contrariety between the two things. So, when a subtle artful man is called a *fox*, the reason of the name is founded in a similitude of qualities. If we say *Cicero will always live*, meaning *his works*, the cause is transferred to the effect; and when we are told, *Cæsar conquered the Gauls*, we understand that he did it with the assistance of his army; where a part is put for the whole, from the relation between them. And, when Cicero calls Anthony *a fine guardian of the state*, every one perceives he means the contrary. But the nature and use of tropes will be explained more fully hereafter, in their proper place. All words must at first have had one original and primary signification, which, strictly speaking, may be called their *proper sense*; but it sometimes happens, through length of time, that words lose their original signification, and assume a new one, which then becomes their proper sense. So *hostis*, in the Latin tongue, at first signified a *stranger*; but, afterwards, that sense of the word was entirely laid aside, and it was used to denote a *public enemy*: and, in our language, it was well known, that the word *knave* anciently signified a *servant*. The reason of the change seems to be much the same as in that of the Latin word *latro*; which first signified a *soldier*, but afterwards a *robber*. Besides, in all languages it has frequently happened, that many words have gradually varied from their first sense to others somewhat different; which may, notwithstanding, all of them, when rightly applied, be looked upon as proper. Nay, in process of time, it is often difficult to say which is the original or most proper sense.

But *perspicuity* arises not only from a choice of *single words*, but likewise from the *construction* of them in sentences: for the meaning of all the words in a sentence, considered by themselves, may be very plain and evident; and yet, by reason of a disorderly placing them, or confusion of the parts, the sense of the whole may be very dark and obscure. Now, it is certain, that the most natural order is the plainest; that is, when both the words and parts of a sentence are so disposed as best agrees with their mutual relation and dependence upon each other; and where this is changed, as is usually done, especially in the ancient languages, for the greater beauty and harmony of the periods; yet due regard is had, by the best writers, to the evidence and perspicuity of the expressions. But, to set this subject in a clearer light, on which the perfection of language so much depends, we shall mention some few things which chiefly occasion obscurity; and this either with respect to single words, or their construction.

And, first, all ambiguity of expression is one cause of obscurity. This sometimes arises from the different senses in which a word is capable of being taken. So we are told, that, upon Cicero's addressing himself to Octavius Cæsar, when he thought himself in danger from his resentment, and reminding him of the many services he had done him, Octavius replied, *He came the last of his friends*. But there was a designed ambiguity in the word *last*, as it might either respect the time of his coming, or the opinion he had of his friendship. And this use of ambiguous words we sometimes meet with, not only in poetry, where the turn and wit of an epigram often rests upon it; but likewise in prose, either for pleasantry or ridicule.

Again, obscurity is occasioned either by too short and concise a manner of speaking, or by sentences too long and prolix; either of these extremes have sometimes a bad consequence. Another cause of obscurity, not inferior to any yet mentioned, is *parenthesis*, when it is either too long, or too frequent. This of Cicero, in his oration for Sylla, is longer than we usually find in him: "O, immortal gods! (for I must attribute to you what is your own; nor indeed can I claim so much to my own abilities, as to have been able of myself to go through so many, so great, such different affairs, with that expedition, in that boisterous tempest of the state) you inflamed my mind with a desire to save my country." But where any obscurity arises from such sentences, they may frequently be remedied by separating the parenthesis from the rest of the sentence, and placing it either before or after.

ART. II. COMPOSITION.

COMPOSITION, in the sense it is here used, gives rules for the structure of sentences, with the several members, words, and syllables, of which they consist, in such a manner as may best contribute to the force, beauty, and evidence of the whole. *Composition* consists chiefly of two parts, which rhetoricians call *period* and *order*. The first of these treats on the structure of sentences; the second, of the parts of sentences, which are words and members.

PERIOD.

In every sentence or proposition, something is said of something. That of which something is said, logicians call the *subject*; and that which is said of it, the *predicate*: but, in grammatical terms, the former is a *noun substantive* of the *nominative case*, and the latter a *finite verb*. These two parts may of themselves constitute a sentence: as, when we say, *The sun shines*, or, *The clock strikes*, the words *sun* and *clock* are the subject in these expressions, *shines* and *strikes* the predicate: but most commonly they are accompanied with other words, which, in grammatical construction, are said either to be connected with, or to depend upon them; but, in a logical consideration, they denote some property or circumstance relating to them, as in the following sentence: *A good man loves virtue for itself*. The subject of this sentence is, *a good man*; and the predicate, or thing affirmed of him, that he *loves virtue for itself*: but the two principal or necessary words, on which all the rest depend, are, *man* and *loves*. Now a simple sentence consists of one such noun and verb, with whatever else is joined to either or both of them: and a compound sentence contains two or more of them; and may be divided into so many distinct propositions as there are such nouns and verbs, either expressed or understood. So, in the following sentence, *Compliance gains friends, but truth procures hatred*, there are two members, each of which contains in it an entire proposition; for, *Compliance gains friends*, is one complete sentence; and, *Truth procures hatred*, is another; which are connected into one compound sentence by the particle *but*.

As the principal art relating to this part of composition lies in the frame and structure of such compound sentences as are properly called *periods*, we shall briefly treat upon them under this head. In the formation of these periods, two things are chiefly to be regarded: their *length*, and *cadency*. As the length ought to be suited to the breath of the speaker, the ancient rhetoricians scarce admit of more than four colons; by which we may here understand compound members of a moderate size, which will be generally found a suitable and proportionate length: for, to extend them farther than the voice can well manage, must be painful to the speaker, and, of consequence, unpleasant to the hearers. As to the cadency, what Cicero has observed is found true by experience, that the ears judge what is full, and what is deficient; and direct us to fill up our periods, that nothing be wanting of which they expect. When the voice is raised at the beginning of a sentence, they are in suspense till it be finished; and are pleased with a full and just cadency, but are sensible of any defect, and are displeased with redundancy. Therefore care must be taken that periods be neither deficient, and, as it were, maimed; that is, that they do not drop before their time, and defraud the ears of what seemed to be promised them; nor, on the other hand, offend them by too long and immoderate excursions. But, as all discourse is made of distinct sentences, so the use of periods is not promiscuous, but suited to answer different designs in speaking: and in this view they are considered and made use of by the orator.

ORDER.

By *order*, rhetoricians mean the placing each word and member of a sentence in such a manner as will most contribute to the force, beauty, or evidence of the whole. Order is of two kinds, *natural* and *artificial*.

Artificial order, as it respects simple sentences, has little or no regard to the natural construction of words; but disposes them in such a manner as will be most agreeable to the ear, and best answer the design of the speaker. As to compound sentences, that is, such as consist of two or more members, either simple, or compounded, what relates to the words in each member separately, is the same as in simple sentences. But with regard to the disposition of the several members, that may be called the *natural order* which so places them as they mutually depend on each other.

ART. III. DIGNITY.

DIGNITY consists in the right use of tropes and figures. It is not sufficient for an orator to express himself with propriety and clearness, or in smooth and harmonious periods; but his language must likewise be suited to the nature and importance of the subject: and, therefore, as *elegance* gives rules for the first of these, and *composition* for the second, so does *dignity* for the last of them. Tropes and figures are distinguished from each other in several respects: tropes most affect single words, but figures whole sentences. A trope conveys two ideas to the mind by means of one word; but a figure throws the sentence into a different form from the common and usual manner of expression. Besides, tropes are chiefly designed to represent our thoughts; but figures our passions.

TROPE.

A *trope*, as it has been usually defined, is *the change of a word from its proper signification to some other, with advantage*. The words

ORATORY.

words, with advantage, are added in the definition, because a trope ought not to be chosen unless there is some good reason for using it rather than the proper word. But in what manner, or how far, it can be said of all tropes in general, that they change the proper signification of words, will best appear by considering the nature of each kind of them separately. Now in every trope a reference is had to two things, which occasions two ideas, one of the things expressed, and another to that thing to which it has a respect, and is supplied by the mind. For all tropes are taken either from things internally related, as the whole and a part; or externally, as cause and effect, subject and adjunct; or from some similitude that is found between them; or from a contrariety. The first of these is called *synecdoche*, the second *metonymy*, the third *metaphor*, and the last *irony*. We shall explain these hereafter. But though in reality there are but four kinds of tropes, which are distinguished by so many different respects which things bear one to another, yet as these several respects are found in a variety of subjects, and attended with different circumstances, the name of tropes has from hence been greatly multiplied; and for distinction sake we shall call the former *primary*, and the latter *secondary*, tropes. We now proceed to consider the reasons which have occasioned the introduction of tropes; and these, Quintilian as observes, are three: *necessity*, *emphasis*, and *beauty*.

Tropes were first introduced from necessity, because no language contains a sufficient number of proper words to express all the different conceptions of our minds. The mind considers the same thing various ways; views it in different lights; compares it with other things; and observes their several relations and affections; wherein they agree, and in what they differ. From all which reflections, it is furnished with almost an infinite number of ideas; which cannot all of them be distinguished and expressed by proper words, since new ones occur daily.

A second reason abovementioned for the use of tropes was, *emphasis*. Tropes often express things with greater force and evidence than can be done by proper words. We receive much the greater part of our knowledge by our senses; and similitudes taken from sensible things, as in metaphors, very much assist the mind in its reflections upon those things which do not come under the cognizance of our senses. Nay, sometimes one bright and lively trope shall convey a fuller and more just idea of a thing, than a large periphrasis. So when Virgil calls the Scipios *two thunderbolts of war*, he gives a more lively image of the rapid force and speedy success of their arms than could have been conveyed by a long description of words. But *beauty* and ornament have been another cause for the use of tropes. Some subjects require a more florid and elegant dress than others. When we describe or applaud, ornaments of speech, and a gaiety of expression, are requisite: and it is the business of an orator to entertain his hearers at the same time that he instructs them. Now Cicero who was an admirable judge of the force and power of eloquence, has observed, that tropical expressions give the mind the greatest delight and entertainment. "I have often wondered (says he) why tropes should give greater pleasure than proper words? I imagine the reason must be, either that there is an appearance of wit in neglecting what is at hand, and making choice of something at a distance; or that the hearer is furnished with a different thought, without being led into a mistake, which affords a very agreeable pleasure; or that a whole similitude is conveyed to the mind by a single word; or that, particularly in the best and most lively metaphors, the image is presented to our sight, which is the quickest of our senses." And therefore he supposes, that "as garments were first invented from necessity, to secure us from the injuries of the weather, but improved afterwards for ornament and distinction; so the poverty of language first introduced tropes, which were afterwards increased for delight." As a moderate use of tropes, justly applied, beautifies and enlivens a discourse; so an excess of them causes obscurity, by running it into absurd allegories and riddles. Tropes are not the common and ordinary dress of our thoughts, but a foreign habit: and therefore he who fills his discourse with a continued series of them, seems to act like one who appears in public in a strange dress, which no man of character would choose to do.

PRIMARY TROPES.

Metaphor. A metaphor as usually defined, is: *A trope, which changes words from their proper signification to another different from it, by reason of some similitude between them.* A word, when used metaphorically, does not alter its signification, but retains its proper sense. In every similitude three things are requisite: two things that are compared together; and a third, in which the similitude or likeness between them consists; and therefore, to keep to this example, when Horace calls a Roman soldier a *lion*, if the word *lion* did not contain its proper sense, there could be no similitude: because there would not be two things to be compared together with respect to a third, which is necessary in every similitude, and was designed by this expression. The real difference between a metaphor and a similitude consists in this: that a metaphor has not those signs of comparison which are expressed in a similitude. The use of metaphors is very extensive, as large as universal nature. For there are scarce any two things which have not some similitude between them. As to the choice of metaphors, those

are esteemed the finest and strongest, which give life and action to inanimate things. The reason of which is, because they do as it were invigorate all nature, introduce new forms of beings, and represent their images to the sight, which of all the senses is the quickest, most active, and yet most unwearied. Care must be taken not to venture upon too bold and daring metaphors. Poets indeed claim greater liberty in this respect, whose view is often to amuse, terrify, or delight, by heightening the just and natural images of things. But it is expected the orator should reason coolly, though strongly and forcibly; and not by theatrical representations so transport the mind as to take it off from reflection, unless perhaps on some particular occasion: and yet, on the other hand, metaphors ought not to sink below the dignity of what they are designed to express; but the idea they convey should at least be equal to the proper word in the place of which they are substituted. All forced and harsh metaphors should be avoided, the one being no less disagreeable to the mind than the other to the ear. Nor should they come too thick in a discourse. In a word, they ought not to be used but either where a proper word is wanting, or they are more significant or beautiful than the proper word.

2. *Metonymy.* This, as defined by Quintilian, is *the putting one word for another.* But Vossius describes it more fully, when he calls it "A trope, which changes the names of things that are naturally united, but in such a manner as that one is not of the essence of the other." When it is said, *to put one word for another*, or *to change the names of things*, the meaning is, that the word so used changes its sense, and denotes something different from its proper signification. Thus, when *Mars* is put for *war*, and *Ceres* for *corn*, they lose their personal sense, and stand for the effects of which those deities were said to be the cause. So likewise, when Virgil says,

He drank the frothing bowl,

the word *bowl* must necessarily signify the liquor in the bowl. Metonymies are very useful in language; for they enrich a discourse with an agreeable variety, and give both force and beauty to an expression. Metonymies are commonly distinguished into four kinds, from the different manner in which things are naturally, but externally, united to one another. Now things are thus united, or one thing depends upon another, either with respect to its production, or in the manner of its existence when produced. In the former way the effect depends upon its cause, and in the latter the adjunct upon its subject: and hence arise four sorts of metonymies, which receive their names from the cause and effect, the subject and the adjunct. It is called a *metonymy of the cause*, when the external cause is put for the effect. The external cause is twofold, the agent and end, which are usually called the *efficient* and *final cause*. Of the former kind are such metonymies, where the inventor or author is put for what was invented or effected by him. Thus, as we said before, *Ceres* is sometimes put for *corn*, the use of which she was said first to have introduced; and *Mars* for *war*, over which he was thought to preside. The second kind of metonymy puts the effect for the efficient cause, whether the agent, or only the means and instrument. So Virgil calls the two Scipios *the destruction of Lybia*, because they were the agents who effected it: and Horace compliments his patron Mæcenas with the titles of being *his guard and honour*; that is, his guardian, and the author of his honour. But when Cicero tells the citizens of Rome that *the death of Clodius was their safety*, he means the occasion only of their safety. In these instances, the effect is put for the efficient cause. The third kind of metonymy is when the subject is put for the adjunct. By subject here, in a large sense of the word, may be understood that wherein some other thing is contained, or about which it is conversant; as likewise the possessor with respect to the thing he possesses; and the thing signified, when put for the sign of it. Now, by the first of these ways of speaking, the seat of any faculty or affection is used for the faculty or affection itself. So it is usual to say, *a man of a clear head*, when we mean a clear mind or understanding; the seat of the mind being in the head. In like manner the place where any actions are performed, is put for the actions done in it: as when Cicero says, "Do not always think of the forum, the benches, the rostra, and the senate;" meaning the discourses which were usually made in those places. So likewise the country, or place of residence, is put for the inhabitants, as in that passage of Cicero: "And, to omit Greece, which always claimed pre-eminence for eloquence, and Athens, the inventress of all sciences, where the art of speaking was invented and perfected, in this city of ours (meaning Rome) no studies have prevailed more than that of eloquence." Where the words Greece and Athens stand to denote the inhabitants of those places. The fourth kind of metonymy is that wherein the adjunct is put for the subject, which is done in the same variety of ways as the former. It is therefore a metonymy of the adjunct when the thing contained is put for that which contains it. As when Virgil says, "They lie down upon purple; that is, upon couches dyed with purple. And again, "They crown the wine;" meaning the bowl which contained the wine; it being the custom of the ancients to deck their bowls with garlands at their entertainments. By these tropes likewise virtues and vices are put for the persons in whom they are found. As in that beautiful passage of Cicero, where, comparing the profligate army of Cataline with

ORATORY.

with the forces of the state, he says, "On this side modesty is engaged, on that impudence: on this chastity, on that lewdness; on this integrity, on that deceit; on this piety, on that profaneness; on this constancy, on that fury; on this honour, on that baseness; on this moderation, on that unbridled passion; in a word, equity, temperance, fortitude, prudence, and all virtues, engage with injustice, luxury, cowardice, rashness, and all vices." And to this trope those expressions are to be referred, in which anything is put for the object about which it is conversant. Lastly, by this metonymy, the sign is put for the thing it signifies; as, *the sceptre for the regal dignity, and the sword for the authority of the magistrate.*

3. *Synecdoche.* This is a trope by which either the whole of a thing is put for a part of it, or a part for the whole; so that the two things, whose ideas are presented to the mind in this trope, are internally related to each other: and thus rhetoric is an integral whole in respect to the four parts that compose it, namely, invention, disposition, elocution, and pronunciation. So likewise any aggregate body, as a civil community, which is divisible into those who govern and are governed; or any army, consisting of the general, and his soldiers. As a whole therefore, in each of these acceptations of the word, is frequently put for a part, and a part for the whole; hence arises six species or sorts of synecdoche. The first of these puts the genus for the species.—Thus, virtue in general is sometimes used to denote some particular sort of virtue. The second kind of synecdoche puts the species for the genus. Thus *bread* denotes any kind of food; as when a person is said to *get his bread by his labour.* The third species of this trope is, when the essential whole is put for one of its parts; that is, either for the matter or form. Thus, in the evangelist, Mary Magdalen says, *They have taken away my Lord, and I know not where they have laid him;* meaning his body. So it is usual to say of a deceased person, *He was buried at such a time.* The fourth kind of synecdoche, is, when either the matter or form is put for the whole being. Thus *silver* and *gold* are used to signify money made of those metals; as when we say, *I have o much silver or so much gold.* And the word *soul*, both in our own and other languages, is put for the whole person. By the fifth sort of synecdoche, the whole of any material thing or quantity, whether continued or discrete, is put for a part of it. So when Cicero says, *A war is kindled through the whole world;* in compliment to his country, he calls the Roman empire *the world.* and this expression is also used by historians. Thus Cornelius Nepos, speaking of the quarrel between Mark Antony and Augustus, tells us, that *each of them desired to be lord of the world.* And in like manner St. Luke says, *There went out a decree from Caesar Augustus, that all the world should be taxed.* The sixth and last kind of synecdoche puts a part of any material thing or quantity for the whole of it. So we say of a man, *He shelters himself under such an one's roof;* that is, *in his house;* and of a fleet, that it *consists of so many sail;* meaning *so many ships.* And to this kind of synecdoche may also be referred such expressions in which the singular number is put for the plural; as if one should say, *man is liable to be misled by the influence of irregular passions;* meaning *all men, or mankind in general.* Or when less than the real number is put for any round number. Thus some ancient writers, when they speak of the Grecian armada which came against Troy, call it a fleet of *a thousand ships;* though, according to Homer's list, it contained 1186. And so likewise the Greek interpreters of the Old Testament are usually called the *Seventy;* whereas, in reality, they were seventy-two.

4. *Irony.* This is a trope in which one contrary is signified by another: as if any one should say, *well done,* when at the same time his design is to intimate that the thing was *ill done.* So that by this manner of expression, the speaker appears to mean something contrary to the sense of the word he makes use of. Not that the word is changed from its usual signification; but by the circumstances attending the expression, we perceive the contrary to what is spoken is intended.

The subjects of irony are vices and follies of all kinds; and this way of exposing them is often more effectual than serious reasoning: for many persons, who, either from temper or want of reflection, cannot be moved by the force of an argument, are not proof against the poignancy of wit and raillery. And therefore we find the most grave and serious persons have not declined the use of this trope upon proper occasions. Socrates, whom the oracle pronounced the wisest man of his age, gave so much into it, that he got the name of *εἰρων*, that is, the *droll.* In the sacred writings we have a remarkable instance of it in the prophet Elijah, where he challenges the priests of Baal to prove the truth of their deity: for it is said expressly, "He mocked them, and said, Cry aloud, for he is a god; either he is talking, or he is pursuing, or he is on a journey, or peradventure he sleepeth, and must be waked." And Solomon takes the like method to expose the follies of youth by this ironical apostrophe: "Rejoice, O young man! in thy youth," with what follows, which is all ironical. Nay, our Saviour himself thought fit thus to reprove the Jewish doctors, when he says, "Full well ye reject the commandment of God, that ye may keep your own tradition:" Where, by the words *full well*, or, as it is in the original, *αὐτως*, it is very evident that a severe reprimand was intended.

SECONDARY TROPES.

Secondary Tropes are so called because they are all of the same nature with the former, and may be referred to some or other of them, though they have received different names. They are chiefly eight in number: *Antonomasia, Communication, Litotes, Euphemism, Catachresis, Hyperbole, Metalepsis, and Allegory.* The three first of these are simple tropes, and may all be referred to a *Synecdoche*: but the five last are of a mixed or complex nature, and not confined to any one of the primary tropes; as will appear in treating upon them in order. When any displeasing or ungrateful thing is expressed by a more soft and agreeable word, it is called *euphemism*: and as the word made use of is either contrary to the proper word, or only different from it, it may be referred to different tropes. The Latins have a soft way of expressing their disregard to a person by saying *valeat*; which we have borrowed from them, and say, *fare him well.* When the contrary being intended to what is expressed, it comes properly under an *irony.* *Catachresis* signifies any harsh trope, though it is most commonly found in metaphors. It is principally used by poets, who make choice of it for novelty, or to enforce an expression, where the proper word does not seem strong enough. As when Milton, in describing the angel Raphael's descent from heaven, says, he

Sails between worlds and worlds;

where the novelty of the word enlivens the image more than if he had said *flies.* *Hyperbole* is the boldest of all tropes; for it exceeds the strict bounds of truth, and represents things either greater or less, better or worse, than they really are. But the representation is made in such a manner as not to impose on the hearers. For an *hyperbole* is not used to define or describe any thing accurately, but only to magnify or depress it in a considerable degree, when we either cannot or do not choose to represent it exactly. The excess in this trope is called *auxesis*; as when we say of any thing that is very high, *it reaches to the skies.* The defect, or contrary extreme, is termed *meiosis*; so we say of a very lean person, *he is nothing but skin and bones, or a mere skeleton.* It is principally metaphorical, but sometimes taken from other tropes. Sometimes two or more tropes, and those of a different kind, are contained under one word; so that several gradations or intervening senses come between the word that is expressed and the thing designed by it: and this is called a *metalepsis.* The contests between Sylla and Marius proved very fatal to the Roman state. Julius Caesar was then a young man; but Sylla observing his aspiring genius, said of him, "In one Caesar there are many Mariuses." In this expression there is a *metalepsis.* *Allegory*: as a *metalepsis* comprises several tropes in one word, so this is a continuation of several tropes in one or more sentences. Thus Cicero says, "Fortune provided you no field in which your virtue could run and display itself:" when the words *field* and *run* are metaphors taken from corporeal things, and applied to the mind. Allegories generally consist of metaphors; which being the most beautiful trope, a number of them well chosen and put together is one of the finest and brightest ornaments in language, and exceeds a single metaphor in lustre, as a constellation does a separate star.

FIGURES.

The term *figure* seems to have been borrowed from the stage, where the different habits and gestures of the actors, suitable to the several characters they sustained, were by the Greeks called *σχημα*, and by the Latins *figura*: and it is not unusual with us to say of a person, both with respect to his dress and action, that he makes a *very bad*, or a *very graceful, figure.* And as language is the dress, as it were, of our thoughts, in which they appear and are represented to others; so any particular manner of speaking may, in a large sense of the word, be called its *figure*, in which latitude writers sometimes use it. But rhetoricians have restrained the sense of the word to such forms of speech as differ from the more common and ordinary ways of expression; as the theatrical habits of actors, and their deportment on the stage, are different from their usual garb and behaviour at other times. A *figure* therefore, in the sense it is used by rhetoricians, is, *A mode of speaking different from, and more beautiful and emphatical than the ordinary and usual way of expressing the same sense.* It must contain some beauty, or express some passion, to merit a place among rhetorical figures, and to be marked out for imitation. Aristotle, who treats so accurately upon other parts, says very little of this. But the Greek writers who came after him have abundantly supplied that deficiency. It is to them we owe the chief observations that have been made on this subject. Indeed, they have treated the matter with that minuteness and subtilty that Quintilian seems, not without reason, to think they have multiplied figures to an excess; but though it was so late before they were taken notice of, and introduced into the art of speaking, yet the use of them in discourse was doubtless very ancient. The author of Homer's life, which some have ascribed to Plutarch, has shewn, by examples taken out of him, that there is scarce a figure mentioned by rhetoricians, but it is to be met with in that most ancient poet; and, if we consider the nature of speech, we shall easily perceive that mankind must have been under a necessity, very early, to introduce the use of *tropes*, for supplying the want of proper words to express their simple ideas: so the like necessity must have put them upon the use of figures to represent their different passions. Though

ORATORY.

Though both of them were afterwards increased, and improved in such a manner as to become the chief ornaments of language. The passions of men have been always the same; they are implanted in us by nature, and we are all taught to discover them by the same ways. When the mind is disturbed, we shew it by our countenance, by our actions, and by our words. Fear, joy, anger, alter the countenance, and occasion different emotions and gestures of the whole body. And we know with what passion a man is affected, by hearing his words, though we do not see him. He does not express himself as he usually does at other times when cool and sedate. Objects appear to him in a different view, and therefore he cannot but speak of them in a different way. He interrogates, he exclaims, he admires, he appeals, he invokes, he threatens, he recalls his words, repeats them, and by many other different turns of expression varies his speech, no less than his countenance, from his common and ordinary manner. Now as nature seems to teach us by these figurative expressions how to represent the different commotions of our minds, hence some have thought fit to call figures *the language of the passions*. And as these are given us, among other wise ends, to excite us the better to provide for our preservation and safety, this is done sometimes by force of arms, and at other times by discourse. And therefore Cicero very properly compares the conduct of an orator to the exercises of the palestra: in which, as each combatant endeavours not only to defend himself and attack his adversary, but likewise to do both with decency; so the principal weapons of an orator, as he represents them, are figures, which being no less the ornaments of language than images of our passions, answer all these purposes. Besides, figures chiefly distinguish the different kinds of style, furnish it with an agreeable variety, and often serve to represent things in a clear and forcible manner. From this short account of the nature of figures, the advantage of them to an orator is very evident. They are a sort of natural eloquence, which every one falls into without attending to it, suitably to that temper of mind with which he is affected himself, and is desirous to affect others. Figures are peculiarly serviceable to an orator for answering many different intentions. And as he finds them in life, from thence he must copy them: as a painter does the features of the countenance, and the several parts of the body; figures being to the one, what lines and colours are to the other. We shall now proceed to lay down a few directions for the proper use of figures. And first they should always be accommodated to the sentiments, and rise in proportion to the images designed to be conveyed by them. So far as they are founded in reason, they are suited to impress the mind; but where the language outstrips the thought, though it may please the ear, and some weak persons may be carried away with a pomp of words, yet an intelligent hearer will soon see through the thin and airy dress. It is the sense which gives weight to the figure, as that by striking the imagination awakens the mind, and excites it to act in conformity to reason. But, the too frequent use of figures ought to be avoided. For what was observed in relation to tropes, is also true with respect to these; that a great number of them is apt to darken and obscure the style. Lastly, figures should be so interwoven with a discourse, as not to render the style rough and uneven, sometimes high, and at other times low: now dry and jejune, then pompous and florid. In a word, they should rather seem to arise from nature than art; to offer themselves, than to be the effect of study; and to appear, not like patches upon a face, but the agreeable beauty of a sound and healthy complexion.

SECT. II. PARTICULAR ELOCUTION.

Or that part of Elocution which considers the several Properties and Ornaments of Language as they are made use of to form different sorts of Style.

ART. I. Of Style, and its different Characters.

The word *style*, properly signifies the instrument which the ancients used in writing. For as they commonly wrote upon thin boards covered over with wax, and sometimes upon the barks of trees, they made use of a long instrument like a bodkin, pointed at one end, with which they cut their letters; and broad at the other, to erase any thing they chose to alter. And this the Latins called *stylus*. But though this be the first sense of the word, yet afterwards it came to denote the manner of expression. In which sense we likewise use it, by the same kind of trope which we call any one's writing his *hand*. The reasons which occasion a variety of style are principally these. Since both speech and writing are only sensible expressions of our thoughts, by which we communicate them to others; as all men think more or less differently, so consequently they in some measure differ in their style. No two persons, who were to write upon one subject, would make use of all the same words. And were this possible, yet they would as certainly differ in their order and connection, as two painters, who used the same colours in painting the same picture, would necessarily vary their mixture and disposition of them, in the several gradations of lights and shades. As every painter therefore has something peculiar in his manner, so has every writer in his style. It is from these internal characters, in a good measure, that critics undertake to discover the true authors of anonymous writings; and to shew that others are spurious; and not the genuine productions of those whose names they bear; as they judge of the age

of such writings from the words and manner of expression which have been in use at different times. And we may often observe in persons a fondness for some particular words and phrases; and a peculiarity in the turn or connection of their sentences, or in their transitions from one thing to another; by which their style may be known, even when they design to conceal it. For these things, through custom and habit, will sometimes drop from them, notwithstanding the greatest caution to prevent it.

Different countries have not only a different language, but likewise a peculiarity of style suited to their temper and genius. The eastern nations had a lofty and majestic way of speaking. Their words are full and sonorous, their expressions strong and forcible, and warmed with the most lively and moving figures. This is very evident from the Jewish writings in the Old Testament, in which we find a most agreeable mixture of simplicity and dignity. On the contrary, the style of the more northern languages generally partakes of the chillness of their climate. "There is," says Mr. Addison, "a certain coldness and indifference in the phrases of our European languages, when they are compared with the oriental forms of speech. And it happens very luckily, that the Hebrew idioms run into the English tongue with a peculiar grace and beauty. Our language has received innumerable elegancies and improvements from that infusion of Hebraisms, which are derived to it out of the poetical passages in holy writ. They give a force of energy to our expressions, warm and animate our language, and convey our thoughts in more ardent and intense phrases than any that are to be met with in our own tongue. There is something so pathetic in this kind of diction, that it often sets the mind in a flame, and makes our hearts burn within us."

Again, people of different nations vary in their customs and manners, which occasions a diversity in their style. This was very remarkable in the Attics, Asiatics, and Rhodians, and is often taken notice of by ancient writers. The Athenians, while they continued a free state, were an active, industrious, and frugal people; very polite, and cultivated arts and sciences beyond any other nation: but as they had powerful enemies, and were exceeding jealous of their liberties, this preserved them from wantonness and luxury. And their way of speaking was agreeable to their conduct; accurate and close, but very full and expressive. The Asiatics, on the other hand, were more gay and loose in their manners, devoted to luxury and pleasure; and accordingly they affected a florid and swelling style, filled with redundancies and superfluities of expression.

If we take a view of our own tongue, Chaucer seems to have been the first who made any considerable attempts to cultivate it. And whoever looks into him, will perceive the difference to be so great from what it is at present, that it scarce appears to be the same language. The gradual improvements it has since received, are very evident in the writers almost of every succeeding age since that time; and how much farther it may be still carried, time only can discover. But the chief distinction of style arises from the different subjects or matter of discourse. The same way of speaking no more suits all subjects than the same garment would all persons. A prince and a peasant ought not to have the same dress; and another different from both becomes those of a middle station in life. The style therefore should always be adapted to the nature of the subject, which rhetoricians have reduced to three ranks or degrees; the *low* or *plain* style, the *middle* or *temperate*, and the *lofty* or *sublime*: Which are likewise called *characters*, because they denote the quality of the subject upon which they treat. It seldom happens that the same person excels in each of these characters. They seem to require a different genius, and most people are naturally led to one of them more than another; though all of them are requisite for an orator upon different occasions.

ART. II. THE LOW STYLE.

This we shall consider under two heads, *thoughts* and *language*; in each of which these several characters are distinguished from one another. With respect to the former, as the subjects proper for this style are either common things, or such as should be treated in a plain and familiar way; so plain thoughts are most suitable to it, and distinguish it from the other characters. By plain thoughts are meant such as are simple and obvious, and seem to rise naturally from the subject, when duly considered; so that any one, upon first hearing them, would be apt to imagine they must have occurred to himself. Not that this is really the case, but because the more natural a thing is, the more easy it seems to be; though in reality it is often otherwise; and the perfection of art lies in its nearest resemblance to nature. Therefore, in order to speak plainly and clearly upon any subject, it must first be duly considered, well understood, and thoroughly digested in the mind; which though it require labour and study, yet the more a person is master of what he says, the less that labour will appear in his discourse. This natural plainness and simplicity, without any disguise or affectation, very much contributes to give credit to what is said. Nor is any thing more apt to impose on us than the appearance of this, when artfully assumed. But there are two properties of plain thoughts, one of which ought constantly to attend them in common with all thoughts, and the other is often necessary to animate and enliven this character: The former of these is justness and propriety, which is what reason dictates in all cases.

O R A T O R Y.

The other property which should often accompany plain and simple thoughts, is, that they be gay and sprightly. This is necessary to animate and enliven such discourses as require the low style. The fewer ornaments it admits of, the greater spirit and vivacity is requisite to prevent its being dry and jejune. A thought may be very brisk and lively, and at the same time appear very natural, as the effect of a ready and flowing wit. Such thoughts attended with agreeable turns, are very suitable to this style; but care should be taken, lest, while fancy is too much indulged, the justness of them be overlooked. With respect to the language proper for this style, it may be observed in general, that the dress ought to be agreeable to the thoughts, plain, simple, and unaffected. But the first thing that comes under consideration is elegance, or a proper choice of words and expressions; which ought always to suit the idea they are designed to convey. And purity, both in the choice of words and expressions, is never more necessary than it is here. This may be called *neatness in language*. And to be plain and neat at the same time, is not only very consistent, but the former can no other way recommend itself, than as joined with the latter. The next thing to be regarded is composition, which here does not require the greatest accuracy and exactness. A seeming negligence is sometimes beautiful in this style, as it appears more natural. Short sentences, or those of a moderate length, are likewise upon the whole best suited to this character. Long and accurate periods, finely wrought up with a gradual rise, harmonious numbers, a due proportion of the several parts, and a just cadency, are therefore improper, as they are plainly the effect of art. As to order, the plainest and clearest disposition, both of the words and members of sentences, and what is most agreeable to the natural construction, best suits with this character. For one of its principal beauties is perspicuity. And a proper connection likewise of sentences, with a regular order in the dependence of things one upon another, very much contributes to this end. A freedom and ease both of thought and expression, attended with an agreeable humour and pleasantry, are its peculiar beauties that engage us. As we see persons of fashion and good breeding, though in the plainest habit, have yet something in their air and manner of behaviour that is very taking and amiable. Somewhat of the like nature attends this style. It has its difficulties, which are not so easily discerned, but from experience. For it requires no small skill, to treat a common subject in such a manner as to make it entertaining. The fewer ornaments it admits of, the greater art is necessary to attain this end. Lofty subjects often engage and captivate the mind by the sublimity of the ideas; and the florid style calls in all the assistance of language and eloquence. But the plain style is in great measure stripped of those advantages; and has little more to recommend it, than its own native beauty and simplicity.

ART. III. THE MIDDLE STYLE.

This we shall treat in the same manner as we did the former, by considering first the *matter*, and then the *language* proper for it. As the subjects proper for this style are things of weight and importance, which require a gravity and accuracy of expression; so fine thoughts are its distinguishing mark, as plain thoughts are of the low character, and lofty thoughts of the sublime. Now a fine thought may deserve that character from some or other of the following properties. The first property we shall mention is gravity and dignity. Thus Cicero in a speech to Cæsar says, "It has been often told me, that you have frequently said, you have lived long enough for yourself. I believe it, if you either lived or was born for yourself only." Nothing could either be more fit and proper than this was when it was spoken; or, at the same time, a finer compliment upon Cæsar. For the civil war was now over, and the whole power of the Roman government in the hands of Cæsar; so that he might venture to say, he had lived long enough for himself, there being no higher pitch of glory to which his ambition could aspire. But then there were many things in the state that wanted redressing, after those times of disorder and confusion, which he had not yet been able to effect, and of which Cicero here takes an opportunity to remind him. Another property of a fine thought is *beauty and elegance*. It is a fine compliment which Pliny pays to the emperor Trajan, when he says: "It has happened to you alone, that you was father of your country, before you was made so." Some of the Roman emperors had been complimented with the title of *father of their country*, who little deserved it. But Trajan had a long time refused it, though he was really so, both by his good government, and the esteem of his subjects, before he thought fit to accept of it. The next property of a fine thought is *delicacy*. As, in the objects of our senses, those things are said to be delicate which affect us gradually in a soft and agreeable manner, so a delicate thought is that which is not wholly discovered at once, but by degrees opening and unfolding itself to the mind, discloses more than was at first perceived. Quintilian seems to refer to this, when he says, "Those things are grateful to the hearers, which when they apprehend, they are delighted with their own sagacity; and please themselves, as though they had not heard, but discovered them." Such thoughts are not unlike the sketches of some pictures, which let us into the design of the artist, and help us to discern more than the lines themselves express. It

was a fine character given of Grotius, when very young, on the account of his surprising genius and uncommon proficiency in learning, that *he was born a man*. As if nature, at his coming into the world, had at once furnished him with those endowments which others gradually acquire by study and application. The last property of a fine thought, which we shall take notice of, is *novelty*. Mankind are naturally pleased with new things; and when at the same time they are set in an agreeable light, this very much heightens the pleasure. Indeed there are few subjects but what have been so often considered, that it is not to be expected they should afford many thoughts entirely new; but the same thought set in a different light, or applied to a different occasion, has in some degree a claim of novelty. Cicero, in his treatise of an orator, among several other encomiums which he there gives to Crassus, says of him: "Crassus always excelled every other person, but that day he excelled himself." He means as an orator. But elsewhere he applies the same thought to Cæsar, upon another account; and with some addition to it. "You had (says he) before conquered all other conquerors by your equity and clemency, but to-day you have conquered yourself: you seem to have vanquished even victory herself, therefore you alone are truly invincible." This thought, with a little variation of the phrase, has since appeared in several late writers; and it is now grown common to say of a person, who excels in any way, upon his doing better than he did before, that he has outdone himself. As to the *language* proper for the middle style, in general, it may be observed, that as the proper subjects of it are things of weight and importance, though not of that exalted nature as wholly to captivate the mind and divert it from attending to the diction; so all the ornaments of speech, and beauties of eloquence, have place here. With regard to elegance, it is plain that a different choice of words makes a very great difference in the style, where the sense is the same. Sometimes one single word adds a grace and weight to an expression, which, if removed, the sense becomes flat and lifeless. Now such words as are most full and expressive, suit best with this character. Epithets also, which are proper and well chosen, serve very much to beautify and enliven it, as they enlarge the ideas of things, and set them in a fuller light. The most accurate composition, in all the parts of it, has place here. Periods, the most beautiful and harmonious, of a due length, and wrought up with the most exact order, just cadency, easy and smooth connexion of the words, and flowing numbers, are the genuine ornaments which greatly contribute to this character. But the principal distinction of style arises from tropes and figures. By these it is chiefly animated and raised to its different degrees or characters, as it receives a lesser or greater number of them; and those either more mild, or strong and powerful. As to tropes, those which afford the most lively and pleasing ideas, especially metaphors, suit the middle character. It is a pretty remark, which has been made by some critics, upon two verses of Virgil; one in his Eclogues, and the other in his Georgics. The former of these works is for the most parts written in the low style; as the language of shepherds ought to be; but the latter in the middle style, suitable to the nature of the subject, and the persons for whom it was designed, the greatest men in Rome not thinking it below them to entertain themselves with rural affairs. The like may also be said of figures either of words or sentences, in reference to this character; which admits of the finest descriptions, most lively images, and brightest figures, that serve either for delight, or to influence the passions without transport or ecstacy, which is the property of the sublime. This is indeed the proper seat of such embellishments, which support and make up a principal part of the middle or florid style.

Descriptions are not only a great ornament to a discourse, but represent things in a very lively and agreeable manner. In what a beautiful light has Cicero placed the polite arts and sciences, when, describing them from their effects, he thus represents to us the great advantages as well as pleasures, which they afford to the mind? "Other studies neither suit with all times, nor all ages, nor all places: but these improve youth, delight old age, adorn prosperity, afford a refuge and solace in adversity, please at home, are no hindrance abroad; sleep, travel, and retire with us." And they often affect us very powerfully, when they are addressed to the senses.

Similitudes and comparisons are another great ornament of this style, and ofteneft found here. Nothing can be finer than the comparison between those two great orators Demosthenes and Cicero, made by Quintilian, when he says, "Demosthenes and Cicero differ in their elocution; one is more close, and the other more copious; the former concludes more concisely, and the latter takes a larger compass; the one always with pungency, and the other generally with weight; one can have nothing taken from him, and the other nothing added to him; the latter has more of art, and the former more of nature. But this must be allowed to Demosthenes, that he made Cicero in a great measure what he was. For as Tully gave himself wholly to an imitation of the Greeks, he seems to us to have expressed the force of Demosthenes, the fluency of Plato, and the pleasantry of Isocrates." Similitudes taken from natural things, serve very much to enliven the style, and give it a cheerfulness; which is a thing so common and well known, that we need not produce any instances of it. These, and such like florid figures, are sometimes found in historians, but of-

ORATORY.

tenor in orators; and indeed this middle character, in the whole of it, is best accommodated to the subjects of history and oratory.

ART. IV. THE SUBLIME STYLE.

The *sublime* is the most noble, as well as the most difficult part of an orator's province. It is this principally which Cicero requires in his perfect orator, whom he could not describe in words, but only conceived of in his mind. And indeed, the noblest genius and greatest art are both requisite to form this character. For where nature hath been most liberal in furnishing the mind with lofty thoughts, bright images, and strong expressions; yet, without the assistance of art there will sometimes be found a mixture of what is low, improper, or misplaced. And a great genius, like a too rich soil, must produce flowers and weeds promiscuously, without cultivation. But the justest propriety, joined with the greatest strength and highest elevation of thought, are required to complete the true sublime. Art therefore is necessary to regulate and perfect the taste of those who are desirous to excel in this character. In explaining the nature and properties of this character, we shall consider first the *thoughts*, and then the *language*, in each of which it is distinguished from them.

1. *Sublime, as it relates to Thoughts.* Lofty and grand sentiments are the basis and foundation of the true sublime. Longinus therefore advises those who aspire at this excellence, to accustom themselves to think upon the noblest subjects. A mind that always dwells upon low and common subjects, can never raise itself sufficiently to represent things great and magnificent in their full extent and proper light. But he who inures himself to conceive the highest and most exalted ideas, and renders them familiar to his thoughts, will not often be at a loss how to express them; for where proper words are wanting, by metaphors and images taken from other things, he will be able to convey them in a just and adequate manner. Noble and lofty thoughts are principally those which either relate to divine objects, or such things as among men are generally esteemed the greatest and most illustrious.—Of the former sort is that of Homer, when describing the goddess Discord, he says, that she

Walks on the ground, and hides her head in clouds.

This stretch of thought, says Longinus, as great as the distance between heaven and earth, does not more represent the stature of the goddess, than the measure of the poet's genius and capacity. But such images, however beautiful in poetry, are not so proper for an orator, whose business it is to make choice of those which are suited to the nature of things and the common reason of mankind.

The true sublime is consistent with the greatest plainness and simplicity of expression. And, generally speaking, the more plain and natural the images appear, the more they surprise us. How fucinate, and yet how majestic, is that expression of Cæsar upon his victory over Pharnaces; *I came, I saw, I conquered.* But there cannot be a greater or more beautiful example of this, than what Longinus has taken notice of from Moses. "The legislator of the Jews, (says he) no ordinary person, having a just notion of the power and majesty of the Deity, has expressed it in the beginning of his laws in the following words: *And God said, what? Let there be light; and there was light. Let the earth be made; and it was made.*" This instance from the divine writer, and the character here given of him by that excellent critic, is the more remarkable, as he was himself a Pagan. And certainly no laboured description could raise in the mind an higher conception of the infinite power of the Deity, than this plain and short narration. To command nature itself into being by a *word*, represents it at once altogether boundless and unlimited.

2. *The Sublime, with regard to Language.* What we have to offer upon this subject, will come under the three heads of *Elegance*, *Composition*, and *Dignity*; which comprehend all the properties of style.

I. *Elegance.* Those words and expressions chiefly contribute to form the sublime, which are most sonorous, and have the greatest splendour, force, and dignity. But the antient languages have much the advantage of ours in both respects; for their words are generally longer, and they are abundantly more happy in their compositions. The use of proper epithets does also in a particular manner contribute to this character. For as they denote the qualities and modes of things, they are, as it were, short descriptions; so that being joined to their subjects, they often greatly enlarge and heighten their image. Thus, when the character of *divine poet* is given to Homer or Virgil, or *prince of orators* to Demosthenes or Cicero, it conveys to the mind a more sublime idea of them than the bare mention of their name.

II. *Composition:* The force of which, as Longinus observes, is so great, that sometimes it creates a kind of sublime where the thoughts themselves are but mean, and gives a certain appearance of grandeur to that which otherwise would seem but common.—But composition consists of several parts; the first of which, in the order we have hitherto considered them, is *period*. Sublimity arises from several parts of a period so connected as to give force, as well as beauty, to the whole. The periods therefore in this character should be of a proper length. If they are too short, they lose their just weight and grandeur; and are gone almost before they reach the ear; as, on the contrary, when they are too prolix, they become heavy, and unwieldy, and by that means lose

their force. But more especially, nothing superfluous ought to be admitted, which very much enervates the force of a sentence.

Another thing to be attended to in composition, is the connection of the words with regard to the sound; that the pronunciation, in passing from one to another, may be most agreeable to the ear, and best suited to the nature of the subject. And as this is generally something grand and magnificent, such a contexture of them as will give the greatest force and energy to the expression is most proper for the sublime. Soft and languid sounds are very unsuitable to this character. They soothe and please the ear; but rather sink and depress the mind, than excite it to things great and noble. In this respect therefore, our tongue, by its multitude of consonants, is more suitable for sublime discourses, than some other modern languages, which abound with vowels.

III. The last head to be considered, is the proper use of tropes and figures; which is here so necessary, that the title of *dignity* seems to have been given to this part of elocution, from the assistance it more especially affords to this character. For if, as has been observed from Longinus, compositions will sometimes create a sort of sublimity; this much oftener happens from the force and efficacy of some lively tropes and strong figures. As to tropes, bright metaphors are peculiarly suited to raise and animate the style.

ART. V. STYLE OF AN ORATOR.

The style of an orator comprehends all the characters already explained, of *low*, *middle*, and *sublime*, as they are applied by him in the different parts of his province. For that the language must be suited to the nature of the subject, we have had occasion to observe already; and the different view of the speaker or writer, necessarily occasions a variety in the manner of expression. Now an orator has three things in his view; to prove what he asserts, to represent it in an agreeable light, and to move the passions. These are all necessary; we do not mean in the order wherein we have now mentioned them, but that the discourse may upon the whole have its desired effect upon the audience. For unless the mind be convinced of the truth of what is offered, by solid and cogent arguments, neither will the most eloquent discourse afford a lasting pleasure, nor the most pathetic long influence the affections. I hough, on the other hand, the hearers expect to be entertained at the same time they are informed; and therefore, unless the language be agreeable to their taste, they will soon call off their attention, and think but meanly of the speaker. And unless both these are warmed and animated by a becoming pathos, the speaker may very probably miss of his end, in bringing his audience over to his sentiments: For bare conviction is not sufficient with many persons to excite them to action. They will acquiesce in the truth of a thing which they cannot contradict, or will not give themselves the trouble to examine; and at the same time remain unconcerned to prosecute it. And the pleasure of a florid discourse will of itself soon vanish, like the harmony of music, or the charms of a fine poem. And therefore to captivate his audience, secure them in his interest, and push them upon action, it is necessary for the orator to engage their affections; these are, as it were, the springs of the soul, which managed by a skilful hand, move and direct it at pleasure. Now each of these parts of an orator's province requires a different style. The *low style* is most proper for proof and information; because he has no other view here but to represent things to the mind in the plainest light, as they really are in themselves, without colouring or ornament. The *middle style* is most suited for pleasure and entertainment, because it consists of smooth and well-turned periods, harmonious numbers, with florid and bright figures. But the *sublime* is necessary in order to sway and influence the passions. Here the orator calls in the assistance both of nature and art; the most raised and lofty thoughts, clothed with the brightest and strongest colouring, enter into this character.

But as an orator has frequently each of these views in the same discourse, we shall first give a summary description of the several characters of style, which we have formerly discoursed on more at large; that, by placing them together in one view, the difference between them may be more plain and obvious: and then we shall proceed to shew to what particular parts of a discourse each of them is more especially to be applied. As shorter periods are proper in the *low style*, so less care is necessary in their turn and cadency. If a sentence now and then drop unexpectedly, and disappoint the ear, or has something rough and harsh in its composition, it is no blemish in this character. For as it is suited to the manner of common discourse, an appearance of regard to the subject, rather than the form of expression, is more becoming than any beauties of art. But the words should be well chosen and proper, suited to the ideas they are designed to convey: the expressions plain and clear, and the artificial ornaments few and modest. As the *middle style* is more adapted for pleasure and delight, it admits of all those beauties and ornaments which soothe and entertain the mind. It has more force and energy than the low style, but less than the sublime. Smooth and harmonious numbers, well turned periods, of a just length, delightful cadency, and accurate disposition of the words, are suited to this style. The most beautiful and shining tropes, which strike the fancy, and all those verbal figures which, by repetition, similitude, or proportion of sounds, please and gratify the ear, help to form this character. The like is to be said as to figures of sentences:

The

ORATORY.

The most florid and beautiful, such as enumeration, description, similitude, and the like, are here the most proper.

But it is the *sublime style* which perfects the orator. This requires the most forcible and emphatical words, the boldest metaphors, and strongest figures. In verbal figures, repetitions, synonyms, gradations, contraries, with others of a like force and energy, are chiefly employed here. But figures of sentences are the most considerable and principally contribute to make up this character. Among these are similes taken from lofty subjects. But due care must likewise be taken of the form, construction, and harmony of the periods; which seem best disposed, when long and short ones are intermixed. For though round and swelling periods carry in them something grand and majestic, yet many times they move too slow to strike the passions; whereas short ones are more acute and pungent, and, by returning quick, awaken the mind, and raise the passions. But to render it complete, it must be supported with strong reason, grandeur of thought, and sentiments every way equal to the expression; without which it will be very liable to swell into bombast, and end barely in amusement. Regard must be had to the nature of the subject, the time, place, persons, and other circumstances, by all which the style is to be regulated. To discourse in a lofty and grand way upon a common topic, or in a low and flat manner upon a sublime argument, are both equally injudicious. Cicero refers us to some discourses of his own, as instances of each kind. His oration for Cæcilia, he says, is written in the low style, that for the Manilian law in the middle style, and that for Rabirius in the sublime; and his Actions against Verres, with some others, are patterns of the variety here mentioned. And he gives us a very comprehensive description of a perfect orator in a very few words, when he says, "he is one who can speak upon a low subject acutely, upon a lofty subject with sublimity, and upon a moderate subject temperately." By which he means no more, than one who is master of the three characters here described, and knows when and how to use them. But although he mentions several among the Greeks, and some few among the Romans, who excelled in one or other of these different kinds; yet one who excelled in them all, he supposes never to have existed, except in the imagination. The reason perhaps may be, because each of them seems to require a very different genius, so that it is scarce possible for the same person to succeed in them all. Since therefore it is so rare and difficult a matter to gain the command of each in any good degree, it is better perhaps for every one to pursue that which nature seems most inclined to, and to excel in it, than to strive against their genius. For every kind has its perfections; and it is more commendable to be master of one thing, than to do several but indifferently.

PART IV. PRONUNCIATION.

SECT. I. PRONUNCIATION IN GENERAL.

PRONUNCIATION is also called *Action* by some of the ancients. Though if we attend to the proper signification of each of these words, the former respects the voice, and the latter the gestures and motions of the body. But if we consider them as synonymous terms, in this large sense pronunciation or action may be said to be, *a suitable conformity of the voice, and the several motions of the body, in speaking, to the subject matter of the discourse.* The best judges among the ancients have represented this as the principal part of an orator's province, from whence he is chiefly to expect success in the art of persuasion. When Cicero, in the person of Crassus, has largely and elegantly discoursed upon all the other parts of oratory, coming at last to speak of this, he says, "All the former have their effect as they are pronounced. It is the action alone that governs in speaking; without which the best orator is of no value, and is often defeated by one in other respects much his inferior." And he lets us know, that Demosthenes was of the same opinion, who when he was asked what was the principal thing in oratory, replied, Action; and being asked again a second and a third time, what was next considerable, he still made the same answer. By which he seemed to intimate, that he thought the whole art did in a manner consist in it. And indeed, if he had not judged this highly necessary for an orator, he would scarce have taken so much pains in correcting those natural defects, under which he laboured at first, in order to acquire it. For he had both a weak voice, and likewise an impediment in his speech, so that he could not pronounce distinctly some particular letters. The former of which defects he conquered, partly by speaking as loud as he could upon the shore, when the sea roared and was boisterous; and partly by pronouncing long periods as he walked up-hill; both which methods contributed to the strengthening of his voice. And he found means to render his pronunciation more clear and articulate, by the help of some little stones put under his tongue. Nor was he less careful in endeavouring to gain the habit of a becoming and decent gesture; for which purpose he used to pronounce his discourses alone before a large glass. And because he had got an ill custom of drawing up his shoulders when he spoke; to amend that, he used to place them under a sword, which hung over him with the point downward. Such pains did the prince of the Grecian orators take to remove those difficulties, which would have been sufficient to discourage an inferior and less aspiring genius.

The more natural the pronunciation is, it will of consequence be the more moving, since the perfection of art consists in its

nearest resemblance to nature. Cicero, speaking upon this subject, says: "It is certain that truth (by which he means nature) in every thing excels imitation; but if that was sufficient of itself in action, we should have no occasion for art." In his opinion therefore (and who was ever a better judge?) art in this case, as well as in many others, if well managed, will assist and improve nature. But that is not all; for sometimes we find the force of it so great and powerful, that where it is wholly counterfeit, it will for the time work the same effect as if it was founded in truth. This is well known to those who have been conversant with the representations of the theatre. In tragedies, though we are sensible that every thing we see and hear is feigned and counterfeit, yet such is the power of action, that we are often-times affected by it in the same manner as if they were all realities. Anger and resentment at the appearance of cruelty, concern and solicitude for distressed virtue, rise in our breasts; and tears are extorted from us for oppressed innocence: though at the same time, perhaps, we are ready to laugh at ourselves for being thus decoyed. If art then has so great an influence upon us, when supported only by fancy and imagination; how powerful must be the effect of a just and lively representation of what we know to be true and real? As action therefore was judged so necessary a qualification in an orator among the ancients, so they made use of several methods and expedients for the better attaining it. The principal of which we shall briefly mention.

Decency of pronunciation is an habit. And as all habits are gained by time, so the sooner they are learned, they are generally acquired with greater ease. For while persons are young, they are not only more flexible, and capable of any particular bent, but they are likewise free from the trouble of encountering and subduing contrary habits, which doubles the labour, and increases the difficulty of attaining any laudable quality. Quintilian was very sensible of this in the case here before us; and therefore, in order to have persons trained up to it, he begins with them in their childhood, and descends so low as even to give directions how they should be taught to pronounce when they first learn to read. And he advises, that they should then be instructed where to suspend their voice, and make the proper pauses, both in distinguishing the several parts of the same sentence, and in separating one sentence from another: likewise when to raise or sink their voice, or give it a proper inflection; to be slower or faster, more vehement or sedate, as the nature of the things may require; and that the tone of their voice be always manly and grave, but at the same time mixed with an agreeable sweetness. These things may perhaps appear in themselves small; but if duly attended to, they will be found of considerable service to bring us to a just and proper pronunciation. For in every thing that is to be attained by practice, it is a great advantage to set out right at first. The ancients likewise had persons whom they called *phonæstæ*, whose proper business it was to teach them how to regulate and manage their voice; and others, who instructed them in the whole art of pronunciation, both as to their voice and gestures. These latter were generally taken from the theatre, being some eminent experienced actors. So Quintilian, treating of the province of these persons, says: "The comedian ought to teach them how to relate facts, with what authority to advise, with what vehemence to express anger, and with what softness compassion." And speaking of gestures, he says, "He should admonish them to raise their countenance, not distort their lips, or stretch their mouths." With several other directions of the like kind. And we are told concerning the emperor M. Antoninus, usually called the philosopher, that, *His first masters were Euphorio the grammarian, and Geminus the comedian.* But though they made use of actors to instruct their youth in forming their speech and gestures, yet the action of an orator was much different from that of the theatre. Cicero very plainly represents this distinction, in the words of Crassus, when, speaking of orators, he says: "The motions of the body ought to be suited to the expressions, not in a theatrical way, mimicking the words by particular gesticulations; but in a manner expressive of the general sense; with a sedate and manly reflection of the sides; not taken from the stage and actors, but from the exercise of arms and the palestra." And Quintilian says to the same purpose: "Every gesture and motion of the comedians is not to be imitated, nor to the same degree." They thought the action of the theatre too light and extravagant for the imitation of an orator; and therefore, though they employed actors to inform young persons in the first rudiments, yet they afterwards sent them to the palestra, or schools designed on purpose to teach them a decent and graceful management of their bodies. And such schools, as Quintilian informs us, were in use both among the Greeks and Romans: Just as of latter ages children learn to dance, in some measure with the same intention. Nor, after all this pains and industry, did they yet think themselves sufficiently qualified to take upon them the character of orators. But it was their constant custom to get together some of their friends and acquaintance who were proper judges of such performances, and declaim before them in private. The business of these persons was to make observations both on their language and pronunciation. And they were allowed the greatest freedom to take notice of any thing they thought amiss, either as to inaccuracy of method, impropriety of style, or indecency of their voice

ORATORY.

or actions. This gave them an opportunity to correct any such defects at first, before they became habitual. What effects might not justly be expected from such an institution? Persons trained up in this manner, with all those advantages, joined to a good natural genius, could not fail of making very complete orators. Having thus far treated on pronunciation in general, we shall now consider the parts of it separately, which are, *voice* and *gesture*.

SECT. II. OF THE VOICE.

Voice is one kind of sounds. Now the influence of sounds, either to raise or allay our passions, is evident from music. And certainly the harmony of a fine discourse, well and gracefully pronounced, is as capable to move us, if not in a way so violent and ecstatic, yet no less powerful, and more agreeable to our rational faculties. As the business of this section is to offer some considerations for the just and decent management of the voice, it may not be improper in the first place to observe in general, what nature does when free and unconstrained. As persons are differently affected when they speak, so they naturally alter the tone of their voice, though they do not attend to it. It rises, sinks, and has various inflections given it, according to the present state and disposition of the mind. When the mind is calm and sedate, the voice is moderate and even; when the former is dejected with sorrow, the latter is languid; and when that is inflamed by passion, this is raised and elevated. It is the orator's business, therefore, to follow nature, and to endeavour that the tone of his voice appear natural and unaffected. And for this end he must take care to suit it to the nature of the subject; but still so as to be always grave and decent. Though the music of speech consists in the variations of the voice, yet they must be gradual to render them pleasant. Sudden and great changes at once are rather to be esteemed chasms in speaking, than variations. Besides, as they often prevent the hearers from taking in the sense of what is said, it gives them no small uneasiness that they are obliged to stretch their attention. Many persons are too apt to be guilty of this, especially at the end of a sentence, by dropping the last word, which ought in a particular manner to be expressed distinctly, because the meaning of the whole sentence often depends upon it.

That some expressions ought to be pronounced faster and swifter than others, is very manifest. Gay and sprightly ideas should not only be expressed louder, but also faster, than such as are sad and melancholy. And when we press an adversary, the voice should be brisk and quick. But to hurry on in a precipitant manner without pausing, till stop for want of breath, is certainly a very great fault. This destroys not only the necessary distinction between sentence and sentence, but likewise between the several words of the same sentence; nay, and often occasions us to express our words by halves, while one is thrown so fast upon another, that we are not able to give each its full and just sound. By this means all the grace of speaking is lost, and in a great measure the advantage of hearing. For when the ears of the hearers cannot keep pace with the volubility of the speaker's tongue, they will be little the better for what he says. As a precipitant and hasty pronunciation is culpable, so likewise on the other hand, it is a fault to speak too slow. This seems to argue a heaviness in the speaker. And as he appears cool himself, he can never expect to warm his hearers, and excite their affections. When not only every word, but every syllable is drawn out to too great a length, the ideas do not come fast enough to keep up the attention without much uneasiness. For till the sense is completed, the mind is in suspense; and, if it be held long in that situation, it will of course flag and grow tired. Indeed, in some cases, it is requisite the pronunciation should be slower than in others; as in representing things great and difficult, or in expressing some particular passions, as admiration, or grief. But the extreme we are now speaking of, is a slowness equally continued through a whole discourse, which must necessarily render it flat and lifeless. Now, to avoid either of the two extremes last mentioned, the voice ought to be sedate and distinct. And in order to render it distinct, it is necessary, not only that each word and syllable should have its just and full sound, both as to time and accent; but likewise that every sentence, and part of a sentence, should be separated by its proper pause and interval. This is more easily to be done in reading, from the assistance of the points; but it is no less to be attended to in speaking, if we would pronounce in a distinct and graceful manner. For every one should speak in the same manner as he ought to read, if he could arrive at that exactness. A strong voice is very serviceable to an orator, because, if it want some other advantages, he is, however, capable to make himself heard. And if at any time he is forced to strain it, he is in less danger of its failing him before he has finished his discourse. But he who has a weak voice, should be very careful not to strain it, especially at first. He ought to begin low, and rise gradually to such a pitch as the key of his voice will well carry him, without being obliged to sink afterwards. Frequent inflections of the voice will likewise be some assistance to him. But especially he should take care to speak deliberately, and ease his voice, by allowing due time for respiration at all the proper pauses. It is an extreme much less inconvenient for such a person rather to speak too slow, than too fast. But this defect of a weak voice is sometimes capable of being helped, by the use of proper methods, as is evident from the instance of Demosthenes, before mentioned. A voice is said

to be *clear*, when the organs of speech are suited to give every single letter, and all the combinations of them in syllables and words, their proper and distinct sounds. Such a voice is very pleasing and agreeable to the hearers; and no less an happiness to the speaker, as it saves him a great expence of spirits. A full voice is not the same as a strong nor a loud voice. It fills the ear, but it is often not pleasant. And therefore to render it so, as well as audible, it should be frequently varied. However this seems better suited to the character of an orator, than a small and shrill voice, because it has something in it more grave and manly. And those who have the misfortune of a very small voice, should be cautious of raising it to too high a pitch, especially at once; because the sudden compression of the organ is apt to occasion a squeaking and very disagreeable sound. A soft and smooth voice is of all the most musical, especially if it be flexible; and on the contrary, nothing is less harmonious than a voice that is harsh and rough. For the one grates as disagreeably upon the ear, as the other gives it pleasure and delight. From the consideration of these properties of the voice, we may conclude that to be the best and fittest for an orator, which is moderate, distinct, firm, clear, and smooth, and withal easily flexible to the several degrees and variations of sound which every part of the discourse may require.

SECT. III. OF GESTURE.

By this is meant, a suitable conformity of the motions of the countenance, and several parts of the body in speaking, to the subject-matter of the discourse. The word *gesture* is here used in a larger sense than is ordinarily done in common language. For we rarely make use of that word to denote the motions of the countenance, or any parts of it; but as these make a considerable part of our present subject, they must here be comprehended under this term. It is not agreed among the learned, whether voice or gesture has the greater influence upon us. But as the latter affects us by the eye, as the former does by the ear, gesture in the nature of it seems to have this advantage, that it conveys the impression more speedily to the mind; for the sight is the quickest of all our senses. Nor is its influence less upon our passions; nay, in some instances it appears to act more powerfully. A cast of the eye shall express desire in as moving a manner, as the softest language; and a different motion of it, resentment. To wring the hands, tear the hair, or strike the breast, are all strong indications of sorrow. And he who claps his hand to his sword, throws us into a greater panic than one who only threatens to kill us. Nor is it in some respects less various and extensive than language. Cicero tells us, he often diverted himself by trying this with Roscius the comedian; who could express a sentence as many ways by his gestures, as he himself by words. And some dramas have been wholly carried on by mutes, who have performed every part by gestures only, without words, in a way very intelligible as well as entertaining to the spectators. Well therefore might Cicero call *action* (or gesture) *the language of the body*, since it is capable in so lively a manner to convey both our ideas and passions.

But with respect to oratory, gesture may very properly be called the *second part of pronunciation*; in which, as the voice should be suited to the impression it receives from the mind, so the several motions of the body ought to be accommodated to the various tones and inflections of the voice.

Though standing appears to be the most proper posture for speaking in public, yet it is very unbecoming for the body to be entirely without any motion like a statue. It should not long continue in the same position, but be constantly changing, though the motion be very moderate. There ought to be no appearance of stiffness, but a certain ease and pliability, naturally suiting itself to every expression; by which means, when a greater degree of motion is necessary, it will appear less sudden and vehement. For as the raising, sinking, and various inflections of the voice must be gradual; so likewise should the motions of the body. It is only on some particular occasions, that an hasty vehemence and impetuosity is proper in either case.

But nothing is more indecent, than violent motions and agitations of the head. And therefore, when a witty writer, who is well known among us, would convey the most ridiculous idea of a pretender to knowledge, he expresses it thus:

For having three times shook his head,
To stir his wit up, thus he said.

HUBB.

It is the countenance that chiefly represents both the passions and disposition of the mind. By this we express love, hatred; joy, sorrow; modesty, and confidence: by this we supplicate, threaten, soothe, invite, forbid, consent, or refuse; and all this without speaking. Nay, from hence we form a judgment not only of a person's present temper, but of his capacity and natural disposition. And therefore it is common to say, *such an one has a promising countenance*, or *that he promises little by his countenance*. The several parts of the face bear their part, and contribute to the proper and decent motion of the whole. In a calm and sedate discourse all the features retain their natural state and situation. In sorrow, the forehead and eyebrows lour, and the cheeks hang down. But in expressions of joy and cheerfulness, the forehead and eyebrows are expanded, the cheeks contracted, and the corners of the mouth drawn upwards. Anger and resentment contract the forehead, draw the brows together, and thrust out the lips. And terror

ORATORY.

elevates both the brows and forehead. As these are the natural signs of such passions, the orator should endeavour to conform to them. But as the eyes are most active and significant, it is the advice of Cicero that the greatest care should be taken in their management. And he gives this reason for it, "Because other parts of the countenance have but few motions, whereas all the passions of the soul are expressed in the eyes, by so many different actions, which cannot possibly be represented by any gesture of the body, if the eyes are kept in a fixed posture."

Common experience does in a great measure confirm the truth of this observation. We readily guess at a person's intention, or how he is affected to us by his eyes. And any sudden change or emotion of the mind is presently followed by an alteration in the look. In speaking therefore upon pleasant and delightful subjects, the eyes are brisk and cheerful; as, on the contrary, they sink and are languid in delivering any thing melancholy and sorrowful. This is so agreeable to nature, that before a person speaks, we are prepared with the expectation of one or the other from his different aspect. So likewise in anger, a certain vehemence and intenseness appear in the eyes, which, for want of proper words to express them by, we endeavour to represent by metaphors taken from fire, the most violent and rapid element, and say in such cases, the eyes *sparkle, burn, or are inflamed*. In expressions of hatred or detestation, it is natural to alter the look, either by turning the eyes aside or downwards. Virgil has very justly observed this: for when he describes Æneas meeting with Dido in the Elysian shades and addressing her, he represents her disregard of him, by saying,

Disdainfully she look'd; then turning round,
Still fix'd her eyes unmov'd upon the ground.

She shewed her resentment for his former treatment of her, by not vouchsafing to look on him. Indeed, the eyes are sometimes turned downwards upon other occasions, as to express modesty. And if at any time a particular object be addressed, whatever it be, the eyes should be turned that way.

But as all the passions are in the most lively manner expressed in the eyes, their motions ought to vary according to the different nature of those passions they are suited both to discover in the speaker, and convey to his hearers; since, as the quickest access to the mind is by the sight, a proper well-timed look will sometimes sooner effect this than it can be done by words; as in discharging a cannon we are struck with the light before we hear the sound. As to other parts of the body distinct from the head, the shoulders ought not to be elevated. Nor, on the other hand, should they be drawn down, and depressed; because this occasions a stiffness both to the neck and the whole body. Their natural posture therefore is best, as being most easy and graceful. A continued motion of the arms any way, is by all means to be avoided. Their action should generally be very moderate, and follow that of the hands, unless in very pathetic expressions, where it may be proper to give them a more lively spring.

The hands need never be idle. Quintilian seems to think them as necessary and powerful in action, as Cicero does the eyes. And as they ought to correspond with our expressions, so they ought to begin and end with them. In admiration, and addresses to heaven, they must be elevated, but never raised above the eyes: and in speaking of things below us, they are directed downwards. Side motion should generally begin from the left, and terminate gently on the right. In demonstrating, addressing, and on several other occasions, they are moved forward; and in threatening, sometimes thrown back. But when the orator speaks of himself, his right-hand should be gently laid on his breast. When no other motion is necessary, the hands should be kept about as high as the breast, so as to make nearly a right angle with the arm. This is not only graceful, but likewise the most easy posture, and gives the least strain to the muscles. They should never be suffered to hang down, nor to loll upon the cushion or bar. The left hand should never move alone, but accommodate itself to the motions of the right. The hands should generally be open; but in expressions of compunction and anger they may be closed. All finical and trifling actions of the fingers ought to be avoided; nor should they be stretched out and expanded in a stiff and rigid posture, but kept easy and pliable.

The gestures we have hitherto discoursed of, are such as naturally accompany our expressions. And we presume those we have mentioned, if duly attended to, will be found sufficient to answer all the purposes of our modern pronunciation.

SECT. IV.

SOME PARTICULAR RULES FOR THE VOICE AND GESTURE.

The subject of pronunciation is of so great importance to an orator, that it can neither be too clearly laid down, nor too strongly inculcated. If we inquire into the causes of that surprising power it has over us, and by what means it so strongly affects us, this may in some measure appear by reflecting on the frame and constitution of human nature. For our infinitely great and wise Maker has so formed us, that not only the actions of the body are subject to the direction of the mind; but we are likewise endowed with various passions and affections, that excite us to pursue those things which make for our happiness, and avoid others which are hurtful to us. And as we are made for society, we are also furnished with speech,

which enables us to converse one with another. And such is the contrivance of our make, and influence of our minds upon the mechanism of our bodies, that we can not only communicate our thoughts to each other, but likewise our passions. For, as Cicero well observes, "Every motion of the mind has naturally its peculiar countenance, voice, and gesture; and the whole body, every position of the face, and sound of the voice, like the strings of an instrument, act agreeably to the impression they receive from the mind." In pronunciation, likewise, the orator ought not only to know the several qualities of the voice, and proper gestures of the body; but also when and where to make use of them. For not only different subjects, but also different parts of the same discourse, and even particular expressions, often require a difference in the manner of pronunciation, both as to the voice and gesture. Having therefore treated on both these parts of pronunciation in general, it may not be improper now to consider, how they are to be applied in each of the two respects last mentioned. Let us suppose a person presenting himself before an assembly, in order to make a discourse to them. It cannot be decent immediately to begin to speak as soon as ever he makes his appearance. He will first settle himself, compose his countenance, and take a respectful view of his audience. This prepares them for silence and attention. To begin precipitately, without first allowing either himself or his hearers time to compose themselves, looks as if he was rather performing a task, than had any design to please them; which will be very apt to make them as uneasy till he has done, as he seems to be himself. Persons commonly form some opinion of a speaker from their first view of him; which prejudices them either in his favour, or otherwise, as to what he says afterwards. A grave and sedate aspect inclines them to think him serious; that he has considered his subject, and may have something to offer worth their attention. A haughty and forbidding air occasions distaste, as it looks like disrespect. A wandering giddy countenance argues levity. A dejected drooping appearance is apt to raise contempt, unless where the subject is melancholy. And a cheerful aspect is a proper prelude to a pleasant and agreeable argument.

To speak low at first has the appearance of modesty, and is best for the voice, which, by rising gradually, will with more ease be carried to any pitch that may be afterwards necessary, without straining it. However, some variation of the voice is always proper to give it an harmony. Nay, and sometimes it is not improper for an orator to set out with a considerable degree of warmth, expressed by such an elevation of the voice, and gestures of the body, as are suited to represent the emotions of his mind. But this is not ordinarily the case.

In the narration, the voice ought to be raised to somewhat an higher pitch. Matters of fact should be related in a very plain and distinct manner, with a proper stress and emphasis laid upon each circumstance, accompanied with a suitable address and motions of the body, to engage the attention of the hearers. The proposition or subject of the discourse, should be delivered with a very clear and audible voice. For if this be not plainly heard, all that follows in proof of it cannot well be understood. The confirmation admits of great variety, both of the voice and gestures. In reasoning the voice is quick and pungent, and should be enforced with suitable actions. In confutation, the arguments of the adverse party ought first to be repeated in a plain and distinct manner, that the speaker may not seem to conceal, or avoid the force of them.

In the conclusion, both the voice and gesture should be brisk and sprightly, which may seem to arise from a sense of the speaker's opinion of the goodness of his cause, and that he has offered nothing but what is agreeable to reason and truth; as likewise from his assurance that the audience agree with him in the same sentiments. All exclamations should be violent. When we address inanimate things, the voice should be higher than when to animated beings; and appeals to heaven must be made in a loftier tone than those to men.

After all that has been said upon this pleasing and elegant subject, it is impossible to gain a just and decent pronunciation of voice and gesture merely from rules, without practice and an imitation of the best examples; which shews the wisdom of the ancients, in training up their youths to it, by the assistance of masters, to form both their speech and actions. Persons should well consider their own make and genius, especially with respect to the passions. We seldom find that any actor can excel in all characters; but if he performs one well, he is deficient in another. And therefore they are commonly so prudent as to confine themselves to such as best suit them. The case is the same in an orator; who should therefore keep within those bounds which nature seems to have prescribed for him. Some are better fitted for action than others, and most for some particular action rather than others; and what suits very well upon one would appear very awkward in another. Every one therefore should first endeavour to know himself, and manage accordingly: though in most cases, nature may be much assisted and improved by art and exercise.

Upon a review of the respective authors on this subject, we have made choice of Dr. Ward's Treatise, conceiving it best adapted to the purposes and economy of this work. We have omitted all the superfluous definitions and examples, and made such occasional remarks and additions as we conceived would best tend to elucidate this treatise.

ORBIT,

ORBIT, in *astronomy*, the path of a planet or comet, or the curve that it describes in its revolution round its central body; thus, the earth's orbit is the curve which it describes in its annual course round the sun, and usually called the ecliptic. See the *System of ASTRONOMY*.

ORCHARD, a garden department, consigned entirely to the growth of standard fruit-trees, for furnishing a large supply of the most useful kinds of fruit.

In the orchard you may have, as standards, all sorts of apple trees, most sorts of pears and plums, and all sorts of cherries: which four species are the capital orchard fruits; each of them comprising numerous valuable varieties. But to have a complete orchard, you may also have quinces, medlars, mulberries, service-trees, filberts, Spanish nuts, barberries; likewise walnuts and chestnuts; which two latter are particularly applicable for the boundaries of orchards, to screen the other trees from the insults of impetuous winds and cold blasts. All the trees ought to be arranged in rows, from twenty to thirty feet distance.

But sometimes orchards consist entirely of apple-trees, particularly in the cyder-making countries, where they are cultivated in very great quantities in large fields, and in hedge-rows, for the fruit to make cyder for public supply.

And sometimes whole orchards of very considerable extent are entirely of cherry-trees. But in this case, it is when the fruit is designed for sale in some great city, as London, &c. for the supply of which city, great numbers of large cherry-orchards are in some of the adjacent counties, but more particularly in Kent, which is famous for very extensive cherry-orchards; many of which are entirely of that sort called *Kentish-cherry*, as being generally a great bearer; others are stored with all the principal sorts of cultivated cherries, from the earliest to the latest kinds.

A general orchard, however, composed of all the before-mentioned fruit-trees, should consist of a double portion of apple-trees or more, because they are considerably the most useful fruit, and may be continued for use the year round.

The utility of a general orchard, both for private use and profit, stored with the various sorts of fruit-trees, must be very great, as well as afford infinite pleasure from the delightful appearance it makes, from early spring, till late in autumn. In spring the various trees in blossom are highly ornamental; in summer the pleasure is heightened by observing the various fruits advancing to perfection; and as the season advances, the mature growth of the different species arriving to perfection, in regular succession from May or June, until the end of October, must afford exceeding delight, as well as great profit.

ORDEAL, an ancient form of trial.—It was an appeal to the immediate interposition of divine power, and was peculiarly distinguished by the appellation of *judicium Dei*; and sometimes *vulgaris purgatio*, to distinguish it from the canonical purgation, which was by the oath of the party. There were two sorts of it more common than the rest, at least in Europe, fire ordeal, and water ordeal. The former was confined to persons of higher rank, the latter to the common people. Both these might be performed by deputy: but the principal was to answer for the success of the trial; the deputy only venturing some corporeal pain, for hire, or perhaps for friendship.

That the purgation by ordeal, of some one kind or other, is very ancient, admits not of a doubt; and that it was very universal in the times of superstitious barbarity, is equally certain. It seems even to have been known to the ancient Greeks: for in the *Antigone* of Sophocles, a person suspected by Creon of a misdemeanour, declares himself ready "to handle hot iron and to walk over fire," in order to manifest his innocence; which the scholiast tells us was then a very usual purgation. And *Grotius* gives us many instances of water-ordeal in Bithynia, Sardinia, and other places. It seems, however, to be carried to a greater height among the Hindoos, than ever it has been in any nation, or among any people, however rude or barbarous; for in a paper of the Asiatic researches, communicated by the celebrated Warren Hastings, Esq. we find that the trial by ordeal among them is conducted in nine different ways: first, by the balance; secondly, by fire; thirdly, by water; fourthly, by poison; fifthly, by the Colha, or water in which an idol has been washed; sixthly, by rice; seventhly, by boiling oil; eighthly, by red-hot iron; ninthly, by images.

The methods of performing the ordeals specified, are too absurd and ridiculous to merit particular notice; but to shew that this custom has not only prevailed among the unenlightened Hindoos, but amongst the Europeans, and even in our country, in former times, we shall cite the following instances.

In Europe fire ordeal was performed either by taking up in the hand, unhurt, a piece of red-hot iron, of one, two, or three pounds weight; or else by walking, bare-foot, and blindfold, over nine red-hot ploughshares, laid lengthwise at unequal distances; and if the party escaped being hurt, he was adjudged innocent; but if it happened otherwise, as without collusion it usually did, he was then condemned as guilty. However, by this latter method Queen Emma, the mother of Edward the confessor,

is mentioned to have cleared her character, when suspected of familiarity with Alwyn bishop of Winchester. The first account we have of christians appealing to the fire ordeal, as a proof of their innocence, is that of Simplicius, bishop of Autun, who lived in the fourth century. This prelate, as the story is related, before his promotion to the episcopal order, had married a wife, who loved him tenderly, and who, unwilling to quit him after his advancement, continued to sleep in the same chamber with him.

The sanctity of Simplicius suffered, at least in the voice of fame, by the constancy of his wife's affection; and it was rumoured about, that the holy man, though a bishop, persisted, in opposition to the ecclesiastical canons, to taste the sweets of matrimony: upon which his wife, in the presence of a great concourse of people, took up a considerable quantity of burning coals, which she held in her cloaths, and applied to her breasts, without the least hurt to her person or her garments, as the legend says; and her example being followed by her husband with the like success, the silly multitude admired the miracle, and proclaimed the innocence of the loving pair. A similar trick was played by St. Brice, in the fifth century. *Mosh. Eccl. Hist.* v. 2.

In Europe water-ordeal was performed, either by plunging the bare arm up to the elbow in boiling-water, and escaping unhurt thereby, or by casting the person suspected into a river or pond of cold water: and if he floated therein without any action of swimming, it was deemed an evidence of his guilt; but if he sunk, he was acquitted. It is easy to trace out the traditional relics of this water-ordeal, in the ignorant barbarity still practised in many counties to discover witches, by casting them into a pool of water, and drowning them to prove their innocence.—And in the Eastern empire the fire-ordeal was used for the same purpose by the emperor Theodore Lascaris; who, attributing his sickness to magic, caused all those whom he suspected to handle the hot iron: thus joining (as has been well remarked) to the most dubious crime in the world, the most dubious proof of innocence.

The superstitious weakness of mankind, when left to themselves, is astonishing. There is indeed nothing so absurd but they may be made most firmly to believe, nor so impious but they will do. Nor can a more notorious instance of the truth of this assertion be possibly given than that of the trial by ordeal. The gross absurdity as well as impiety of pronouncing a man guilty unless he was cleared by a miracle, and of expecting that all the powers of nature should be suspended by an immediate interposition of providence to save the innocent, whenever it was presumptuously required, is self-evident. Yet the origin of it may be traced as well to necessity as to superstition. At the time in which it originated in England, as well as in other countries in Europe, it was no easy matter for an innocent person, when accused of guilt, to get himself cleared by the then established mode of trial. It was therefore natural for superstition to fly to Heaven for those testimonies of innocence which the absurdity of human laws often prevented men from obtaining in the ordinary way; and in this way doubtless did the trial by ordeal commence: and thus begun by necessitous superstition, it was fostered by impious priestcraft and unjust power. There was during all the processes great room for collusion and deceit: and there can be no question but it was often practised: it could not therefore on any account, or in any case, be a sign of innocence or of guilt.

Besides those particular methods of trial which we have already mentioned, there were some few more common in European countries; as the judicial combat—the ordeal of the cross—the ordeal of the corded.

The judicial combat was well suited to the genius and spirit of fierce and warlike nations, and was, as we may reasonably expect, one of the most ancient and universal modes, of trial.

We know that it was exceedingly common in Germany in very remote ages. It was also used in some countries on the continent at pretty early periods: it is not, however, mentioned in any of the Anglo-Saxon laws; and it does not appear to have been much used in England till after the conquest. There are, however, two remarkable instances of it upon record, which we shall give in the words of Dr. Henry: "Henry de Essex, hereditary standard-bearer of England, fled from a battle in Wales, A. D. 1158, threw from him the royal standard, and cried out, with others, that the king was slain. Some time after he was accused of having done this with a treasonable intention, by Robert de Montfort, another great baron, who offered to prove the truth of his accusation by combat. Henry de Essex denied the charge and accepted the challenge. When all preliminaries were adjusted, this combat was accordingly fought in the presence of Henry the II. and all his court. Essex was defeated, and expected to be carried out to immediate execution. But the king, who was no friend to this kind of trial, spared his life, and contented himself with confiscating his estate, and making him a monk in the abbey of Reading.

"The priory of Tinmouth in Northumberland, was a cell of the abbey of St. Alban's. One Simon of Tinmouth claimed a right

a right to two corrodies, or the maintenance of two persons in the priory, which the prior and monks denied. This cause was brought before the abbot of St. Alban's, and his court baron, who appointed it to be tried by combat on a certain day, before him and his barons. Ralf Gubion, prior of Tintmouth, appeared at the time and place appointed, attended by his champion, one William Pegun, a man of gigantic stature. The combat was fought, Pegun was defeated, and the prior lost his cause; at which he was so much chagrined, that he immediately resigned his office. This judicial combat is the more remarkable, that it was fought in the court of a spiritual baron, and that one of the parties was a priest."

We need scarcely add, that this detestable form of trial was the foundation of the no less detestable form of duelling, which so much disgraces our age and nation; which is defended only by ignorance, false honour, and injustice; which is a relic of barbarous superstition; and which was absolutely unknown to those brave and generous nations, the Greeks and Romans, which it is so much the fashion to admire, and who in this particular so well merit our imitation.

It was so much the custom in the middle ages of Christianity, to respect the cross even to superstition, that it would have been indeed wonderful if the same ignorant bigotry had not converted it into an ordeal: accordingly we find it used for this purpose, in so many different ways as almost to preclude description.

We shall however transcribe, for the satisfaction of our readers, Dr. Henry's account of it, and of the confessions: "In criminal trials, the judgment of the cross was commonly thus conducted. When the prisoner had declared his innocence upon oath, and appealed to the judgment of the cross, two sticks were prepared exactly like one another: the figure of the cross was cut on one of these sticks but no figure on the other: each of them was then wrapped up in a quantity of fine white wool, and laid on the altar, or on the relics of the saints; after which a solemn prayer was put up to God, that he would be pleased to discover, by evident signs, whether the prisoner was innocent or guilty. These solemnities being finished, a priest approached the altar, and took up one of the sticks, which was uncovered with much anxiety. If it was the stick marked with the cross, the prisoner was pronounced innocent; if it was the other, he was declared guilty. When the judgment of the cross was appealed to in civil causes, the trial was conducted in this manner: The judges, parties, and all concerned, being assembled in a church, each of the parties chose a priest, the youngest and stoutest that he could find, to be his representative in the trial. These representatives were then placed one on each side of some famous crucifix: and at a signal given, they both at once stretched their arms at full length, so as to form a cross with their body. In this painful posture they continued to stand while divine service was performing; and the party whose representative dropped his arms first lost his cause.

"The confessions, or the consecrated bread and cheese, was the ordeal to which the clergy commonly appealed when they were accused of any crimes: in which they acted a very prudent part, as it was attended with no danger or inconveniency. This ordeal was performed in this manner: A piece of barley-bread, and a piece of cheese, were laid upon the altar, over which a priest pronounced certain conjurations, and prayed with great fervency, that if the person accused was guilty, God would send his angel Gabriel to stop his throat, that he might not be able to swallow that bread and cheese. These prayers being ended, the culprit approached the altar, took up the bread and cheese, and began to eat it. If he swallowed freely, he was declared innocent; but if it stuck in his throat, and he could not swallow, (which we may presume seldom or never happened,) he was pronounced guilty."

There were besides these a variety of other ordeals practised in Christian countries, many of which retain the same names as among Pagans, and differ only in the mode of execution. In all nations of Christians where those trials were used, we find the clergy engaged in them. Indeed, in England; so late as King John's time, we find grants to the bishops and clergy to use the *judicium ferri, aquæ, et ignis*. And, both in England and Sweden, the clergy presided at this trial, and it was only performed in the churches or in other consecrated ground; for which Stiernhook gives the reason, *Non defuit illis operæ et laboris pretium; semper enim ab ejusmodi judicio aliquid lucris sacerdotibus obveniebat*. But, to give it its due praise, we find the canon law very early declaring against trial by ordeal, or *vulgaris purgatio*, as being the fabric of the devil, *cum sit contra præceptum Domini, Non tentabis Dominum Deum tuum*. Upon this authority, though the canons themselves were of no validity in England, it was thought proper (as had been done in Denmark above a century before) to disuse and abolish this trial entirely in our courts of justice, by an act of parliament in 3 Hen. III. according to Sir Edward Coke, or rather by an order of the king in council.

It may still perhaps be a *postulatium* with some of our readers how the effects of these trials were evaded, and how it was possible to appear to do, what we know could not be really done, without material injury to the persons concerned: and here we

find the subject so well handled by the learned historian whom we have already quoted, as far as concerns the ordeals in ancient Britain, which, *mutatis mutandis*, will answer for others, that we shall finish the article, which has already extended we fear to too great a length, in his words: "If we suppose that few or none escaped conviction who exposed themselves to those fiery trials, we shall be very much mistaken. For the histories of those times contain innumerable examples of persons plunging their naked arms into boiling water, handling red hot balls of iron, and walking upon burning ploughshares, without receiving the least injury. Many learned men have been much puzzled to account for this, and disposed to think that Providence graciously interposed, in a miraculous manner, for the preservation of injured innocence.

But if we examine every circumstance of those fiery ordeals with due attention, we shall see sufficient reason to suspect that the whole was a gross imposition on the credulity of mankind. The accused person was committed wholly to the priest who was to perform the ceremony three days before the trial, in which he had time enough to bargain with him for his deliverance, and give him instructions how to act his part. On the day of trial, no person was permitted to enter the church but the priest and the accused till after the iron was heated, when twelve friends of the accuser, and twelve of the accused, and no more, were admitted, and ranged along the wall on each side of the church, at a respectful distance. After the iron was taken out of the fire, several prayers were said; the accused drank a cup of holy water, and sprinkled his hand with it, which might take a considerable time if the priest was indulgent. The space of nine feet was measured by the accused himself with his own feet, and he would probably give but scanty measure. He was obliged only to touch one of the marks with the toe of his right foot, and allowed to stretch the other foot as far towards the other mark as he could, so that the conveyance was almost instantaneous. His hand was not immediately examined, but wrapped in a cloth prepared for that purpose, three days. May we not then, from all these precautions, suspect that these priests were in possession of some secret that secured the hand from the impressions of such a momentary touch of hot iron, or removed all appearances of these impressions in three days; and that they made use of this secret when they saw reason? Such readers as are curious in matters of this kind may find two different directions for making ointments that will have this effect in the work here quoted. What greatly strengthens these suspicions is, that we meet with no example of any champion of the church who suffered the least injury from the touch of hot iron in this ordeal; but when any one was so foolhardy as to appeal to it, or to that of hot water, with a view to deprive the church of any of her possessions, he never failed to burn his fingers, and lose his cause."

ORGASM *οργασμος*, denoting violence or turbulence; formed from *οργαω*, *turgeo*, "I swell," an ecstasy or impetuous desire of coition, occasioned by a turbulence of the femoral vessels, which are no longer able to restrain their contents. The ancients also extend orgasm to the other humours, and even excrements, which being accumulated, and coming to ferment, demand excretion. Quincey uses orgasm for an impetuous or too quick motion of the blood or spirits; whereby the muscles are distended with an uncommon force.

ORGIA, feasts and sacrifices in honour of Bacchus, held every third year, and chiefly celebrated by wild distracted women, called *Bacchæ*. The chief solemnities were performed in the night, to conceal, perhaps, their shocking impurities; and a mountain was generally chosen as the place of celebration. They were instituted by Orpheus; and from him are sometimes called *Orphica*.

Authors are not agreed as to the derivation of the word; but if we consider the frantic proceedings of the Bacchanals, *οργη*, *furor*, bids fair for the true etymology. See MYSTERY.

ORIOLE, or ORIOLE, in ornithology, a genus belonging to the order of picæ. The bill in this genus is straight, comely, very sharp pointed; edges cultrated, inclining inwards; mandibles of equal length. Nostrils small, placed at the base of the bill, and partly covered. Tongue divided at the end. Toes, three forward, one backward; the middle joined near the base to the outermost one.—These birds are inhabitants of America, except in a few instances, are a noisy, gregarious, frugivorous, granivorous, and voracious race, very numerous, and often have penile nests.

The most remarkable species is the sharp-tailed oriole, which is about the size of a lark: The bill is bushy; the crown is brown and cinereous; the cheeks are brown, bounded above and below with deep dull yellow. The throat is white; the breast, sides, thighs, and vent, are a dull pale yellow, spotted with brown; the belly is white; the back is varied with ash-colour, black and white; the wings-coverts are dusky, with ferruginous edges. The quills are also dusky; the tail consists of narrow sharp pointed feathers, of a dusky colour tinged with olive, and obscurely barred; and the legs are pale brown. For representation see Plate I. Genus 14.

whom
cient
at we
ar to
none
rials,
times
naked
and
least
count
nter-
d in-

deals
spect
man-
oriett
l, in
ance,
ay of
oriett
ends
were
urch,
fire,
ater,
rable
was
ould
ouch
d to
ould,
was
d for
pre-
ecret
ntary
tions
they
kind
will
gth-
any
the
fool-
w to
ed to

orm-
uous
vel-
The
n ex-
nent,
is or
ticles

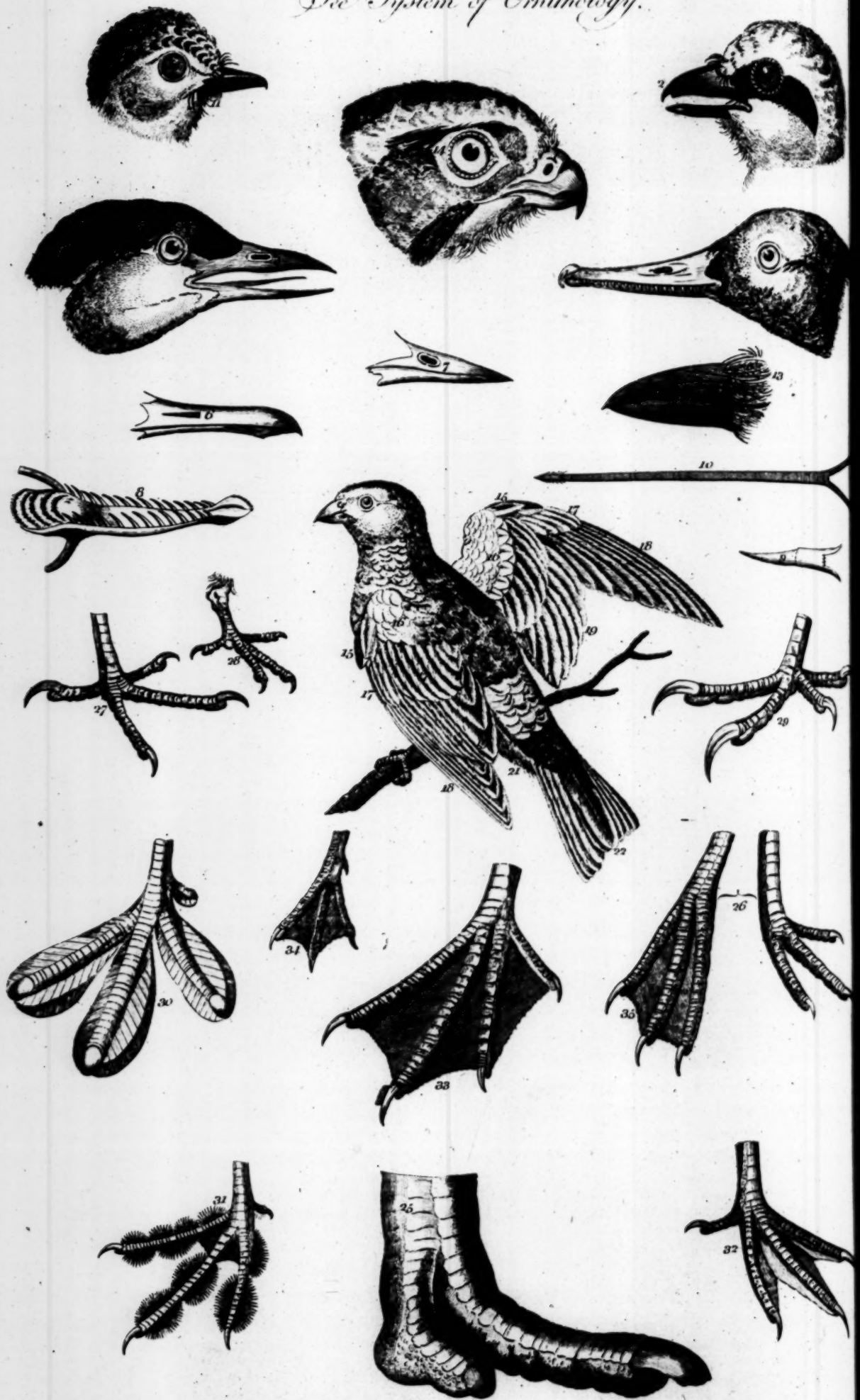
held
men,
n the
nd a
They
alled

ord;
tcha-
See

aging
onic,
man-
f the
oes,
bale
erica,
rous,
have

which
rown
elow
ides,
own;
t and
dges.
intated
urely
a fee

*Various Parts of Birds which regulate their Classification.
See System of Ornithology.*





Birds, Order 8. Pinnated Feet, Order 9. Web-footed See Ornithology.



Order 8. Genus 77. Phalarope.



Order 8. Genus 78. Coot.



Order 8. Genus 79. Grebe.



Order 9. Genus 80. Avocet.



Order 9. Genus 81. Courier.



Order 9. Genus 82. Flamingo.



Order 9. Genus 83. Albatross.



Order 9. Genus 84. Lark.



Order 9. Genus 85. Guillemot.



Order 9. Genus 86. Diver.



Order 9. Genus 87. Skimmer.



Order 9. Genus 88. Tern.



Order 9. Genus 89. Gull.



Order 9. Genus 90. Petrel.



Order 9. Genus 91. Merganser.



Order 9. Genus 92. Duck.



Order 9. Genus 94. Duck.



Order 9. Genus 93. Penguin.



Order 9. Genus 94. Pelican.



Order 9. Genus 95. Tropic.



Order 9. Genus 96. Darter.

Birds, Order 6. *Stuthious*, Order 7. *Waders*. See *Ornithology*.



Order 6. Genus 57. *Dodo*. *Extinct*



Order 6. Genus 58. *Ostrich*.



Order 6. Genus 59. *Cassowary*.

DIVISION 2.
Water Fowl.



Order 7. Genus 60. *Spoonbill*.



Order 7. Genus 61. *Screamer*.



Order 7. Genus 62. *Jabiru*.



Order 7. Genus 63. *Boathill*.



Order 7. Genus 64. *Uimbre*.



Order 7. Genus 65. *Heron*.



Order 7. Genus 66. *Ibis*.



Order 7. Genus 67. *Curlew*.



Order 7. Genus 68. *Snipe*.



Order 7. Genus 69. *Sandpiper*.



Order 7. Genus 70. *Plover*.



Order 7. Genus 71. *Oyster-catcher*.



Order 7. Genus 72. *Pratincole*.



Order 7. Genus 73. *Rail*.



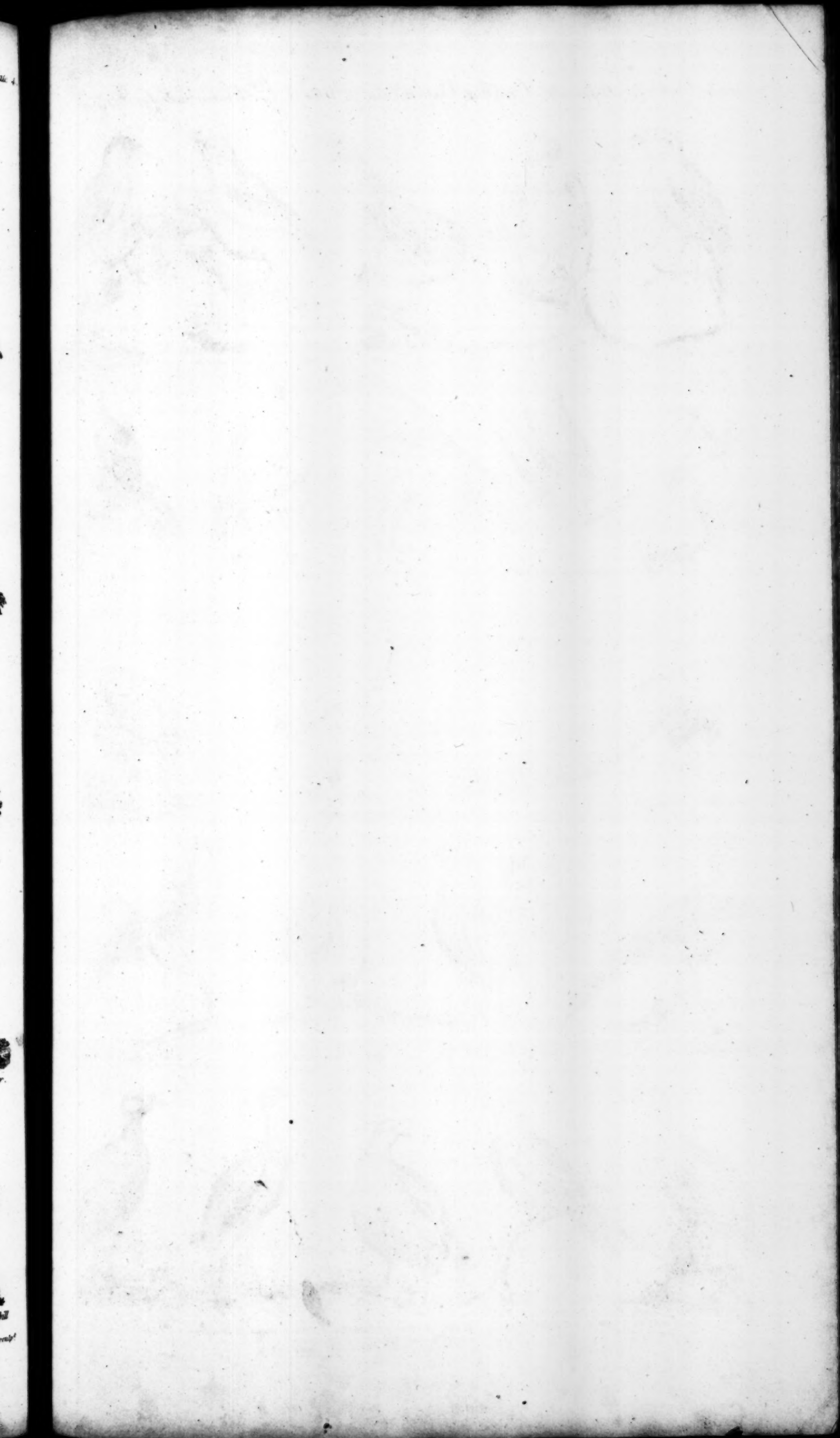
Order 7. Genus 74. *Jacana*.



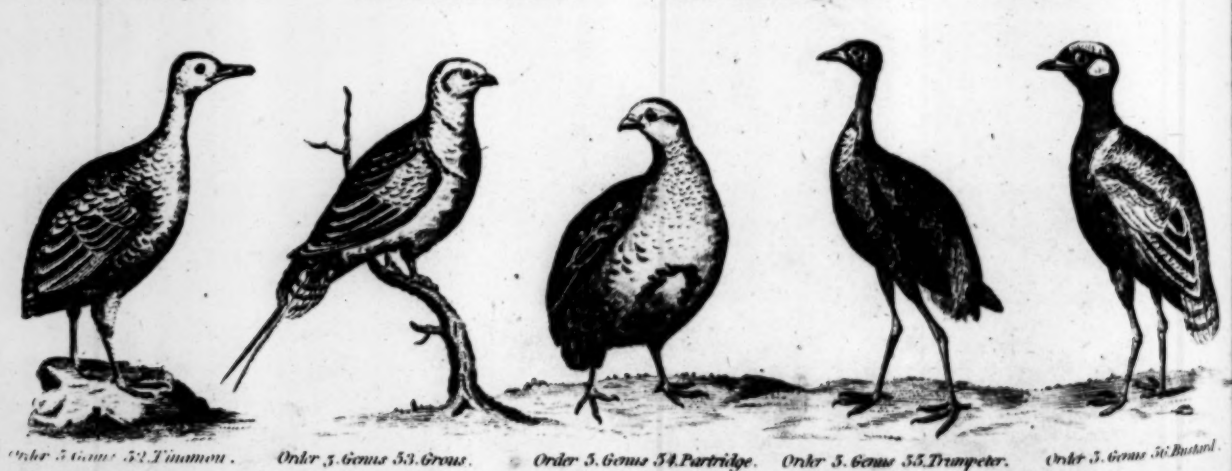
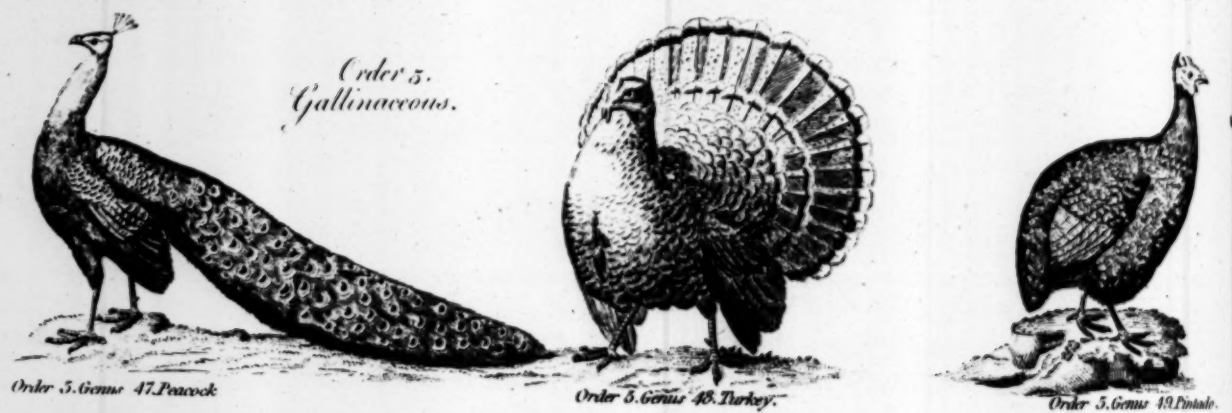
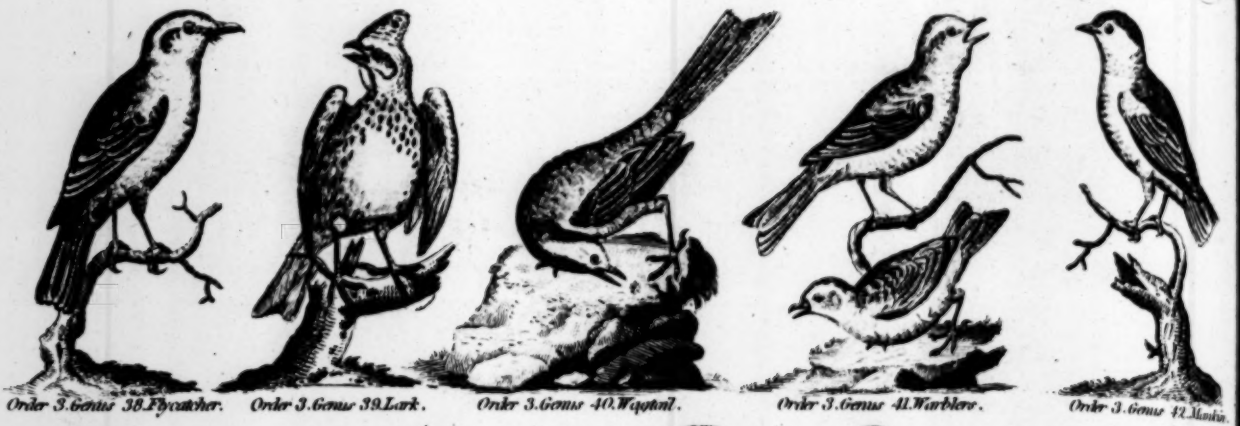
Order 7. Genus 75. *Gallinule*.

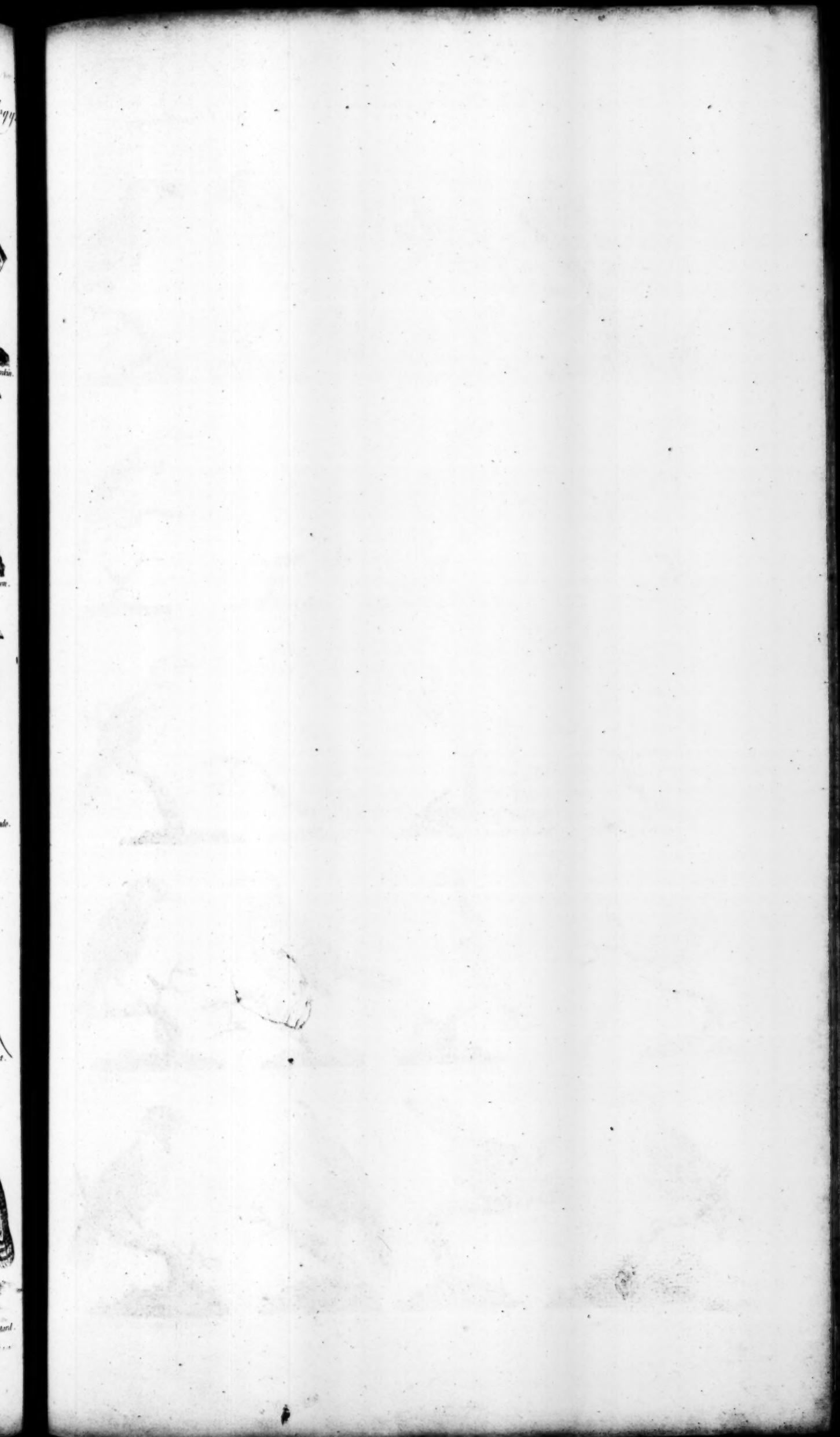


Order 7. Genus 76. *Shovell*.



Birds, Order 3. Psittacine, Order 4. Columbine, Order 5. Gallinaceous. See Ornithology





Birds. Order 1. Rapacious. Order 2. Pies. See Ornithology.



Order 1. Genus 1. Vulture



Order 1. Genus 2. Falcon



Order 1. Genus 3. Owl



Order 1. Genus 3. Owl

Order 2. Pies.



Order 2. Genus 4. Shrike



Order 2. Genus 5. Parrot



Order 2. Genus 5. Parrot



Order 2. Genus 5. Parrot



Order 2. Genus 6. Toucan



Order 2. Genus 7. Motmot



Order 2. Genus 8. Hornbill



Order 2. Genus 9. Bristle



Order 2. Genus 10. Ani



Order 2. Genus 11. Noddy



Order 2. Genus 12. Crow



Order 2. Genus 13. Roller



Order 2. Genus 14. Oriole



Order 2. Genus 15. Grackle



Order 2. Genus 16. Paradise



Order 2. Genus 17. Grosbeak

SYSTEM OF ORNITHOLOGY.

ORNITHOLOGY is a science which treats of birds; describes their form, external, and internal; and teaches their economy and uses. But, before we proceed to analyse the characteristic parts of birds, it will be proper to premise an explanation of the terms used by naturalists in describing them.

EXPLANATION of some Technical Terms in Ornithology used by PENNANT and LINNÆUS.

1. *Cere. Cera.* The naked skin that covers the base of the bill in the hawk kind.
2. *Emarginatum.* A bill is called *rostrum emarginatum* when there is a small notch near the end: this is conspicuous in that of butcher birds and thrushes.
3. *Rostrum subulatum.* A term Linnæus uses for a straight and slender bill.
4. *Unguiculatum.* A bill with a nail at the end, as in those of goosanders and ducks.
5. *Rostrum cultratum.* When the edges of the bill are very sharp, such as in that of the crow.
6. *Nares Lineares.* When the nostrils are very narrow, as in sea-gulls.
7. *Emarginatæ.* With a rim round the nostrils, as in the flare.
8. *Lingua ciliata.* When the tongue is edged with fine bristles, as in ducks.
9. *Integra.* When plain or even.
10. *Lambriciformis.* When the tongue is long, round, and slender, like a worm, as that of the woodpecker.
11. *Vibrissa.* *Vibrissæ pectinatae*, stiff hairs that grow on each side the mouth, formed like a double comb, to be seen in the goatfucker, fly-catcher, &c.
12. *Lorum.* The space between the bill and the eye, generally covered with feathers; but in some birds naked, as in black and white grebe.
13. *Capistrum.* A word used by Linnæus to express the short feathers on the forehead just above the bill. In crows these fall forwards, over the nostrils.
14. *Orbits. Orbita.* The skin that surrounds the eye, which is generally bare; particularly in the heron and parrot.
15. *Basilar Wing. Alula spuria.* A small joint rising at the end of the middle part of the wing, or the *cubitus*; on which are three or five feathers.
16. *Lesser coverts of the wings.* The small feathers that lie in several rows on the bones of the wings. The under coverts are those that line the inside of the wings.
17. *Greater coverts.* The feathers that lie immediately over the quill feathers and secondary feathers.
18. *Quill feathers. Primæ.* The largest feathers of the wings, or those that rise from the first bone.
19. *Secondary feathers. Secundariæ.* Those that rise from the second.
20. *Coverts of the tail. Uropygium.* Those that cover the base of the tail.
21. *Vent feathers.* Those that lie from the vent to the tail. *Crissum Linnæi.*
22. *The tail. Rectrices.*
23. *Scapular feathers.* That rise from the shoulders and cover the sides of the back.
24. *Nucha.* The hinder part of the head.
25. *Pes didactylus.* In which the foot is composed of two toes, observed only in the ostrich.
26. *Pes tridactylus vel curviflorus.* Such as want the back toe.
27. *Pes ambulatorius.* All the toes divided to the bottom.
28. *Pes gravior.* The outer toe more or less united to the middle one, particularly conspicuous in the feet of the kingsfisher.
29. *Pes scanforius.* The foot of the woodpecker, formed for climbing. Climbing feet.
30. *Finned foot. Pes lobatus.* Such as those of the grebes.
31. *Scalloped foot. Pes pinnatus.* The webs indented in the sides, as in the coots and scalloped-toed sandpipers.
32. *Semipalmated. Pes semipalmatus.* When the webs reach only half way of the toes.
33. *Digitis 4 omnibus palmatis.* All the four toes connected by webs, as in the corvants.
34. *Ungue postico sessili.* When the hind claw adheres to the leg without any toe, as in the petrels.
35. *Pedes compedes.* When the legs are placed so far behind as to make the bird walk with difficulty, or as if in fetters; as is the case with the auks, grebes, and divers.

SECT. I. EXTERNAL PARTS OF BIRDS.

A Bird may be divided into Head, Body, and Limbs.

I. HEAD.

1. **BILL** (*rostrum*), is a hard horny substance, consisting of an upper and under part, extending from the head, and answering to the mandibles in the quadrupeds. Its edges generally plain and sharp, like the edge of a knife, *cultrated*, as are the bills of crows; but sometimes *serrated*, as in the toucan; or *jagged*, as in the gannet and some herons; or *pectinated*, as in the duck; or *denticulated*, as in the mergansers; but always destitute of real teeth immersed

in sockets. The base in falcons is covered with a naked skin, or *cere* (*cera*); in some birds with a caraneous appendage, as the turkey; or a callous, as the curassow. In birds of prey, the bill is hooked at the end, and fit for tearing: in crows, straight and strong for picking: in water-fowl, either long and pointed, for striking: or slender and blunt, for searching in the mire: or flat and broad, for gobbling. Its other uses are for building nests; feeding the young; climbing, as in parrots; or, lastly, as an instrument of defence, or offence.

2. **NOSTRILS**, (*nares*), the nice instruments of discerning their food, are placed either in the middle of the upper mandible, or near the base, or at the base, as in parrots; or behind the base, as in toucans and hornbills; but some birds, as the gannet, are destitute of nostrils. The nostrils are generally naked: but sometimes covered with bristles reflected over them, as in crows, or hid in the feathers, as in parrots, &c. The fore-part of the head is called the *front* (*capistrum*); the summit (*vertex*), or the *crown*: the hind part, with the next joint of the neck (*nucha*), the *nape*: the space between the bill and the eyes, which in herons, grebes, &c. is naked, (*lora*), the *strips*: the space beneath the eyes, (*genæ*) the *cheeks*.

3. **ORBITS**, (*orbite*), the eye-lids; in some birds naked, in others covered with short soft feathers. Birds have no eye-brows; but the grous kind have in lieu a scarlet naked skin above, which are called *supercilia*; the same word is also applied to any line of a different colour that passes from the bill over the eyes.

4. **EARS**. Birds are destitute of auricles or external ears, having an orifice for admission of sound, open in all but owls, whose ears are furnished with valves.

5. **THE CHIN**, the space between the parts of the lower mandible and the neck, is generally covered with feathers; but, in the cock, and some others, have caraneous appendages called *wattles* (*palearia*); in others, is naked, and furnished with a pouch, capable of great dilatation (*sacculous*), as in the pelican and corvants.

6. **NECK**, (*collum*), the part that connects the head to the body, is longer in birds than any other animals; and longer in such as have long legs than those that have short, either for gathering up their meat from the ground, or striking their prey in the water, except in web-footed fowl, which are, by reverting their bodies, destined to search for food at the bottom of waters, as swans, and the like. Birds, especially those that have a long neck, have the power of retracting, bending, or stretching it out, in order to change their centre of gravity from their legs to their wings.

II. BODY.

1. Consists of the **BACK**, (*dorsum*): which is flat, straight, and inclines; terminated by the

2. **RUMP**, (*uropygium*), furnished with two glands, secreting a fattish liquor from an orifice each has, which the birds express with their bills to oil or anoint the discomposed parts of their feathers. These glands are particularly large in moist web-footed water-fowl; but in the grebes, which want tails, they are smaller.

3. **BREAST**, (*pectus*) is ridged and very muscular, defended by a forked bone, (*clavicula*), the merry-thought. The short winged birds, such as grous, &c. have their breasts most fleshy or muscular; as they require greater powers in flying than the long-winged birds, such as gulls, herons, which are specifically lighter, and have greater extent of sail.

4. **BELLY**, (*abdomen*), is covered with a strong skin, and contains the entrails.

5. **THE VENT**, or vent-feathers, (*crissum*), which lies between the thighs and the tail. The anus lies hid in those feathers.

III. LIMBS.

1. **WINGS**, (*alæ*), adapted for flight in all birds except the dodo, ostriches, great auk, and the penguins, whose wings are too short for the use of flying; but in the dodo and ostrich, when extended, serve to accelerate their motion in running; and in the penguins perform the office of fins, in swimming or diving. The wings have near their end an appendage covered with four or five feathers, called the *basilar wing*, (*ala notha*), and *alula spuria*. The lesser coverts (*teftrices*), are the feathers which lie on the bones of the wings. The greater coverts are those which lie beneath the former, and cover the quill-feathers and the secondaries. The quill-feathers (*primores*), spring from the first bones (*digiti* and *metacarpi*) of the wings, and are 10 in number. Quill-feathers are broader on their inner than exterior sides. The secondaries (*secundariæ*), are those that rise from the second part (*cubitus*), and are about 18 in number, are equally broad on both sides. The primary and secondary wing feathers are called *remiges*. A tuft of feathers placed beyond the secondaries near the junction of the wings with the body. This, in water-fowl, is generally longer than the secondaries, and cuneiform. The scapulars are a tuft of long feathers arising near the junction of the wings (*brachia*) with the body, and lie along the sides of the back, but may be easily distinguished, and raised with one's finger. The inner coverts are those that clothe the under-side of the wing. The subaxillary are peculiar to the greater Paradise. The wings of some birds are instruments of offence. The anhima of Maregrave has two strong spines in the front of each wing. A species of plover, has a single one on each; the whole tribe of jacana, and the gambo, or spur-winged goose of Mr. Willoughby, the same. D d—1

The BINDER is desired to observe that this Sheet [D d—1] is to be placed before Half Sheet [D d—2] it being an additional Half Sheet, introduced in the new Edition of this Work to enlarge on the Article ORDEAL.

ORNITHOLOGY.

2. The **TAIL** is the director, or rudder, of birds in their flight; they rise, sink, or turn by its means; for, when the head points one way, the tail inclines to the other side: it is besides, an equilibrium or counterpoise to the other parts; the use is very evident in the kite and swallows. The tail consists of strong feathers (*rectrices*), 10 in number, as in the woodpeckers, &c. 12 in the hawk tribe, and many others; in the gallinaceous, the mergansers, and the duck kind, of more. It is either even at the end, as in most birds; or forked, as in swallows; or cuneated, as in magpies, &c. or rounded, as in the purple jackdaw of Catesby. The grebe is destitute of a tail, the rump being covered with down; and that of the callosary with the feathers of the back. Immediately over the tail, are certain feathers that spring from the lower part of the back, and are called the *coverts of the tail*, (*uropigium*).

3. **THIGHS**, (*femora*), are covered entirely with feathers in all land-birds, except the bustards and the ostriches; the lower part of those of all waders, or cloven-footed water-fowl, are naked, that of all web-footed fowl the same, but in a less degree; in rapacious birds, they are very muscular.

4. **LEGS**, (*crura*), those of rapacious fowls very strong, furnished with large tendons; and fitted for tearing and a firm gripe. The legs of some of this genus are covered with feathers down to the toes, such as the golden eagle; others to the very nails; but those of most other birds are covered with scales, or with a skin divided into segments, or continuous. In some of the pies, and in all the passerine tribe, the skin is thin and membranous; in those of web-footed water-fowl, strong. The legs of most birds are placed near the centre of gravity; in land-birds, or in waders that want the back toe, exactly so; for they want that appendage to keep them erect. Auks, grebes, divers, and penguins, have their legs placed quite behind, so are necessitated to sit erect: their pace is awkward and difficult, walking like men in fetters: hence Linnaeus styles their feet *pedes compedes*. The legs of all cloven-footed water-fowl are long, as they must wade in search of food: of the palmated, short, except those of the flamingo, the avoet, and the courier.

5. **FEET**, (*pedes*), in all land-birds that perch, have a large back toe: most of them have three toes forward, and one backward. Woodpeckers, parrots, and other birds that climb much, have two forward, two backward; but parrots have the power of bringing one of their hind toes forward while they are feeding themselves. Owls have also the power of turning one of their fore toes backward. All the toes of the *swift* turn forward, which is peculiar among land birds: the tridactylous woodpecker is also anomalous, having only two toes forward, one backward: the ostrich is another, having but two toes.

6. **TOES**, (*digiti*) The toes of all waders are divided: but between the exterior and middle toe, is generally a small web, reaching as far as the first joint. The toes of birds that swim are either plain, as in the single instance of the common water-hen or gallinule; or pinnated, as in the coots and grebes; or entirely webbed or palmated, as in all other swimmers. All the plover tribe, or charadrii, want the back toe. In the swimmers the same want prevails among the albatrosses and auks. No water-fowl perch, except certain herons, the corvorant, and the shag.

7. **CLAWS**, (*ungues*). Rapacious birds have very strong, hooked, and sharp claws, vultures excepted. Those of all land-birds, that roost on trees, have also hooked claws, to enable them to perch in safety while they sleep. The gallinaceous tribe have broad concave claws for scraping up the ground. Grebes have flat nails like the human. Among water-fowl, only the skua, and the black-toed gull, have strong hooked or aquiline claws. All land-birds perch on trees, except the struthious and some of the gallinaceous tribes. Parrots climb; woodpeckers creep up the bodies and boughs of trees; swallows cling. All water-fowl rest on the ground, except certain herons, and one species of ibis, the spoonbill, one or two species of ducks and of corvorants.

IV. FEATHERS.

FEATHERS are designed for two uses; as coverings from the inclemency of the weather, and instruments of motion through the air. They are placed in such a manner as to fall over one another, (*tegulatum*), so as to permit the wet to run off, and to exclude the cold; and those on the body are placed in a quincuncial form; most apparent in a thick-skinned water-fowl, particularly in the divers.

1. The parts of a feather are, the shafts; corneous, strong, light, rounded, and hollow at the lower part; at the upper convex above, concave beneath, and chiefly composed of a pith.

2. On each side the shafts are the vanes, broad on one side, narrow on the other; each vane consists of a multitude of thin laminae, stiff, and of the nature of a split quill. These laminae are closely braced together by the elegant contrivance of a multitude of small bristles; those on one side hooked, the other straight, which lock into each other, and keep the vanes smooth, compact, and strong. The vanes near the bottom of the shafts are soft, unconnected, and downy.

3. Feathers are of three kinds. (1.) Such as compose instruments of flight: as the pen-feathers, or those which form the wings and tail, and have a large shaft. The vanes of the exterior side

bending downward, of the interior upwards, lying close on each other, so that, when spread, not a feather misses its impulse on the air. The component parts of these feathers are described before. (2.) The feathers that cover the body, which may be properly called the *plumage*, have little shaft, and much vane; and never are exerted or relaxed, unless in anger, fright, or illness. (3.) The **DOWN**, (*plumæ*), which is dispersed over the whole body amidst the plumage, is short, soft, unconnected, consists of laminae, and is intended for excluding that air or water which may penetrate or escape the former. This is particularly apparent in aquatic birds, and remarkably so in the anserine tribe. There are exceptions to the forms of feathers. The vanes of the subaxillary feathers of the Paradise are unconnected, and the laminae distant, looking like herring-bone. Those of the tail of the ostrich and head of a species of curassow, curled. Those of the callosary consist of two shafts, arising from a common stem at the bottom: as do, at the approach of winter, (after moulting), those of the ptarmigans of arctic countries. The feathers of the penguins particularly those of the wings, consist chiefly of thin flat shafts, and more resemble scales than feathers; those of the tail, like split whale-bone.

SECT. II. FLIGHT OF BIRDS.

The flight of birds is various; for, had all the same, none could elude that of rapacious birds. Those which are much on wing, or sit from place to place, often owe their preservation to that cause, those in the water, to diving. Kites, and many of the falcon tribe, glide smoothly through the air, with scarce any apparent motion of the wings. Most of the order of pies fly quick, with a frequent repetition of the motion of their wings. The Paradise floats on the air. Woodpeckers fly awkwardly, and by jerks, and have a propensity to sink in their progress. The gallinaceous tribe, in general, fly very strong and swiftly; but their course is seldom long, by reason of the weight of their bodies. The columbine race is of singular swiftness; witness the flight of the *CARRIER-Pigeon*. The passerine fly with a quick repetition of strokes; their flight, except in migration, is seldom distant. Among them, the swallow tribe is remarkably agile, their evolutions sudden, and their continuance on wing long. Nature hath denied flight to the struthious; but still, in running, their short wings are of use, when erect, to collect the wind, and like sails to accelerate their motion. Many of the greater cloven-footed water-fowl, or waders, have a slow and flagging flight; but most of the lesser fly swiftly, and most of them with extended legs, to compensate the shortness of their tails. Rails and gallinules fly with their heads hanging down. Coots and grebes, with difficulty are forced from the water; but when they rise fly swiftly. Grebes, and also divers, fly with their hind parts downwards, by reason of the forwardness of their wings. Web-footed fowl are various in their flight. Several have a flagging or flagging wing, such as gulls. Penguins and a single auk, are denied the power of flight. Wild geese, in their migrations, do not fly all together, but in a regular figure, in order to cut the air with greater ease; for example, in long lines, in the figure of a Δ , or some pointed form or letter.

SECT. III. NUPTIALS, NIDIFICATION, AND EGGS OF BIRDS.

1. Most birds are monogamous, or pair, in spring fixing on a mate, and keeping constant till the cares of incubation and educating the young brood is past. This is the case, as far as we know, with all the birds of the first, second, fourth and fifth orders. Birds that lose their mates early, associate with others; and birds that lose their eggs will pair and lay again. The male, as well as the female, of several, join alternately in the trouble of incubation, and always in that of nutrition; when the young are hatched, both are busied in looking out for and bringing food to the nestlings; and at that period, the mates of the melodious tribes, who, before were perched on some sprig, and by their warbling alleviated the care of the females confined to the nest, now join in the common duty. Of the gallinaceous tribe, the greatest part are polygamous, at least in a tame state; the pheasant, many of the grouse, the partridges, and bustards, are monogamous; of the grouse, the cock of the wood, and the black game, assemble the females during the season of love, by their cries. The males of polygamous birds neglect their young; and, in some cases, would destroy them, if they met with them. The oeconomy of the struthious order, in this respect, is obscure. It is probable that the three species in the genus ostrich are polygamous, like the common poultry, for they lay many eggs; the dodo is said to lay but one. All waders, or cloven-footed fowl, are monogamous; and all with pinnated feet, are also monogamous, except the ruffs. The swimmers or web-footed fowl observe the same order, as far as can be remarked with any certainty; but many of the auks assemble in the rocks in such numbers, and each individual so contiguous, that it is not possible to determine their method in this article: It may be remarked, that the affection of birds to their young is very violent during the whole time of nutrition, or as long as they continue in a helpless state; but, as soon as the brood can fly and shift for itself, the parents neglect, and even drive it from their haunts, the affection ceasing with the necessity of it: but, during that period, The

ORNITHOLOGY.

The mothers nurse it, and the fires defend.
The young dismiss'd, to wander earth, or air,
There stops the instinct, and there ends the care:
The link dissolves; each seeks a fresh embrace;
Another love succeeds, another race.

2. The nest of a bird is one of those daily miracles that from its familiarity is passed over without regard. We stare with wonder at things that rarely happen, and neglect the daily operations of nature that ought first to excite our admiration, and claim our attention. Each bird, after nuptials, prepares a place suited to its species, for the depositing its eggs and sheltering its little brood: of different genera, and different species, set about the task in a manner suitable to their several natures; yet, every individual of the same species collects the very same materials, puts them together in the same form, and chooses the same sort of situation for placing this temporary habitation. The young bird of the last year, which never saw the building of a nest, directed by a heaven-taught sagacity, pursues the same plan in the structure of it, and selects the same materials as its parent did before. Birds of the same species, of different and remote countries, do the same. The swallows of Britain, and of the remotest parts of Germany, observe the same order of architecture. The nests of the larger rapacious birds are rude, made of sticks, and bents, but often lined with something soft; they generally build in high rocks, ruined towers, and in desolate places: enemies to the whole feathered creation, they seem conscious of attacks, and seek solitude. A few build upon the ground. Shrikes, the least of rapacious birds, build their nests in bushes, with moss, wool, &c. The order of pies is very irregular in the structure of their nests. Parrots, and in fact all birds with two toes forward and two backward, lay their eggs in the hollows of trees. And most of this order creep along the bodies of trees, and lodge their eggs also within them. Crows build in trees: among them, the nest of the magpie, composed of rude materials, is made with much art, quite covered with thorns, and only a hole left for admittance. The nests of the orioles are contrived with wonderful sagacity, and are hung at the end of some bough, or between the forks of extreme branches. In Europe, only three birds have pensile nests; the common oriole, the parus pendulinus, or hanging titmouse, and one more. But in the torrid zones, where the birds fear the search of the gliding serpent and inquisitive monkey, the instances are very frequent; a marvellous instinct implanted in them for the preservation of their young. All the gallinaceous and frutious orders lay their eggs on the ground. The ostrich is the only exception, among birds, of the want of natural affection: "Which leaveth her eggs in the earth, and warmeth them in the dust, and forgetteth that the foot may crush them, or the wild beast may break them." The columbine race makes a most artless nest, a few sticks laid across may suffice. Most of the passerine order build their nests in shrubs or bushes, and some in holes or walls of banks. Several in the torrid zone are pensile from the boughs of high trees; that of the taylor-bird, (see *MUTACILLA*) a wondrous instance. Some of this order, such as larks, and the goat-sucker, on the ground. Some swallows make a curious plaster-nest beneath the roofs of houses; and an Indian species, one of a certain glutinous matter, which are collected as delicate ingredients for soups of Chinese epicures. Most of the cloven-footed water-fowl, or waders, lay upon the ground. Spoonbills and the common heron build in trees; and make up large nests with sticks, &c. Storks build on churches, or the tops of houses. Coots make a great nest near the water-side. Grebes, in the water, a floating nest, perhaps adhering to some neighbouring reeds. Web-footed fowl breed on the ground, as the avoet, terns, some of the gulls, mergansers, and ducks: the last pull the down from their breasts, to make a softer and warmer nest for their young. Auks and guillemots lay their eggs on the naked shelves of high rocks; penguins, in holes under ground: among the pelicans, that which gives name to the genus, makes its nest in the desert on the ground. Shags sometimes on trees; corvorants and gannets, on high rocks, with sticks, dried algæ, and other coarse materials.

3. Rapacious birds, in general, lay few eggs; eagles, and the larger kinds, fewer than the lesser. The eggs of falcons and owls are rounder than those of most other birds; they lay more than six. The order of pies vary greatly in the number of their eggs. Parrots lay only two or three white eggs. Crows lay six eggs, greenish, mottled with dusky. Cuckoos, as far as we can learn, two. Woodpeckers, wryneck, and kingsfisher, lay eggs of a clear white and semi-transparent colour. The woodpeckers lay six, the others more. The nuthatch lays often in the year, eight at a time, white, spotted with brown. The hoopoe lays but two cinereous eggs. The creeper lays a great number of eggs. The honey-sucker, the least and most defenceless of birds, lays but two: but Providence wisely prevents the extinction of the genus, by a swiftness of flight that eludes every pursuit. The gallinaceous order, the most useful of any to mankind, lay the most eggs, from 8 to 20. *Benigna circa hæc natura, innocua et esculenta animalia sæcunda generavit*, is a fine observation of Pliny. With exception to the bustard, a bird that hangs between the gallinaceous and the waders, which lays only two. The columbine order lays but two white eggs; but the domestic kind, breeding almost every month, supports the remark of the Roman naturalist. All of the passerine order lay from four to

six eggs; except the titmice and the wren, which lay 15 or 18, and the goat-sucker, which lays only two. The frutious order, which consists but of two genera, disagree much in the number of eggs: the ostrich laying many, as far as 50; the dodo but one. The cloven-footed water-fowl, or waders, lay, in general, four eggs: the crane and the Norfolk plover, seldom more than two. All those of the snipe and plover genus are of a dirty white, or olive spotted with black, and scarce to be distinguished in the holes they lay in. The bird called the Land Rail, (an ambiguous species) lays from 15 to 20. Of birds with pinnated feet, the coot lays seven or eight eggs, and those white.

The web-footed, or swimmers, differ in the number of their eggs. Those which border on the order of waders, lay few eggs; the avoet, two; the flamingo, three; the albatross, the auks, and guillemots, lay only one egg a-piece: the eggs of the two last are of a size strangely large in proportion to the bulk of the birds. They are commonly of a pale green colour, spotted, and striped so variously, that not two are alike; which gives every individual the means of distinguishing its own on the naked rock, where such multitudes assemble. Divers, only two. Terns and gulls lay about three eggs, of a dirty olive, spotted with black. Ducks lay from eight to twenty eggs; the eggs of all the genus are of a pale green, or white, and unspotted. Penguins probably lay but one egg. Of the pelican genus, the gannet lays but one egg; the shags or corvorants, six or seven, all white: the last the most oblong of eggs. A minute account of the eggs of birds might occupy a treatise of itself. This is only meant to shew the great conformity nature observes in the shape and colours of the eggs of congeneric birds; and also that she keeps the same uniformity of colour in the eggs, as in the plumage of the birds they belong to. Zinnani published, at Venice, in 1737, a treatise on eggs, illustrated with accurate figures of 106 eggs. Mr. Reyger of Dantzick published in 1766, a posthumous work by Klein, with 21 plates, elegantly coloured: but much remains for future writers.

SECT. IV.

ORIGIN AND PROGRESS OF SYSTEMATIC ARRANGEMENT.

Considering the many systems that have been offered to the public of late years, Mr. Pennant gives the preference to that composed by Mr. Ray in 1667, and afterwards published in 1678; but observes, at the same time, that it would be unfair to conceal the writer, from whom our great countryman took the original hint of forming that system which has proved the foundation of all that has been composed since that period. It was a Frenchman, Belon of Mans, who first attempted to range birds according to their natures: and performed great matters, considering the unenlightened age he lived in; for his book was published in 1555. His arrangement of rapacious birds is as judicious as that of the latest writers. For his second chapter treats of vultures, falcons, shrikes, and owls: in the next, he passes over to the web-footed water-fowl, and to the cloven-footed; in the fifth, he includes the gallinaceous and frutious; but mixes with them the plovers, buntings, and larks: in the sixth are the pies, pigeons, and thrushes; and the seventh takes in the rest of the passerine order. Notwithstanding the great defects that every naturalist will at once see in the arrangement of the lesser birds of this writer, yet he will observe a rectitude of intention in general, and a fine notion of system, which was left to the following age to mature and bring to perfection. Accordingly, Mr. Ray, and his illustrious pupil the Hon. Francis Willoughby, assumed the plan; but, with great judgment, arranged into their proper stations and proper genera those which Belon had confusedly mixed together. They formed the great division of terrestrial and aquatic birds; they made every species occupy its proper place, consulting at once exterior form and natural habit. They could not bear the affected intervention of aquatic birds in the midst of terrestrial birds. They placed the last by themselves, clear and distinct from those whose haunts and œconomy were so different.

The subjoined scheme of arrangement by Mr. Pennant, is introduced with the following observations.

"Mr. Ray's general plan is so judicious, that to me it seems scarce possible to make any change in it for the better: yet, notwithstanding he was in a manner the founder of systematic zoology, later discoveries have made a few improvements on his labours. My candid friend Linnæus did not take it amiss, that I, in part, neglect his example: for I permit the land-fowl to follow one another, and divided by the water-fowl, the grassæ, and anseres of his system; but in my generical arrangement, I most punctually attend to the order he has given in his several divisions, except in those of his anseres, and a few of his grassæ. For, after the manner of Mr. Brisson, I make a distinct order of water-fowl with pinnated feet, placing them between the waders or cloven-footed water-fowl, and the web-footed. The ostrich, and land-birds with wings useless for flight, I place as a distinct order. The trumpeter (*psophia Linnæi*), and the bustards, I place at the end of the gallinaceous tribe. All are land-birds. The first multiparous, like the generality of the gallinaceous tribe; the last granivorous, swift runners, avoiders of wet places; and both have bills somewhat arched. It must be confessed, that both have legs naked above the knees; and the last, like the waders, lay but few eggs. They seem ambiguous birds, that have affinity with each order; and it is hoped that each naturalist may be indulged the toleration of placing them as suits his own opinion."

TABLE

ORNITHOLOGY.

TABLE of Pennant's ARRANGEMENT, with the correspondent ORDERS and GENERA in the SYSTEMA NATURÆ of Linnæus.

DIVISION I. LAND BIRDS.

Order I. Rapacious.	<i>Accipitres</i> LINNÆI.
II. Pica.	<i>Pica</i> .
III. Gallinaceous.	<i>Gallina</i> .
IV. Columbina.	<i>Passeres</i> .
V. Passerine.	<i>Passeres</i> .
VI. Struthious.	<i>Gallina</i> .

DIVISION II. WATER-FOWL.

Order VII. Cloven-footed } or Waders.	<i>Grallæ</i> .
VIII. Pinnated Feet.	<i>Anseres</i> .
IX. Web-footed.	<i>Grallæ</i> .

DIVISION I.

ORDER I. RAPACIOUS.

1 Vulture,	<i>Vultur</i> .	3 Owl,	<i>Strix</i> .
2 Falcon,	<i>Falco</i> .		

ORDER II. PIES.

4 Shrike,	<i>Lanius</i> .	17 Curucui,	<i>Trogon</i> .
5 Parrot,	<i>Pitacus</i> .	18 Barbet,	<i>Bucco</i> .
6 Toucan,	<i>Ramphastos</i> .	19 Cuckoo,	<i>Cuculus</i> .
7 Motmot,	<i>Ramphastos</i> .	20 Wryneck,	<i>Junco</i> .
8 Hornbill,	<i>Buceros</i> .	21 Woodpecker,	<i>Picus</i> .
9 Bee-eater,	<i>Buphaga</i> .	22 Jacamar,	<i>Alcedo</i> .
10 Ani,	<i>Crotophaga</i> .	23 Kingfisher,	<i>Alcedo</i> .
11 Wattle,		24 Nuthatch,	<i>Sitta</i> .
12 Crow,	<i>Corvus</i> .	25 Tody,	<i>Todus</i> .
13 Roller,	<i>Coracias</i> .	26 Bee-eater,	<i>Merops</i> .
14 Oriole,	<i>Oriolus</i> .	27 Hoopoe,	<i>Upupa</i> .
15 Grackle,	<i>Gracula</i> .	28 Creeper,	<i>Certhia</i> .
16 Paradise,	<i>Paradisæa</i> .	29 Honeycreeper,	<i>Trochilus</i> .

ORDER III. GALLINACEOUS.

30 Cock,	<i>Phasianus</i> .	35 Pheasant,	<i>Phasianus</i> .
31 Turkey,	<i>Meleagris</i> .	36 Grouse,	<i>Tetrao</i> .
32 Pintado,	<i>Numida</i> .	37 Partridge,	<i>Tetrao</i> .
33 Curassow,	<i>Crax</i> .	38 Trumpeter,	<i>Pipha</i> .
34 Peacock,	<i>Pavo</i> .	39 Bustard,	<i>Otis</i> .

ORDER IV. COLUMBINE.

40 Pigeon,	<i>Columba</i> .		
41 Stare,	<i>Sturnus</i> .	49 Flycatcher,	<i>Muscicapa</i> .
42 Thrush,	<i>Turdus</i> .	50 Lark,	<i>Alauda</i> .
43 Chatterer,	<i>Ampelis</i> .	51 Wagtail,	<i>Motacilla</i> .
44 Colly,	<i>Loxia</i> .	52 Warbler,	<i>Motacilla</i> .
45 Grosbeak,	<i>Loxia</i> .	53 Manakin,	<i>Pipra</i> .
46 Bunting,	<i>Emberiza</i> .	54 Titmouse,	<i>Parus</i> .
47 Tanager,	<i>Tanagra</i> .	55 Swallow,	<i>Hirundo</i> .
48 Finch,	<i>Fringilla</i> .	56 Goatsucker,	<i>Caprimulgus</i> .

ORDER VI. STRUTHIOUS.

57 Dodo,	<i>Didus</i> .	58 Ostrich,	<i>Struthio</i> .
----------	----------------	-------------	-------------------

DIVISION II.

ORDER VII. CLOVEN-FOOTED or WADERS.

59 Spoonbill,	<i>Platalea</i> .	68 Sandpiper,	<i>Tringa</i> .
60 Screamer,	<i>Palamedea</i> .	69 Plover,	<i>Charadrius</i> .
61 Jabiru,	<i>Myfertia</i> .	70 Oystercatcher,	<i>Hæmatopus</i> .
62 Boatbill,	<i>Cancroma</i> .	71 Jacana,	<i>Parra</i> .
63 Heron,	<i>Ardea</i> .	72 Pyatincole,	<i>Hirundo</i> .
64 Umbre,	<i>Scopus</i> BRISS.	73 Rail,	<i>Rallus</i> .
65 Ibis,	<i>Tantalus</i> .	74 Sheathbill,	<i>Fulica</i> .
66 Curlew,	<i>Scolopax</i> .	75 Gallinule,	<i>Fulica</i> .
67 Snipe,	<i>Scolopax</i> .		

ORDER VIII. PINNATED-FEET.

76 Phalarope,	<i>Tringa</i> .	78 Grebe,	<i>Colymbus</i> .
77 Coot,	<i>Fulica</i> .		

ORDER IX. WEB-FOOTED.

79 Avosetta,	<i>Recurvirostra</i> .	88 Gull,	<i>Larus</i> .
80 Courier,	<i>Currua</i> BRISS.	89 Petrel,	<i>Procellaria</i> .
81 Flammant,	<i>Phænicopterus</i> .	90 Merganser,	<i>Mergus</i> .
82 Albatross,	<i>Diomedea</i> .	91 Duck,	<i>Anas</i> .
83 Auk,	<i>Alca</i> .	92 Pinguin,	<i>Diomedea</i> .
84 Guillemot,	<i>Colymbus</i> .	93 Pelican,	<i>Phæo</i> .
85 Diver,	<i>Colymbus</i> .	94 Tropic,	<i>Pelicanus</i> .
86 Skimmer,	<i>Rhynchops</i> .	95 Darter,	<i>Phæton</i> .
87 Tern,	<i>Sterna</i> .		

To the above we have thought it necessary to subjoin an extract of the Orders and Genera as they stand in the *Index Ornithologicus* and General Synopsis of Birds, as published by Mr. Latham; as from the copious manner in which he has treated the subject, and from the very great addition he has been enabled to make to this branch of natural history, some deviations from the plan of preceding authors, as well as the formation of some new genera, have necessarily arisen.

TABLE of the ORDERS and GENERA of BIRDS.
according to Mr. Latham.

AVIUM ORDINES.

DIVISION I.

Order I. Accipitres,
II. Pica,
III. Passeres,
IV. Columbæ,
V. Gallinæ,
VI. Struthiones,

DIVISION II.

Order VII. Grallæ,
VIII. Pinnatipedes,
IX. Palmipedes,

ORDERS OF BIRDS.

DIVISION I.

Rapacious.
Pica.
Passerine.
Columbine.
Gallinaceous.
Struthious.

DIVISION II.

Waders.
Pinnated feet.
Web-footed.

GENERA OF BIRDS.

DIVISION I. AVES TERRESTRES, or LAND BIRDS.

ORDER I. ACCIPITRES, or RAPACIOUS.

1 Vultur,	<i>Vulture</i> .	3 Strix,	<i>Owl</i> .
2 Falco,	<i>Falcon</i> .		

ORDER II. PICÆ, or PIES.

4 Lanius,	<i>Shrike</i> .	18 Trogon,	<i>Curucui</i> .
5 Pitacus,	<i>Parrot</i> .	19 Bucco,	<i>Barbet</i> .
6 Ramphastos,	<i>Toucan</i> .	20 Cuculus,	<i>Cuckoo</i> .
7 Momotus,	<i>Motmot</i> .	21 Junco,	<i>Wryneck</i> .
8 Scythrops,		22 Pica,	<i>Woodpecker</i> .
9 Buceros,	<i>Hornbill</i> .	23 Galbula,	<i>Jacamar</i> .
10 Buphaga,	<i>Bee-eater</i> .	24 Alcedo,	<i>Kingfisher</i> .
11 Crotophaga,	<i>Ani</i> .	25 Sitta,	<i>Nuthatch</i> .
12 Calceus,	<i>Wattle-Bird</i> .	26 Todus,	<i>Tody</i> .
13 Corvus,	<i>Crow</i> .	27 Merops,	<i>Bee-eater</i> .
14 Coracias,	<i>Roller</i> .	28 Upupa,	<i>Hopoe</i> .
15 Oriolus,	<i>Oriole</i> .	29 Carthia,	<i>Creeper</i> .
16 Gracula,	<i>Grackle</i> .	30 Trochilus,	<i>Humming Bird</i> .
17 Paradisæa,	<i>Paradise Bird</i> .		

ORDER III. PASSERES, or PASSERINE.

31 Sturnus,	<i>Starling</i> .	40 Muscicapa,	<i>Flycatcher</i> .
32 Turdus,	<i>Thrush</i> .	41 Alauda,	<i>Lark</i> .
33 Ampelis,	<i>Chatterer</i> .	42 Motacilla,	<i>Wagtail</i> .
34 Colius,	<i>Colly</i> .	43 Sylvia,	<i>Warbler</i> .
35 Loxia,	<i>Grosbeak</i> .	44 Pipra,	<i>Manakin</i> .
36 Emberiza,	<i>Bunting</i> .	45 Parus,	<i>Titmouse</i> .
37 Tanagra,	<i>Tanager</i> .	46 Hirundo,	<i>Swallow</i> .
38 Fringilla,	<i>Finch</i> .	47 Caprimulgus,	<i>Goatsucker</i> .
39 Phytotoma,			

ORDER IV. COLUMBÆ, or COLUMBINE.

48 Columba,	<i>Pigeon</i> .
-------------	-----------------

ORDER V. GALLINÆ, or GALLINACEOUS.

49 Pavo,	<i>Peacock</i> .	55 Tinamus,	<i>Tinamon</i> .
50 Meleagris,	<i>Turkey</i> .	56 Tetrao,	<i>Grouse</i> .
51 Penelope,		57 Perdix,	<i>Partridge</i> .
52 Numida,	<i>Fintado</i> .	58 Plophila,	<i>Trumpeter</i> .
53 Crax,	<i>Curassow</i> .	59 Otis,	<i>Bustard</i> .
54 Phasianus,	<i>Pheasant</i> .		

ORDER VI. STRUTHIONES, or STRUTHIOUS.

60 Didus,	<i>Dodo</i> .	62 Casuarius,	<i>Cassowary</i> .
61 Struthio,	<i>African Ostrich</i> .	63 Rhea,	<i>American Ostrich</i> .

DIVISION II. AVES AQUATICÆ, or WATER-BIRDS.

ORDER VII. GRALLÆ, or WADERS.

64 Platalea,	<i>Spoonbill</i> .	73 Tringa,	<i>Sandpiper</i> .
65 Palamedea,	<i>Screamer</i> .	74 Charadrius,	<i>Plover</i> .
66 Myfertia,	<i>Jabiru</i> .	75 Curforius,	
67 Cancroma,	<i>Boatbill</i> .	76 Hæmatopus,	<i>Oyster Catcher</i> .
68 Scopus,	<i>Umbre</i> .	77 Glareola,	<i>Pratincole</i> .
69 Ardea,	<i>Heron</i> .	78 Rallus,	<i>Rail</i> .
70 Tantalus,	<i>Ibis</i> .	79 Parra,	<i>Jacana</i> .
71 Numenius,	<i>Curlew</i> .	80 Gallinula,	<i>Gall mdr</i> .
72 Scolopax,	<i>Snipe</i> .	81 Vaginalis,	<i>Sheath-bill</i> .

ORDER VIII. PINNATIPEDES. With PINNATED FEET.

82 Phalaropus,	<i>Phalarope</i> .	84 Podiceps,	<i>Grebe</i> .
83 Fulica,	<i>Coot</i> .		

ORDER IX. PALMIPEDES, or WEB-FOOTED.

* Pedibus lon-	* With long legs.	92 Rhynchops,	<i>Skimmer</i> .
gioribus,		93 Sterna,	<i>Tern</i> .
85 Recurvirostra	<i>Avoset</i> .	94 Larus,	<i>Gull</i> .
86 Corrua,	<i>Courier</i> .	95 Procellaria,	<i>Petrel</i> .
87 Phœnicopterus	<i>Flamingo</i> .	96 Mergus,	<i>Merganser</i> .
†† Pedibus bre-	†† With short legs.	97 Anas,	<i>Duck</i> .
vioribus,		98 Aptenodytes,	<i>Penguin</i> .
88 Diomedea,	<i>Albatross</i> .	99 Pelicanus,	<i>Pelican</i> .
89 Alca,	<i>Auk</i> .	100 Phæton,	<i>Tropic Bird</i> .
90 Uria,	<i>Guillemot</i> .	101 Plotus,	<i>Darter</i> .
91 Colymbus,	<i>Diver</i> .		

In the latter arrangement of birds, although it cannot be said that the authors have lost sight of their great predecessor Linnæus, yet the necessity of deviating from him must be obvious, when the very great number of species that have come to our knowledge of late years, sufficient to justify such alteration, and satisfy the most scrupulous advocates of this great man, is considered. In his last edition of the *Systema Naturæ*, Linnæus enumerates about 930 birds only; but in the *Index and Synopsis* of Mr. Latham, they have been increased to very near 4000, a number never imagined by former writers on the subject to exist in nature.

M. Biberg, in his excellent treatise *Œconomia Naturæ animæ*, acad. vol. 2. calculates the probability of the vegetable kingdom furnishing as far as 10,000 species; that of the vermes 2000; insects 10,000; amphibia 300; fishes 2000; birds 2000; quadrupeds 200; how far we have already exceeded this number in every department the naturalists can testify; but how much farther the list may be increased, no one will pretend to foretell, whilst the ardour and indefatigable industry of the present race of naturalists, added to the taste for possessing new acquisitions, and exploring new countries shall continue.

We have not entered into a description of the modes and economy of life peculiar to the species belonging to each Genus, as they are described under the respective Genera, in the order of the alphabet.

OROBUS, BITTER VETCH: a Genus of the Decandria order, belonging to the Diadelphica class of plants.

The Scots Highlanders have a great esteem for the tubercles of the roots of the tuberous, or species sometimes called *wood pea*. They dry and chew them in general to give a bitter relish to their liquor; they also affirm that they are good against most disorders of the breast, and that by the use of them they are enabled to resist hunger and thirst for a long time. In Breadalbane and Ross-shire, they sometimes bruise and steep them in water, and make an agreeable fermented liquor with them. They have a sweet taste, something like the roots of liquorice; and, when boiled, we are told, they are nutritious and well flavoured; and in times of scarcity they have served as a substitute for bread.

ORPHEUS, in ancient mythology, was the son of Oeagrus, king of Thrace, and of the Muse Calliope. He excelled in poetry, and especially in music, to such a degree, that he is represented as taming the most ferocious animals, changing the course of the winds by his melody, and as causing the trees of the forest to dance in concert with his lyre. In the character of Orpheus, according to the account that is recorded concerning him, were comprehended not only the sciences of music and poetry, but those also of moral philosophy, legislature and theology. Diodorus Siculus, lib. iv. cap. 25. says of him, that he was a man who diligently applied himself to literature, and having learned the mythical part of theology, travelled into Egypt, where he attained to farther knowledge, and became the greatest of all the Greeks, in the mysterious rites of religion, theological skill, and poetry. To which Pausanias, lib. ix. page 586, adds, that he gained great authority, as being believed to have found out expiations for wicked actions, remedies for diseases, and appeasements of the divine displeasure. The general tradition of the Greeks derived the Thracian religious rites and mysteries from Orpheus; and Suidas expressly declares it is commonly said, that Orpheus the Thracian was the first inventor of the religious mysteries of the Greeks, and that religion was called *Orphica*, *Threskeia*, as being a Thracian invention. Some, however, have doubted, from what Cicero says, *Orpheum poetam docet Aristoteles nunquam fuisse; Aristotele teacheth, that there never was such a man as Orpheus the poet*, whether there ever existed such a person. But Dr. Cudworth has shewn, from the general testimony of ancient writers, that there was such a person, who is commonly supposed to have lived before the Trojan war, (that is, in the time of the Israelitish judges) or at least to have been senior to Hesiod and Homer, and also to have died a violent death; most writers affirming that he was torn in pieces by women, because their husbands deserted them, in order to follow him. The same learned writer has also inquired into the suspected authenticity of the poems ascribed to Orpheus; and he inclines to the opinion, that they were either written by him, or that they were very ancient, and contained his doctrine and opinions. He farther argues, that though Orpheus was a Polytheist, and asserted a multiplicity of gods, he nevertheless acknowledged one supreme, unmade deity, as the original of all things; and that the Pythagoreans and Platonists not only held Orpheus in great esteem, being commonly called by them the *Theologer*, but were also thought in a great measure to have owed their theology and philosophy to him, deriving it from his principles and traditions. Cudworth's Intellectual System, book i. chap. 4. § 17. p. 294, &c. ed. 2. by Birch.

ORPIMENT, *auripigmentum*, in natural history, a bituminous mineral, composed of sulphur and arsenic, sometimes artificially produced, but found also native in the earth, and constituting one of the ores of arsenic. It is of two kinds, red and yellow, the former generally found in an indurated state; though Cronstedt supposes that it may also be met with in loose scaly powder, as it is sometimes met with in the shops. It is commonly found in shapeless masses, very seldom crystallised; though Baron Borne once found it in a polyhedral form on a blue clay in Hungary. The name *red orpiment* has been given by the more judicious to sandarach, and by the vulgar to red arsenic; but it is to be restrained only to this fossil, which is of a fine bright red, and of the regular texture of the orpiments, and answering all their characters. It is a very beautiful substance, of a fine bright red, very glossy, and a little transparent, and is found in the Turkish dominions, in the islands of the Archipelago, and even in our own country, Dr. Hill having received some of it from Cornwall, under the name of *red mundic*. The yellow kind is met with commonly of shining flexible lamellæ, like mica, the specific gravity about 5515. It burns with a blue flame, and contains about one tenth of its weight of sulphur.—It is found native in Hungary, and in many parts of Germany and the Turkish dominions: it is the common orpiment of the shops. Some are of opinion, that the noxious qualities of the arsenic are so much counteracted by the sulphur with which this substance is mixed, that it may be swallowed with safety; but Macquer positively asserts the contrary, and very seriously cautions against its use, even though we be certain that the orpiment is native. There is besides a broad flaked, gold-coloured kind, well known among the ancients, as is plain from the description of it No. 122.

left us by Dioscorides, and much esteemed at present by our painters. This is found in several places, as in the islands of the Archipelago, in the mines of Gosselaer in Saxony, in some parts of Turkey and the East Indies, and in its utmost purity about Smyrna; this makes the finest of all yellows in painting. The small-flaked, yellow kind, which is the common orpiment of the shops, is also of a fine colour, though greatly inferior to the former. The Indians use orpiment, corrected with juice of lemons, with good success against fevers.

The red arsenic, or *realgar*, is likewise found in an indurated state, and in irregular or stalactitical masses. It is either opaque or semitransparent; sometimes it is found quite transparent, and regularly crystallised in octoedral prisms or pyramids; in which last form it is called *ruby of arsenic*. Its specific gravity is about 3225; it contains 16 per cent. of sulphur; and its red colour is easily destroyed by the nitrous acid. In order to analyse these two kinds of orpiment, they ought to be digested in marine acid, adding the nitrous by degrees to assist the solution. The sulphur is then left on the filter, while the arsenic remains in the solution; from which it may be precipitated in its metallic form by zinc, adding spirit of wine to the solution. See the System of CHYMISTRY, Part III. Chap. I. Sect. I.

ORRERY, an astronomical instrument or rather machine for representing the motions and various appearances of the sun and planets; and hence, with greater propriety called *PLANETARIUM*. The reason of its being called an orrery was this. Mr. Rowley, a mathematical instrument maker, having got one from Mr. George Graham, the original inventor, to be sent abroad with some of his own instruments, he copied it, and made the first for the Earl of Orrery. Sir Richard Steel, who knew nothing of Mr. Graham's machine, thinking to do justice to the first encourager, as well as to the inventor, of such a curious instrument, called it an orrery, and gave Mr. Rowley the praise due to Mr. Graham. Defaguliers, Experiment. Phil. vol. i. p. 430. For a copious description of the ORRERY, its construction and uses, see the System of ASTRONOMY, Sect. 16. For representation, see Plate II. For a full description of the construction and uses of the Planetarium Tellurian and Lunarian, an instrument made by Mr. George Adams, see the System of ASTRONOMY, Sect. XVI. For representation, see Plate II.

ORTHODOXY, formed from *ὀρθός*, right, and *δόξα*, opinion, judgment, a soundness of doctrine or belief, with regard to all the points and articles of faith. According to the proper etymology of the word, orthodoxy denotes what every honest man believes his own opinions to be, in contradistinction to the opinions of others, which he rejects. In England it is vulgarly restricted to signify the opinions contained in the Thirty-nine Articles; and in Scotland, it is in like manner used to denote the doctrines contained in their confession of faith. It is, in general, applied to the opinions that are maintained by those called *CALVINISTS*. *Orthodoxy* is used in opposition to *heterodoxy* or *heresy*.

ORTHOGRAPHY, formed from *ὀρθός*, right, and *γραφία*, writing, in grammar, the art of spelling: that is, writing words justly, and with all the proper and necessary letters. Or it is the art of combining letters into syllables, and syllables into words. Orthography makes one of the greatest divisions or branches of grammar. See the SYSTEM, Part II. Chap. I.

ORYZA, RICE, in botany: a Genus of the Digynia order, belonging to the Hexandria class of plants; the calyx is a bivalved uniflorous glume; the corolla bivalved, nearly equal and adhering to the seed. There is but one species, namely the *fativa* or common rice. This plant is greatly cultivated in most of the eastern countries, where it is the chief support of the inhabitants; and great quantities of it are brought into England and other European countries every year, where it is much esteemed for puddings, &c. it being too tender to be produced in these northern countries without the assistance of artificial heat; but from some seeds which were formerly sent to Carolina there have been great quantities produced, and it is found to succeed as well there as in the eastern countries.

Rice, according to Dr. Cullen, is preferable to all other kinds of grain, both for largeness of produce, quantity of nourishment, and goodness. This, he says, is plain from macerating the different grains in water; for as the rice swells to the largest size, so its parts are more intimately divided. Rice is said to affect the eyes; but this is purely prejudice. Thus it is alleged of a particular people of Asia, who live on this grain, are blind-eyed: but if the soil be sandy, and not much covered with herbage, and as these people are much employed in the field, this affection of their eyes may be owing to the strong reflection of the rays of light from this sandy soil; and our author is the more inclined to this opinion, because no such effect is observed in Carolina, where rice is very commonly used.

Dr. Percival informs us, that as a wholesome nourishment rice is much inferior to falep. He digested several alimentary mixtures prepared of mutton and water, beat up with bread, sea-biscuit, falep, rice flower, fago powder, potato, old cheese, &c. in a heat equal to that of the human body. In 48 hours

Dd—2 they

they had all acquired a vinous smell, and were in brisk fermentation, except the mixture with rice, which did not emit any air-bubbles, and was but little changed. The third day several of the mixtures were sweet, and continued to ferment; others had lost their intestine motion, and were sour; but the one which contained the rice was become putrid. From this experiment it appears that rice, as an aliment is slow of fermentation, and a very weak corrector of putrefaction. It is therefore an improper diet for hospital patients, but more particularly for sailors, in long voyages, because it is incapable of preventing, and will not contribute much to check the progress of that fatal disease the sea-scurvy. Under certain circumstances, rice seems disposed of itself, without mixture to become putrid. For by long keeping it sometimes acquires an offensive savor. Nor, according to our author, can it be considered as a very nutritive kind of food, on account of its difficult solubility in the stomach. Experience confirms the truth of this conclusion; for it is observed by the planters in the West Indies, that the negroes grow thin, and are less able to work, whilst they subsist upon rice.

OSCILLATION, in mechanics, *vibration*; or the reciprocal ascent and descent of a pendulum. *Axis of Oscillation*, is a right line, parallel to the apparent horizontal one, and passing through the centre; about which the pendulum oscillates. Mr. Huygens's whole doctrine of oscillation is founded on this hypothesis, that the common centre of gravity of several bodies connected together, must return precisely to the same height whence it fell; whether those weights return conjointly, or whether, after their fall, they return separately: each with the velocity it had then acquired. This supposition was opposed by several and very much suspected by others. And some, who inclined to believe it true, yet thought it too daring to be admitted into a science, which demonstrates every thing.

OSIRIS, in mythology, one of the gods of ancient Egypt, and very generally believed to have been the sun, or at least the mind actuating that luminary. The Egyptians derived all things from two principles, an *active* and a *passive*. Their active principle, according to the learned Jablonki, was an infinite and eternal *spirit*; and their passive principle was *nicht*. This spirit they considered sometimes as a *male*, sometimes as a *female* divinity, and occasionally they attributed to it *both sexes*; but it does not appear to have been the object of their worship. The earliest objects of pagan adoration were the sun, moon, and planets; and that the philosophers and priests of ancient Egypt worshipped the sun by the name of *Osiris*, may be proved by numberless testimonies from the most authentic records of antiquity. Diogenes Laertius affirms, that they held the sun and moon for divinities, and that they called the latter *Isis*. In the hieroglyphic writings of ancient Egypt, "Osiris was represented by a sceptre and an eye," to denote that this god was the *sun* looking down from heaven on all things upon earth.

Some of the ancients, and a few of the most learned moderns, have contended, that by *Osiris*, the Egyptians understood the Nile, or spirit of the Nile, whilst others have confounded him with the Grecian Bacchus. In one sense Osiris might be Bacchus, because the original Bacchus was himself the sun. See **MYSTERY**.

It is indeed true, that the Greeks, who borrowed their religion as well as the first principles of science from Egypt, attributed to their Bacchus many of the actions of Osiris; but it is likewise true, that they gave him other attributes, which the Egyptian god could not possess consistently with the known superstitions of that country. Diodorus Siculus, Eusebius, Sextus Empiricus, &c. all affirm, that the Egyptians worshipped the sun by the name of *Osiris*, but that by this name they meant the *power* or *governing mind* of the sun, as the Greeks and Romans seem to have done by their *Phæbus* and *Apollo*.

But though the original Osiris was undoubtedly the sun, or the intelligence actuating the sun, yet there is reason to believe that there was a *secondary Osiris*, who at a very early period reigned in Egypt, and was deified after his death for the benefits he had rendered to his country. This is indeed so generally admitted, as to have occasioned great controversies among the learned respecting the time when he flourished, and whether he was the civilizer of rude barbarians or the victorious sovereign of a polished nation. The illustrious Newton, it is well known, has adopted the latter opinion; and with much plausibility endeavoured to prove, that *Osiris* was the same with *Sesostris* or *Serac*; but it must be confessed, that his conclusion is contrary to all the most authentic records of antiquity; and that it would be easy by the same mode of arguing, to give a shew of identity to two persons universally known to have flourished in very distant ages. The annals of Egypt, as may be seen in the writings of Herodotus, Diodorus Siculus, Strabo, Plutarch, and others, who copied from those annals, expressly asserted the distinct personality of Osiris and Sesostris, and placed them in æras vastly distant from each other. Osiris, if any credit be due to those historians, was the founder of the Egyptian monarchy; and, as was customary in those days, having either received the name of the sun, or communicated his own to that luminary, was after his death deified for the benefits which he had rendered to his country, and

being first worshipped only as a demigod, was in process of time advanced to full divinity, and confounded with his heavenly grandfather. The Greeks, who, though original in nothing, were always prompted by their vanity, to hold themselves out as the first of the nations, claimed this Osiris as their own, and pretended that he was the son of Jupiter and Niobe. He reigned, say they, over the Argives; but afterwards delivered his kingdom to his brother Algialeus, and took a voyage into Egypt, of which he made himself master, and married Io or Isis. He established good laws there; and they were both after their deaths worshipped as gods. That this is a ridiculous fiction needs no proof; since every one knows, that good laws were established in Egypt long before the Argives had any king, or indeed existed either as a tribe or nation.

OSSIFICATION, in the animal economy, the formation of the bones, but more particularly the conversion of parts naturally soft to the hardness and consistency of bones. Bones, Dr. Drake contends, are formed out of the most comminute or broken parts of the blood; since we see that the blood of old men, which by a long course of circulation becomes in a manner unfit for the common office of nutrition, will however ossify, and convert into bones, many of the tendons and ligaments, and even the coats of the vessels themselves, whose substance being next to the bones the most compact, admits only of the smallest particles of the blood, which therefore soonest become ossificous, as they are frequently found. Dr. Nesbit's opinion of ossification is, that in the blood, or a fluid secreted from it, there is an ossifying juice, having particles which are not apparent: that whenever nature desires an ossification between membranes, or within a cartilage, she occasions a more than usual afflux of this fluid; which so much distends the vessels which were before invisible, as to make them capable of receiving the red globules of blood, which is always to be seen near to the place where ossification is begun. In this blood, gritty, bony particles may be felt by the point of a knife, which have been formed by the attraction and cohesion of the particles of the ossifying juice obstructed, along with the other grosser fluids, in the beginning of the vessels prepared to receive resistent juices. The blood being capable of forming fine membranes, the membranous parts of a bone, which act as a gluten to keep these particles and fibres together, if there be any such, that do not arise from the coats of its vessels, are produced by a cohesion round the cretaceous particles of a part of the fluid, in which they were generated and contained. Thus the membranes of cartilages serve as a bed between or within which the bony particles are deposited, or shoot; but without any intermixture of the particles of the bone and cartilage, or continuation of the fibres of the one substance to those of the other, as is evident in cartilages containing bones kept long enough in water, and then slit; for the bone will, as soon as the large vessels that enter its substance are divided, slip as easily, and perhaps easier from it than an acorn does out of its cup; and there is a smoothness and polish of the parts of both cartilage and bone, which shew there is no conjunction of the fibres of the two substances. While the bones are increasing within cartilages, the cartilages are extended and spread out; by which, with the pressure which they suffer, and the great influx of various fluids, and the nutritious matter being hindered to flow freely into them, they decrease continually, and at last may truly be said to be entirely destroyed. Dr. Buddus endeavours to prove, that the preternatural ossifications, which are commonly said to be formed in different parts of the body, do not deserve that name; for that these hard substances have scarce any other properties of bone except whiteness and hardness.

OSTEOLOGY, *osteo*, from *osteo*, bone, and *logos*, discourse, that part of anatomy which teaches the nature and fabric of the bones of the human body; their form, disposition, articulation, use, &c. For a full description and explanation of this part of Anatomy, see the **SYSTEM**, Part I. throughout. For representation, see Plate I.

OSTREA, the *oyster*, a Genus belonging to the order of *Vermetes Testacea*. For the generic character and description of the principal species of this Genus, see the **System of CONCHOLOGY**, Order II. Genus 14.

This sea-fish occupies in the scale of nature one of the degrees the most remote from perfection: destitute of defensive weapons and progressive motion, without art or industry, it is reduced to mere vegetation in perpetual imprisonment, though it every day opens regularly to enjoy the element necessary to its preservation. The animal figure, and the springs of its organization, are scarce discernible through the coarse and shapeless mass; a ligament placed at the summit of the shell serves as an arm to its operations. Oysters are reputed to be hermaerodites: the spawn which they cast in May adheres to the rocks and other matters at the bottom of the sea; and in the space of 24 hours is provided with shells in which are contained other oysters that never leave the spot on which they were fixed, till the greedy fisherman tears them from the element. The green oysters eaten at Paris are commonly brought from Dieppe. Their colour is owing to the care taken to bed them in creeks, encompassed with verdure, whence they acquire their delicacy. Common oysters should be fresh,

fresh, tender, and moist. The most esteemed are those caught at the mouth of rivers, and in clear water. Great account is made of oysters from Brittany, but still greater of those that come from Marennes in Saintonge. Preference is given to those that are edged with small brown fringe, or beard, which epicures call *secundated oysters*; but that those are females is a mistake. The want of fresh-water renders oysters hard, bitter, and unpalatable. Mud and sea-weeds destroy them in their very birth; galangal-root, muscles, scollops, sea-flairs, and crabs, are formidable enemies to the oysters. There are found in Spain red and russet coloured oysters; in Illyria, brown coloured, with the flesh black; and in the Red Sea, of the colour of the Iris. Oysters of the mangle-tree are of two sorts; those of St. Domingo are delicate, adhering to the stumps of the trees that dip in the water. The negro divers cut them off with a bill, and they are served upon table with the roots."

Britain has been noted for oysters from the time of Juvenal, who, satyrizing Montanus, an epicure, says,

He, whether Circe's rock his oysters bore,
Or Lucrine lake, or distant Richborough's shore,
Knew at first taste.

The luxurious Romans were very fond of this fish, and had their layers or stewers for oysters, as we have at present. Sergius Orata was the first inventor, as early as the time of L. Craffius the orator. He did not make them for the sake of indulging his appetite, but through avarice, and made great profits from them. Orata got great credit for his Lucrine oysters; for, says Pliny, the British were not then known.

The ancients ate them raw, having them carried up unopened, and generally eating them at the beginning of the entertainment, but sometimes roasted. They had also a custom of stewing them with mallows and ducks, or with fish, and esteemed them very nourishing.

Britain still keeps its superiority in oysters over other countries. Most of our coasts produce them naturally; and in such places they are taken by dredging, and are become an article of commerce, both raw and pickled. The very shells, calcined, become an useful medicine as an absorbent. In common with other shells, they prove an excellent manure.

Stews or layers of oysters are formed in places which nature never allotted as habitations for them. Those near Colchester have been long famous; at present there are others that at least rival the former, near the mouth of the Thames. The oysters, or their spats, are brought to convenient places, where they improve in taste and size. It is an error to suppose that the fine green observed in oysters taken from artificial beds, is owing to copperas; it being notorious how destructive the substance, or the solution of it, is to all fish. We cannot give a better account of the cause, or of the whole treatment of oysters, than what is preserved in the learned bishop Sprat's History of the Royal Society, from p. 307 to 309.

"In the month of May, the oysters cast their spawn (which the dredgers call their *spat*); it is like to a drop of candle, and about the bigness of a halfpenny. The spat cleaves to stones, old oyster-shells, pieces of wood, and such like things, at the bottom of the sea, which they call the *cultch*. It is probably conjectured that the spat in 24 hours begins to have a shell. In the month of May, the dredgers (by the law of the admiralty court) have liberty to catch all manner of oysters, of what size soever. When they have taken them, with a knife they gently raise the small brood from the cultch, and then they throw the cultch in again, to preserve the ground for the future, unless they be so newly spat, that they cannot be safely severed from the cultch; in that case they are permitted to take the stone or shell &c, that the spat is upon, one shell having many times 20 spats. After the month of May, it is felony to carry away the cultch, and punishable to take away any other oysters, unless it be those of size (that is to say) about the bigness of an half-crown piece, or when, the two shells being shut, a fair shilling will rattle between them."

"The places where these oysters are chiefly caught are called the *Pent-Burnham, Malden*, and *Colne-Waters*; the latter taking its name from the river of Colne, which passeth by Colchester, gives name to that town, and runs into a creek of the sea, at a place called the *Hythe*, being the suburbs of the town. This brood and other oysters they carry to the creeks of the sea, at Brickelsea, Melfy, Langno, Frinrego, Wivenho, Tolebury, and Saltcoase; and there throw them into the Channel, which they call their *beds* or *layers*, where they grow and fatten; and in two or three years the smallest brood will be oysters of the size aforesaid. Those oysters which they would have green, they put into pits about three feet deep in the salt-marshes, which are overflowed only at spring-tides, to which they have sluices, and let out the salt-water until it is about a foot and a half deep. These pits, from some quality in the soil co-operating with the heat of the sun, will become green, and communicate their colour to the oysters that are put into them in four or five days, though they commonly let them continue there six weeks or two months, in which time they will be of a dark green. To prove that the sun operates in the greening, Tolebury pits will green only in summer; but

No. 123.

that the earth hath the greater power, Brickelsea pits green both winter and summer; and for a further proof, a pit within a foot of a greening-pit will not green; and those that did green very well, will in time lose their quality. The oysters, when the tide comes in, lie with their hollow shell downwards; and when it goes out, they turn on the other side: they remove not from their place, unless in cold weather, to cover themselves in the ouse. The reason of the scarcity of oysters, and consequently of their dearth, is because they are of late years bought up by the Dutch.

"There are great penalties by the admiralty court laid upon those that fish out of those grounds which the court appoints; or that destroy the cultch; or that take any oysters that are not of size; or that do not tread under their feet, or throw upon the shore, a fish which they call a *five-finger*, resembling a spur-rowel, because that fish gets into the oysters when they gape, and sucks them out.

"The reason that such a penalty is set upon any that shall destroy the cultch, is because they find that if that be taken away, the ouse will increase, and the muscles and cockles will breed there, and destroy the oysters, they having not whereon to stick their spat.

"The oysters are sick after they have spat; but in June and July they begin to mend, and in August they are perfectly well: the male oyster is black-sick, having a black substance in the fin; the female white-sick (as they term it) having a milky substance in the fin. They are salt in the pits, salter in the layers, but saltest at sea."

The oyster affords the curious in microscopic observations a very pleasing entertainment. In the clear liquor many little round living animalcules have been found, whose bodies being conjoined, form spherical figures, with tails not changing their place otherwise than by sinking to the bottom, as being heavier than the fluid; these have been seen frequently separating, and then coming together again. In other oysters, animalcules of the same kind were found, not conjoined, but swimming by one another, whence they seemed in a more perfect state, and were judged by M. Leewenhoek to be the animalcules in the roe or semen of the oysters. A female oyster being opened, incredible multitudes of small embryo oysters were seen, covered with little shells, perfectly transparent, and swimming along slowly in the liquor; and in another female, the young ones were found of a brown colour, and without any appearance of life or motion. Monsieur Joblot also kept the water running from oysters three days, and it appeared full of young oysters swimming about nimbly in it; these increased in size daily: but a mixture of wine, or the vapour of vinegar, killed them.

In the month of August oysters are supposed to breed, because young ones are then found in them. Mr. Leewenhoek, on the 4th of August, opened an oyster and took out of it a prodigious number of minute oysters, all alive, and swimming nimbly about in the liquor, by means of certain exceedingly small organs, extending a little way beyond their shells; and these he calls their *beards*. In these little oysters, he could discover the joinings of the shells; and perceive that there were some dead ones, with their shells gaping. These, though so extremely minute, are seen to be as like the large oysters in form, as one egg is to another. As to the size of them, he computes that 120 of them in a row would extend an inch; and consequently, that a globular body, whose diameter is an inch, would, if they were also round, be equal to 1,728,000 of them. He reckons 3000 or 4000 are in one oyster, and found many of the embryo oysters among the bairds; some fastened thereto by slender filaments, and others lying loose; he likewise found animalcules in the liquor 500 times less than the embryo oysters. It is not very uncommon to see on oyster-shells, when in a dark place, a shining matter or bluish light, like a flame of brimstone, which sticks to the fingers when touched, and continues shining and giving light for a considerable time, though without any considerable heat. This shining matter being examined with a microscope, was found to consist of three sorts of animalcules; the first whitish, and having 24 or 25 legs on a side, forked, a black speck on one part of the head, the back like an eel with the skin stripped off. The second sort, red, resembling the common glow-worm, with folds on its back, but legs like the former; a nose like a dog's, and one eye in the head. The third sort speckled, with a head like a foal, with many tufts of whitish hairs on the sides of it. Some much larger and greyish might be seen, having great heads, two horns like a snail's, and six or eight whitish feet; but these did not seem to shine.

OSTRICH, the English name of the genus *Struthio*, in the system of ornithology. For description of the genus, see STRUTHIO. For the representation, see Plate IV. Genus 58.

OTIS, in ornithology, a genus of birds belonging to the order *Gralla*. There are four species, principally distinguished by their colour. The most remarkable, the tarda, or bustard, is the largest of the British land-fowl; the male, at a medium, weighing 25 pounds: there are instances of some very old ones weighing 27. The breadth nine feet; the length near four. Besides the size and difference of colour, the male is distinguished from the female by a tuft of feathers, about five inches long, on each side of the lower mandible. Its neck and head are ash-coloured;

E c

coloured: the back is barred transversely with black and bright rust colour: the greater quill-feathers are black: the belly white: the tail is marked with broad red and black bars, and consists of twenty feathers: the legs dusky.

The female is about half the size of the male: the crown of the head is of a deep orange, traversed with black lines: the rest of the head is brown. The lower part of the fore-side of the neck is ash-coloured; in other respects it resembles the male, only the colours of the back and wings are more dull.

These birds inhabit most of the open countries of the south and east parts of this island, from Dorsetshire, as far as the Wolds in Yorkshire. They are exceeding shy, and difficult to be shot; run very fast, and when on the wing can fly, though slowly, many miles without resting. It is said that they take flight with difficulty, and are sometimes run down with greyhounds. They keep near their old haunts, seldom wandering above 20 or 30 miles. Their food is corn and other vegetables, and those large earth-worms that appear in great quantities on the downs before sun-rising in the summer. These are replete with moisture, answer the purpose of liquids, and enable them to live long without drinking on those extensive and dry tracts. Besides this, nature hath given the males an admirable magazine for their security against drought, being a pouch, whose entrance lies immediately under the tongue, and which is capable of holding near seven quarts; and this they probably fill with water, to supply the hen when sitting, or the young before they can fly. Buntards lay only two eggs, of the size of those of a goose, of a pale olive-brown, marked with spots of a dark colour: they make no nest, only scrape a hole in the ground. In autumn they are (in Wiltshire) generally found in large turnip-fields near the Downs, and in flocks of 50 or more. For representation, see Plate III. Genus 56.

OTTER, the English name of the species *Lutra*, belonging to the genus *Mustela*, in the system of mammalia. For description of the genus, see *MUSTELA*. For representation of this species, see Plate V. Genus 15, Species 1.

OVA, in the human anatomy, are little spherical bodies, in the form of bladders or bubbles, consisting each of two concentric membranulae, replete with a limpid humour, like the white of an egg, found under the external membranes of the ovaries of women, and connected to the minute orifices of the vessels that compose the substances of the ovaries themselves by a calyx. After the use of venery, the ova swell sensibly, become more and more pellucid, their membranes grow thicker, and at length raise that of the ovary in form of papillae, till at last, breaking the membranes of the ovary, they are detached from the calyx, taken into the cavities of the Fallopian tubes, and thence conveyed into the uterus; where being cherished and impregnated with a male seed, they commence embryos; or for want of that are again ejected. See the System, Part III. Sect. XV. See the System of MIDWIFERY, Part I. Sect. I. See also the article GENERATION.

OVARY, *ovarium*, in anatomy, that part of a female animal wherein the ova, or eggs, are formed and lodged. See the System, Part III. Sect. XV. and Plate 10, Fig. 3, Letter M. See also the System of MIDWIFERY, Part I. Sect. I. and Plate I. Fig. 4; Letters M. K.

OVARIUM of Fish. All fish have *ovaria*, but they, as well as the eggs they contain, differ greatly in the different kinds, in number, situation, figure and structure. See the System of COMPARATIVE ANATOMY. Chap. III. Sect. 2.

OVERFLOWING, or Inundation. The farmers of England having long observed how great an advantage it was to meadow and pasture land to be sometimes *overflowed* by the sudden rise of brooks, rivers, or the like, which brings the soil of the uplands upon them, and makes them need no other mending or manuring, though constantly mowed, have found an artificial method of working the same end, and by it producing the same good effect, in many of their grounds, without any ill one. For the most approved methods of effecting this important purpose in Agriculture, see the System, Sect. XIX.

OVIPAROUS, in natural history, a term applied to such animals as produce their young *ab ovo*, from the egg; as birds, insects, &c. The oviparous kind stand in opposition to those which bring forth their young alive, called viviparous animals, as man, quadrupeds, &c. Oviparous animals may be defined to be such as conceive eggs, which they afterwards bring forth, and from which, by the incubation of the parent, or some other principle of warmth and fermentation, at length arise animals; which after they have spent the moisture or humour they were surrounded withal, and are grown to a sufficient bulk, firmness, and strength, break their shell and come forth. The oviparous kind, beside birds, includes divers species of animals; as serpents, lizards, tortoises, crabs, lobsters, &c. The distinction between oviparous and viviparous creatures seems, in the insect world, to be much less fixed and determinate than is supposed. It is evident that some flies which are naturally oviparous, if they are kept from the finding a proper nidus for their eggs, be it meat, or any thing else, will retain them so long beyond their due time of exclusion, that they will hatch into worms in the body of the parent, and be afterwards deposited alive in flesh, or in the manner of the young of

viviparous insects. Bartholine gives an account, in his Medical Observations, of a hen which, instead of eggs, brought forth no less than five living chickens; but she died of it.

OVIS, the SHEEP, in the system of mammalia, a genus of the order *Pecora*; the characters of which are these: The horns are concave, turned backwards and full of wrinkles; there are eight foreteeth in the under-jaw, and no dogteeth. The species are,

1. Aries, or ram and ewe, the horns of which are shaped like a half-moon, and compressed. See Plate IX. Genus 31, Species 1. The sheep, unquestionably a mild and gentle creature, is also represented by Buffon as the most stupid, defenceless, and timid of all quadrupeds; inasmuch that, without the assistance of man, it could never, he thinks, have subsisted or continued its species in a wild state.

"The female is absolutely devoid of every art and of every means of defence. The arms of the ram are feeble and awkward. His courage is only a kind of petulance, which is useless to himself, inconvenient to his neighbours, and is totally destroyed by castration. The wedder is still more timid than the sheep. It is fear alone that makes sheep so frequently assemble in troops: upon the smallest unusual noise, they run close together; and these alarms are always accompanied with the greatest stupidity. They know not how to fly from danger, and seem not even to be conscious of the hazard and inconvenience of their situation. Wherever they are, there they remain obstinately fixed; and neither rain nor snow can make them quit their station. To force them to move or to change their route, they must be provided with a chief, who is learned to begin the march: the motions of this chief are followed step by step by the rest of the flock. But this chief himself would also continue immoveable, if he were not pushed off by the shepherd, or by his dog, an animal which perpetually watches over their safety, which defends, directs, separates, assembles, and, in a word, communicates to them every movement necessary to their preservation.

"Of all quadrupeds, therefore, sheep are the most stupid, and derive the smallest resource from instinct. The goat, who so greatly resembles the sheep in other respects, is endowed with much more sagacity. He knows how to conduct himself on every emergency: he avoids danger with dexterity, and is easily reconciled to new objects. But the sheep knows neither how to fly, nor to attack: however imminent her danger, she comes not to man for assistance so willingly as the goat; and to complete the picture of timidity and want of sentiment, she allows her lamb to be carried off, without attempting to defend it, or shewing any mark of resentment. Her grief is not even expressed by any cry different from that of ordinary bleating."

In this climate ewes fed in good pastures admit the ram in July or August; but September or October are the months when the greatest part of our ewes, if left to nature, take the ram. They go with young about five months, and generally bring forth but one at a time, though frequently two: in warm climates, they may bring forth twice in a year; but in Britain, France, and most parts of Europe, only once. They give milk plentifully for seven or eight months. They live from 10 to 12 years: they are capable of bringing forth as long as they live, when properly managed; but are generally old and useless at the age of seven or eight years. The ram, who lives 12 or 14 years, becomes unfit for propagating when eight years old. The ram, ewe, and wedder, when one year old, lose the two foreteeth of the under jaw: six months afterwards they lose the two foreteeth next to these; and at the age of three years, the teeth are all replaced. The age of a ram may likewise be discovered by the horns, which always appear the first year, and frequently as soon as they are brought forth. These horns uniformly acquire an additional ring every year, as long as the creature lives. The ewes commonly have no horns, but a kind of long protuberance in place of them: however, some of them have two, and some four horns.

In Spain, and the southern parts of Europe, the flocks are kept in shades or stables during the night; but in Britain, where there is now no danger from wolves, they are allowed to remain without, both night and day: which makes the animals more healthy, and their flesh a more wholesome food. Dry and mountainous grounds, where thyme and sheep's fescue-grass abound, are the best for the pasturing sheep. The sheep is subject to many diseases: some arise from insects which deposit their eggs in different parts of the animal; others are caused by their being kept in wet pastures; for as the sheep requires but little drink, it is naturally fond of a dry soil. The dropy, vertigo (the *pendro* of the Welsh) the phthisis, jaundice, and worms in the liver, annually make great havoc among our flocks: for the first disease, the shepherd finds a remedy by turning the infected into fields of broom; which plant has been also found to be very efficacious in the same disorder among the human species. The sheep is also infected by different sorts of insects: like the horse, it has its peculiar *æstrus* or gadfly, which deposits its eggs above the nose in the frontal sinuses: when those turn into maggots, they become excessively painful, and cause those violent agitations that we so often see the animal in. The French shepherds make a common practice of easing the sheep, by trepanning and taking out the maggot; this practice is sometimes used

used by the English shepherds, but not always with the same success. Besides these insects, the sheep is troubled with a kind of tick and louse, which magpies and starlings contribute to ease it of, by lighting on its back, and picking the insects off.

2. The Guineensis, or Guinea sheep, has pendulous ears, lax hairy dew-lips, and a prominence on the hind part of the head. The wool is short, like that of a goat. It is a native of Guinea.

3. The Strepliceros, or Cretan sheep, has strait carinated horns, twisted in a spiral manner. It is a native of mount Iola. For representation, see Plate IX. Genus 31, Species 3. For several important informations respecting these highly useful animals, see the System of AGRICULTURE, Sect. 24.

OUTLAWRY, the punishment of a person who, being called into law, and lawfully, according to the usual forms, sought, does contemptuously refuse to appear.

The effect of being outlawed at the suit of another, in a civil cause, is the forfeiture of all the person's goods and chattels to the king, and the profits of his land, while the outlawry remains in force. If in treason or felony, all the lands and tenements which he has in fee, or for life, and all his goods and chattels, are also forfeited: and besides, the law interprets his absence as a sufficient evidence of guilt; and, without requiring farther proof, accounts the person guilty of the fact, on which ensues corruption of blood, &c. and then, according to Bracton, he may perish without law, &c. However, to avoid inhumanity, no man is entitled to kill him wantonly or wilfully: but, in so doing, he is guilty of murder, unless it happens in endeavouring to apprehend him: for any body may arrest an outlaw, either of his own head, or by writ or warrant of *capias utlagatum*, in order to bring him to execution.

If, after outlawry, in civil cases, the defendant publicly appear, he is to be arrested by a writ of *capias utlagatum*, and committed till the outlawry be reversed: which reversal may be had by the defendant's appearing in court (and, in the king's-bench, by sending an attorney, according to statute 4 and 5 W. & M. cap. 11) and any plausible circumstance, however trifling, is in general sufficient to reverse it; it being considered only as a process to force appearance. The defendant must, however, pay full costs, and must put the plaintiff in the same condition as if he had appeared before the writ of *exigi facias* was awarded. It is appointed by Magna Charta, that no freeman shall be outlawed but according to the law of the land. A minor, or a woman, cannot be outlawed.

In Scotland, outlawry anciently took place in the case of refusal to fulfil a civil obligation, as well as in criminal cases. At present, however, it only takes place in the two cases of flying from a criminal prosecution, and of appearing in court attended by too great a number of followers. But the defendant, upon appearing at any distance of time, and offering to stand trial, is entitled, *de jure*, to have the outlawry reversed, and to be admitted to trial accordingly, and even to bail, if the offence be bailable.

OWL, the English name of the genus *Strix*, in the system of ornithology: for description of the genus, &c. see STRIX. For representation, see Plate I. Genus 3.

OX, the English name of a species of the genus *Bos*, after having undergone the operation of castration, for the purpose of food and agriculture. For directions concerning the choice and uses of this animal, see the article BOS, and the System of AGRICULTURE, Sect. 13.

OXYD, is the term used in the new chymical nomenclature, to express a very numerous class of bodies, formed by the union of certain bases with a smaller proportion of oxygene than what is necessary for their conversion into acids. (See OXYGENE.) The most remarkable of these bodies are what were formerly called metallic calces, and have for their base some metallic substance. It is in this state that metals are contained in their ores, from which they are extracted, and converted into the reguline or metallic form, by the process called *reduction*. Metals are converted into oxyds by combustion, and by solution into acids; and many of them assume this form from the action of the atmosphere alone, but more readily when this is assisted by moisture. During their conversion into oxyds, metals lose their splendour, and acquiring a considerable increase of absolute weight, put on an earthy, pulverent appearance. It has of late been supposed, that all earths are metallic oxyds, and that all of them would be capable of reduction, were we possessed of any body for which oxygene had a stronger elective attraction than that by which it is kept in conjunction with the bases of these supposed oxyds. But this opinion, being perfectly unsupported by experiment, cannot be admitted in a science which, like the chymistry of the present day, aspires to demonstration.

The term oxyd, however, is not confined to the combinations of metals with oxygene, but expresses that first degree of oxygenation in all bodies which, without converting them into acids, causes them to approach to the nature of salts; and of these there is a prodigious variety; as, the oxyd of phosphorus, which is the white concrete substance into which that body is converted by combustion; the oxyd of azote, or nitrous air of Dr. Priestley; and a great many others. Most of the oxyds from the vegetable

and animal kingdoms have bases compounded of different simple combustible bodies. Thus, sugar, all the gums, mucus, and starch, are vegetable oxyds; the bases of which are hydrogen and carbone, combined in various proportions. We find, accordingly, that all these bodies are, by farther additions of oxygenes, convertible into acids, and it is probable that these acids differ from each other only in the proportion of the hydrogen and carbone in their bases. The bases of the animal oxyds are still more complicated; all, or most of them, consisting of various combinations of azote, phosphorus, hydrogen, carbone, and sulphur. See the System of CHYMISTRY, Part I. throughout.

OXYDATION, is the term employed by the later chymists to express the process by which bodies are converted into oxyds; and it is allowed, on all hands, to be exactly similar to combustion. The nature of this process has been much disputed; and the question on this subject involves in itself great part of the controversy between the followers of the immortal Stahl and the justly celebrated Lavoisier, the founders of the phlogistic and antiphlogistic theories, which have for some years divided the chymical world. A view of this question, sufficiently distinct, may be taken from the case of metals and their oxyds. Metallic calces (*oxyds*, say the phlogisticians) are simple bodies, which, when united with phlogiston, form metals. The process of *reduction* consists in exposing the ores of metals to an intense heat, in contact with some inflammable body, and commonly charcoal. During this operation, say they, the charcoal, being inflamed, parts with its phlogiston, which is immediately absorbed by the calx, and a metal is formed. Lavoisier and his followers, on the contrary, contend that metals are simple bodies; but that, in the state of oxyds, that is, as they commonly exist in their ores, they are combined with oxygene. But as oxygene, at a high temperature, is more strongly attracted by charcoal than by most metals, during the process of reduction the oxyd is decomposed, and the oxygene unites with the charcoal to form carbonic acid, leaving the regulus or metal free. On this point hinges the great question, the decision of which must materially affect almost every part of chymical theory. Without presuming to decide between these two opinions, the former of which is still supported by one or two chymists of the first rank, we agree with Dr. Black, in thinking that though there still remain a few facts which have not been thoroughly explained on antiphlogistic principles, this theory is much more simple, and better supported by facts, than any that precede it. It has this great advantage over the doctrine of Stahl, that it requires not the supposition of any arbitrary body, which does not affect our senses, and of the existence of which we have not even a shadow of proof. Perhaps we may farther venture to assert, that though it may be extremely difficult, or even impossible, to refute the phlogistic theory, influenced as we have all been by a strong prejudice in its favour; yet had it been brought forward for the first time, when our knowledge had arrived at the point which it now holds, it never would have been generally received. See CALCINATION, COMBUSTION, INFLAMMATION.

OXYGENE, a term adopted in the new chymical nomenclature, to express the acidifying principle; from *ὄξυς*, "acid," and *γενναί*, "to generate." It is not found naturally in a separate state, but always combined or mixed with some other substance. In this æriform or elastic state, it is called by the French chymists, *oxygeneous gas*, and is the same as the *dephlogisticated air* of Priestley and Cavendish, the *empyrean air* of Scheele, the *vital air* and *pure air* of other modern chymists. It was called *dephlogisticated* by the followers of Stahl's doctrine, who imagined it to be air deprived of phlogiston; the epithet of *empyrean* was given to it by Mr. Scheele, who first discovered it to be the only constituent part of the atmosphere which contributes to support inflammation or combustion. He made many curious experiments on inflammation, and was the first who completely analysed common air, shewing it to consist of 27 parts of empyreal, 72 of foul, and 1 of fixed air. He found, that these 27 parts only were consumed by a burning body; and that these, during the act of combustion, were united and combined with the inflammable body burnt in them, so as to form a compound no longer combustible. Lavoisier, extending these experiments, found that the body, thus produced by empyreal air, being combined with the matter of the inflammable body burnt in it, was, in many cases, an acid: in consequence of which property, he gave this air the name of *oxygene*, i. e. "the generator of acidity." He was, perhaps, too hasty in adopting this name; for the same air is found in combination with inflammable matter, forming compounds that are by no means acid, of which we shall content ourselves with producing only one example, namely, *water*, which is the compound resulting from the combination of this air with inflammable air. See WATER.

Common atmospheric air was found by Scheele to promote animal life in a manner somewhat similar to its promoting combustion. He extended his experiments to this subject also; and he concludes, that this empyreal air is the only part of the atmosphere which is capable of supporting animal life, and that no animal can exist a minute without it. In consequence of this property

O Y S

property it has been called *vital air*. Since, however, it is absolutely necessary for the support both of combustion and of animal life, and since neither of these can exist without it, both the terms *emphyreal* and *vital* are deficient, expressing only certain properties of this elastic fluid (which may be also said of the word *oxygene*); and hence some later chymists have suggested the propriety of defining it by the name of *pure air*. See COMBUSTION, INFLAMMATION, WATER, and the System of AEROLOGY, Sect. III. and XIII.

OYSTER, the English name of the genus *Ostrea*. See the article OSTRA.

Fossile OYSTERS. The largest bed that is known of fossile oysters is that near Reading in Berkshire. They are entirely shaped, and have the same substance with recent oyster-shells; and yet since the oldest histories that mention the place give an account of them, we must suppose they have laid there for a long time. They extend over no less than six acres of ground; and just above them is a large stratum of a greenish loam, which some writers call a green earth, and others a green sand. It is composed of a crumbly marle, and a large portion of sand. Under them is a thick stratum of chalk. They all lie in a level bed; and the strata above the shells are natural, and appear never to have been dug through till the time of finding the shells.

The oyster-shells and green earth united make a stratum of about two feet thick; and over this there is a much thicker stratum of a bluish and very brittle clay; but neither has this ever been dug through, except where the shells are found. This is vulgarly denominated *piercy-clay*, and is esteemed useless. This clay-bed is about a yard deep, and above it is a stratum of fuller's-earth, about two feet and a half deep; it is extremely good, and is used by the clothiers. Over this there lies a stratum of a fine white sand, unmixed either with the clay or fuller's-earth: this is near seven feet deep, and above it is a stratum of a stiff red clay, of which tiles are made. This is again covered with a little vegetable mould; the depth however of this stratum of tile-clay cannot be ascertained, on account of the unevenness of the hill. These oysters are occasionally found whole, but most frequently in single shells. When they are in pairs, there is generally some of the green sand found within them: they seldom stick very fast

together; so that unless very carefully taken up, it is not easy to preserve them in pairs.

OYSTER-SHELLS, an alkali far more powerful than is generally allowed, and in all probability are much better medicines than many of the most costly and pompous alkalis of the same class. The proof of alkalis is in their solution by acid-spirits; and M. Homberg found that they dissolved far easier in acids of nitre and sea-salt than either pearls or coral, or indeed than any of the rest. This he supposes to be owing to their containing in the body of the shell a large portion of sal-salsus, which is easily perceived upon the tongue, and which keeps the whole substance of the shell in a sort of half-dissolved state. These shells are found to produce very sensible effects on the stomach, when it is injured by acid humours; and M. Homberg thinks that this easiness of solution is a great argument of their good effects, and that the quantity of sal-salsus which it contains contributes not a little towards it; for we are not to look upon that as a salt merely, but as a salt of a peculiar nature, formed of sea-salt by the organs of the animal, and the several fermentations it undergoes in the body of it, in the same manner as the nitrous and other salts of the earth cease to be nitrous, &c. whenever they become blended with the juices of plants, and form with them a salt peculiar to that plant; which is evidently the case as far as respects this salt, it being plainly of a more penetrating taste, and of a different smell, from the salt left by the sea-water between the several external scales or flakes of the shell. Oyster-shells being thus found by M. Homberg to be a very valuable medicine, and as one of the common methods of preparing them is by calcination, which, he observes, considerably impairs their virtues, he gives the following method of preparing them for taking inwardly, which he himself always used: Take the hollow shells of the oysters, throwing away the flat ones, as not sufficiently good; make them perfectly clean, and then dry them in the sun; when they appear dry, beat them to pieces in a marble mortar: they will still be found to contain a large quantity of moisture; lay them therefore again in the sun till perfectly dried, and then finish the powdering them, and sift the powder through a fine sieve. Give 20 or 30 grains of this powder every morning, and continue it three weeks or a month.

P A I

P or p, the 15th letter and the 11th consonant of the alphabet; the sound of which is formed by expressing the breath somewhat more suddenly than in forming the sound of *b*; in other respects these two sounds are pretty much alike, and are often confounded one with another; when *p* stands before *t* or *f*, its sound is lost; as in the words *psalms*, *psychology*, *ptolemaic*, *ptisan*, &c. When placed before *h*, they both together have the sound of *f*; as in *philosophy*, *physic*, &c.

Among astronomers, P.M. is used to denote *post meridiem*, or afternoon. Among physicians, P. stands for *pugil*, or the eight part of a handful; P.E. *partes aquales*, or equal parts of the ingredients; P.P. signifies *pulvis patrum*, or Jesuit's bark in powder; and *ppt. praparatus*, or prepared.

PACA, a species of the genus *Mus*, in the system of mammalia. For description of the genus, see *Mus*; for representation of this species, see Plate 7, Genus 24; Species 6.

PACIFIC Ocean, or South-Sea, in Geography, that vast ocean which separates Asia from America; it is called Pacific, from the moderate weather the first mariners who sailed in it met with between the tropics: and it was called South-Sea, because the Spaniards crossed the Isthmus of Darien from North to South. It is properly the Western Ocean with regard to America. See the System on the NATURAL DIVISIONS OF THE EARTH.

PAGAN, *Paganus*, a heathen, gentile, or idolater, one who adores false gods. See MYTHOLOGY.

PAGANISM, the religious worship and discipline of pagans; or the adoration of idols and false gods. The gods of paganism were either men, as Jupiter, Hercules, Bacchus, &c.; or fictitious persons, as Victory, Fame, Fever, &c.; or beasts, as in Egypt, crocodiles, cats, &c.; or, finally, inanimate things, as onions, fire, and water, &c. See IDOLATRY and MYTHOLOGY.

PAGOD, a name which the Portuguese have given to all the temples of the Indians, and all the idolaters of the East. The pagods of the Chinese and Siamese are exceedingly magnificent. The revenues of the pagod of Janigrade are so great as to subsist, every day, from fifteen to twenty thousand pilgrims. Pagod is also used for the idol adorned in the temple. Hence many gave the name of pagod to those little porcelain images brought from China.

PAIN, an uneasy sensation, arising from a sudden and violent solution of continuity, or other accident in the nerves, membranes, vessels, muscles, &c. of the body. Pain, according to some, consists in a motion of the organs of sense; and, according to others, it is an emotion of the soul occasioned by those organs.

As the brain is the seat of sensation, so it is of pain. Boer-

P

haave, and most other authors on this subject, assign a stretching of the nerves as the most immediate cause of pain; but as the nerves do not appear to consist of fibres, this cause of pain does not seem to be well founded: nor indeed, will it be easy to treat this subject clearly, but in proportion as the means of sensation are understood.

Many kinds of pain are met with in authors: such as, a gravitative pain; in which there is a sense of weight on the part affected, which is always some fleshy one, as the liver, &c. A pulsative pain; which, Galen says, always succeeds some remarkable inflammation in the containing parts, and is observed in abscesses while suppurating. A tensive pain, which is also called a distending pain; it is excited by the distension of some nervous, muscular, or membranous part, either from some humour, or from flatulence. An acute pain is when great pain is attended with quick and lively sensations. A dull pain is, when a kind of numbness is as much complained of as the pain is.

The mediate and more remote causes of pain are generally obvious: and when so, the cure will consist, for the most part, in removing them: for though, in many instances, the chief complaint is very distant from the seat of these causes, yet their removal is the proper method of relief. See the System of MEDICINE, *passim*.

Perhaps all pains may be included, with irritation, in those that have spasm or inflammation for their source. When pain is owing to inflammation, the pulse is quicker than in a natural state; it is also generally full, hard, and tense; the pain is equal, throbbing, and unremitting. If a spasm is the cause, the pulse is rarely affected; at intervals the pain abates, and then returns with some degree of aggravation; gentle motion sometimes abates, or even cures, in some instances: but in inflammatory cases no such effects are ever experienced. See Dr. Lobb's *Treatise on painful Distempers*.

The pain so frequently attendant on women in child-bed, called *after-pains* (from their happening only after being delivered of a child) are often occasioned by scooping; to fetch away coagulated blood, which is a needless endeavour. When no improper treatment in delivering the secundines can be suspected, the irritability of the uterus alone is to be considered as the cause. Care should be taken not to confound these after-pains with, or mistake the pains attending puerperal fevers for, the colic. After-pains come by fits, and soon go off: but return at different intervals, which are longer each day, and after two or three days are usually at an end, though sometimes they continue seven or eight: notwithstanding these pains, the lochia flow properly, and generally more abundantly after the cessation of each fit; this does not happen

O Y S

in colicky complaints, nor is the belly so free from tumefaction when the puerperal fever is attendant. As these pains are of the spasmodic kind, anodynes and gentle opiates, with frequent draughts of warm caudle, camomile tea, &c. are all that is required in order to their relief. See the System of MIDWIFERY, Part X. Sect. 5.

Among the various causes of pain, a singular cure is related in the third vol. of the *Lond. Med. Obs. and Inq.* p. 241, &c.—Some persons who had taken cold during their being salivated, were afflicted with pains which resisted all the usual methods of relief. At length the author of the narrative referred to, suggested the cause; and by exciting a fresh salivation the pains abated; the spitting was kept up a little while, and permitted to abate with some caution; and thus the cures were completed.

PAINTING, *Pictura*, the art of representing all visible objects by lines and colours, on an even and uniform surface. Painting is said to have had its rise among the Egyptians; and the Greeks, who learned it of them, carried it to its perfection, if we may believe the stories related of their Apelles and Zeuxis. The Romans were not without considerable masters in this art, in the latter times of the republic, and under the first emperors; but the inundation of barbarians, who ruined Italy, proved fatal to painting, and almost reduced it to its first elements; nor was it recovered in Europe till the age of Julius II. and Leo X. This last revolution in the history of painting has given occasion for distinguishing it into ancient and modern. The ancient painting comprehends the Greek and Roman: the modern has formed several schools, each of which has its peculiar character and merit.

It was in Italy, however, that the art afterwards returned to its ancient honour, and about the middle of the thirteenth century, when Cimabue, born at Florence, A.D. 1240, betaking himself to the pencil, translated the poor remains of the art from a Greek painter or two, into his own country. He was seconded by some Florentines: the first who got any reputation was Ghirlandaio, Michael Angelo's master, born in 1449: Pietro Perugino, Raphael Urbino's master, born in 1446; and Andrea Verocchio, Leonardo da Vinci's master, born in 1432.

But these scholars vastly surpassed their masters; they not only effaced all that had been done before them, but carried painting to a pitch from which it has, till within these twenty years, been declining. It was not by their own noble works alone that they advanced painting, but by the number of pupils they bred up, at the schools they formed.

Angelo, born in 1474, in particular, founded the school of Florence; Raphael, born in 1483, the school of Rome; and Leonardo, born in 1445, the school of Milan: to which must be added, the Lombard school, established about the same time, and which became very considerable under Giorgione, born in 1477, and Titian, born also in 1477. Besides the Italian masters, there were other very great ones on this side of the Alps, who had no communication with those of Italy: such were Albert Durer, in Germany; Holbens, Switzerland; Lucas, in Holland; and others in France and Flanders; but Italy, and particularly Rome, was the place where the art was practised with the greatest success; and where, from time to time, the greatest masters were produced. To Raphael's school succeeded that of the Caraccios, which has lasted, in its scholars, almost to the present time. In Paris they have two considerable bodies of painters: the one *The Royal Academy of Painting and Sculpture*; the other *The Community of Masters in Painting, Sculpture, &c.* Our own country has for the two last centuries been distinguished by its artists, and by the encouragement it has afforded to persons of distinguished merit. The art of painting is divided, by Frenoy, into three principal parts: invention, designing, and colouring; to which some add a fourth, viz. disposition. Felibien divides painting into composition, designing, and colouring.

The only difference between painting and drawing is in the management of the colours: which it would be absurd in practitioners to attempt before they had acquired a competent knowledge of drawing. Besides, had we under this head, entered into the management of the colours, it would have been of very little use, as it cannot be obtained without practice, and a strict observation of the capital masters. We shall therefore refer the reader to our Treatise on **DRAWING**, where the fundamental principles of this elegant art are fully explained.

PAIRING, the uniting or joining in couples.—The instinct of pairing is bestowed on every species of animals to which it is necessary for rearing their young; and on no other species. All wild birds pair; but with a remarkable difference from such as place their nests on trees, and such as place them on the ground. The young of the former being hatched blind, and without feathers, requires the nursing care of both parents till they are able to fly. The male feeds his mate on the nest, and cheers her with a song. As soon as the young are hatched, singing yields to a more necessary occupation, that of providing food for a numerous issue: a task that requires both parents.

Eagles, and other birds of prey, build on trees, or other inaccessible spots. They not only pair, but continue in pairs all the year round; and the same pair procreates year after year.—This at least is the case of eagles; the male and the female hunt

together, unless during incubation, at which time the female is fed by the male. A greater number than a single pair are never seen in company.

Gregarious birds pair, in order, probably, to prevent discord in a society confined to a narrow space. This is the case particularly of pigeons and rooks. The male and female sit on the eggs alternately, and divide the care of feeding their young.

Partridges, plovers, pheasants, sea-fowl, grouse, and other kinds, that place their nests on the ground, have the instinct of pairing; but differ from such as build on trees in the following particular: that after the female is impregnated, she completes her task without needing any help from the male. Retiring from him, she chooses a safe spot for her nest, where she can find plenty of worms and grubs-feed at hand; and her young, as soon as hatched, take foot and seek food for themselves. The only remaining duty incumbent on the dam is to lead them to proper places for food, and to call them together when danger impends. Some males, provoked at the desertion of their mates, break the eggs, if they stumble on them. Eider ducks pair like other birds that place their nests on the ground; and the female finishes her nest with down plucked from her own breast. If the nest be destroyed for the down, which is remarkably warm and elastic, she makes another nest, as before. If she is robbed a second time, she makes a third nest; but the male furnishes the down. A lady of spirit observed, that the eider duck may give a lesson to many a married woman, who is more disposed to pluck her husband than herself. The black game never pair: in spring, the cock on an eminence crows, and claps his wings; and all the females within hearing instantly resort to him.

Pairing birds, excepting those of prey, flock together in February, in order to choose their mates. They soon disperse, and are not seen afterward but in pairs. Pairing is unknown to quadrupeds that feed on grubs. To such it would be useless; as the female gives suck to her young while she herself is feeding. If M. Buffon deserves credit, the roe-deer are an exception.—They pair, though they feed on grubs, and have but one litter in a year.

Beasts of prey, such as lions, tigers, wolves, pair not. The female is left to shift for herself and for her young; which is a laborious task, and often so unsuccessful as to shorten the life of many of them. Pairing is essential to birds of prey, because incubation leaves the female no sufficient time to hunt for food. Pairing is not necessary to beasts of prey, because their young can bear a long fast. Add another reason, that they would multiply so fast by pairing, as to prove troublesome neighbours to the human race. Among animals that pair not, males fight desperately about a female. Such a battle among horned cattle is finely described by Lucretius. Nor is it unusual for seven or eight lions to wage bloody war for a single female.

The same reason that makes pairing necessary for gregarious birds, obtains with respect to gregarious quadrupeds; those especially who store up food for winter, and during that season live in common. Discord among such would be attended with worse consequences than even among lions and bulls, who are not confined to one place. The beavers, with respect to pairing, resemble birds that place their nests on the ground. As soon as the young are produced, the males abandon their stock of food to their mates, and live at large; but return frequently to visit them while they are suckling their young. Hedgehogs pair as well as several of the monkey-kind. We are not well acquainted with the natural history of these animals; but it would appear that the young require the nursing care of both parents. Seals have a singular economy. Polygamy seems to be a law of nature among them, as a male associates with several females. The sea-turtle has no occasion to pair, as the female concludes her task by laying her eggs in the sand. The young are hatched by the sun and immediately crawl to the sea.

PALAMEDEA, in ornithology, a genus belonging to the order *Grallæ*. The character of this genus, according to Latham, is, the bill bends down at the point, with a horn, or with a tuft of feathers erect near the base of it; the nostrils are oval; the toes are divided almost to their origin, with a small membrane between the bottoms of each.

There are two species of it; the first of which is the *Palamedea Cornuta*, or Horned Screamer. It is about the size of a turkey; in length about three feet four inches. The bill is two inches and a quarter long, and black; the upper mandible is a little gibbous at the base, the under shuts beneath it, as in the gallinaceous tribe; the nostrils are oval and pectinate, and placed near the middle of the bill. From the crown of the head springs a slender horn of more than three inches in length, and pointed at the end. For representation, see Plate IV. Genus 31.

It is remarked that they are always met with in pairs; and if one dies, the other mourns to death for the loss. They frequent places near the water; make a large nest of mud, in the shape of an oven, upon the ground; and lay two eggs, the size of those of a goose. The young are brought up in the nest till able to shift for themselves. The *Cornuta* is a rare species. It is found in certain districts in Cayenne, Guiana, Surinam, and other parts of South America, chiefly in the marshes and wet savannas, and

P A L

for the most part near the sea. These should seem to be the birds mentioned by Ulloa, which are called by the inhabitants of Quito *dispertadores*, or "awakeners," from their giving notice to others of the approach of danger; as on hearing the least noise, or seeing any one, though at a great distance, they rise from the ground, and make a loud chattering like a magpie, continuing the noise, and hovering over the object which caused the alarm, whereby the rest of the birds, taking the hint, are able in time to escape the impending danger. The screaming noise, which some authors relate as being exceedingly loud and terrible, has occasioned Mr. Pennant to give the genus the name annexed to it. In Dr. Hunter's museum, there is a fine specimen of this bird, brought from Cayenne.

PALATE, *Palatum*, in anatomy, the flesh that composes the roof, i. e. the upper and inner part of the mouth. Du Laurence says it has its name from the Latin *pali*; because inclosed with two rows of teeth, resembling little stakes, which the Latins call *pali*. The palate is a little vaulted or concave; it is lined with a glandulous coat, under which are great numbers of pretty conspicuous glands, scattered in the forepart of it, like grains of millet, with many interstices, whose excretory ducts, piercing the membrane, open into the mouth; but towards the hinder part they lie much thicker; about the root of the uvula, they are gathered so close together that they appear to form one pretty large conglomerate gland, called by Verheyen *glandula conglomerata palatina*. For description of the bones of the palate, see the System, Part I. Sect. 2, Art. 2.

PALATINATE, *Palatinatus*, a province or district, possessed by a *palatine*, and from which he takes his title and dignity. The palatinates now subsisting are either those of Germany or Poland. Those of Germany are the principalities of the Upper and Lower Rhine, i. e. of Bavaria and the Rhine. The palatinates in Poland are the provinces and districts of the Polish grandees or senators, who are the governors thereof.

PALMATED Roots, are tuberoso roots, of a flattish shape, and divided into several oblong and slender branches, resembling so many fingers. Of this sort are the roots of some of the orchis kind, called hence palmated. See System of BOTANY, Sect. 1, and Plate I.

PALM-SUNDAY, *Dominica Palmarum*, the Sunday next before Easter-Sunday; or, the last Sunday in *Lent*. It has been thus called from the primitive days, on account of a pious ceremony then in use, of bearing *palms*, in memory of the triumphal entry of Jesus Christ into Jerusalem, eight days before the feast of the passover, described by St. Matthew, chap. xxi. St. Mark, chap. xi. and St. Luke, chap. xix.

PALMYRENE Ruins, or *Ruins of Palmyra*, in ancient and modern Geography, are the ruins of a famous city of this name, situate in a desert of Syria, about forty-eight leagues from Aleppo, and as far from Damascus, twenty leagues west from the Euphrates, and in the latitude of 34° N. Little is known concerning the state of Palmyra since the time of Mahomet, except that it was considered as a place of strength, and that in the twelfth century there were two thousand Jews in it.

With respect to the ruins, they appear to be of two different and distinct periods; the oldest are so far decayed as not to admit of mensuration, and seem to have been reduced to that state by the hand of time; the other appears to have been broken into fragments by violence. Of the inscriptions none are earlier than the birth of Christ, and none are later than the destruction of the city by Aurelian, except one, which mentions Dioclesian. It is scarcely less difficult to account for the situation of this city than for its magnificence; the most probable conjecture is, that as soon as the springs of Palmyra were discovered by those who first traversed the desert in which it is situated, a settlement was made there for the purpose of carrying on the trade of India, and preserving an intercourse between the Mediterranean and Red Sea. This trade, which flourished long before the Christian æra, accounts not only for its situation, but also for its wealth. As it lay between Egypt, Persia, and Greece, it was natural to expect, that traces of the manners and sciences of those nations should be discovered among the Palmyrenes; who accordingly appear to have imitated the Egyptians in their funeral rites, the Persians in their luxury, and the Greeks in their buildings; and therefore the buildings which now lie in ruins were probably neither the works of Solomon, nor of the Seleucide, nor, a few excepted, of the Roman emperors, but of the Palmyrenes themselves.

Palmyra was formerly incircumscribed by palms and fig-trees, and covered an extent of ground, according to the Arabs, near ten miles in circumference; and might probably have been reduced to its present confined and ruined state by quantities of sand, driven over it by whirlwinds. The walls of this city are flanked by square towers; and it is probable, by their general direction, that they included the great temple, and are three miles in circumference. But of all the monuments of art and magnificence in this city, the most considerable is the Temple of the Sun. The whole space containing its ruins is a square of two hundred and twenty yards, incircumscribed with a stately wall, and adorned with pilasters, within and without, to the number of 62 on a side. Within the court are the remains of two rows of very noble marble pillars, 37 feet high;

P A N

the temple was incircumscribed with another row of pillars fifty feet high; but the temple itself was only thirty-three yards in length, and thirteen or fourteen in breadth. This is now converted into a mosque, and ornamented after the Turkish manner. North of this place is an obelisk, consisting of seven large stones, besides its capital, and the wreathed work about it, about fifty feet high, and just above the pedestal, twelve in circumference. Upon this there was probably a statue, which the Turks have destroyed. At a small distance there are two others, and a fragment of a third, which gives reason for concluding that they were once a continued row. There is also a piazza forty feet broad, and more than half a mile in length, inclosed with two rows of marble pillars, twenty-six feet high, and eight or nine feet in compass; and the number of these, it is computed, could not have been less than five hundred and sixty. Near this piazza appear the ruins of a stately building, supposed to have been a banquetting-house, elegantly finished, with the best sort of marble. In the west side of the piazza there are several apertures for gates into the court of the palace, each adorned with four porphyry pillars, thirty feet long and nine in circumference. There are several other marble pillars differently arranged, on the pedestals of which there appear to have been inscriptions, both in the Greek and Palmyrene languages, which are now altogether illegible. Among these ruins there are also many sepulchres, which are square towers, four or five stories high, and varying in size and splendor. We are indebted for an account of these very magnificent remains of antiquity, partly to some English merchants who visited them in 1678 (Phil. Transf. No. 217, 218) but chiefly to M. Bouverie and Mr. Dawkins, accompanied by Mr. R. Wood, who travelled thither in 1751. The result of their observations was published in 1753, in the form of an Atlas, containing fifty-seven copperplates, admirably executed.

PALPITATION, *Palpitatio*, in medicine, beating, or pulsation, of any of the solid parts of the body, especially the heart. For the description, causes, prognosis, and cure of this disease, see the System, Genus 13.

PALSY, *Paralysis*, in medicine, a disease wherein the body, or some of its parts, lose their motion, and sometimes their sensation, or feeling. For description, causes, prognosis, and cure, see the System; Genus 36.

PAN, in mythology, the son of Mercury and Penelope, and the deity who presided over huntsmen, shepherds, and those whose occupations led them to frequent the fields. The fable says, that Mercury transformed himself into a he-goat to please Penelope; and to this circumstance is attributed the origin of his horns and cloven feet, as well as the whole tribe of fauns and satyrs. He is called Pan, Πᾶν, it is said, because Penelope, in the absence of Ulysses, granted favours to all her lovers, and Pan himself was the fruit of this intercourse. However, Epimenides, says, that he was the son of Jupiter and Calista; others say that he was the son of the Air and a Nereid, or of the Heaven and Earth. He is commonly represented with a shepherd's crook, and a kind of flute, with many pipes. He was particularly revered among the Arcadians, to whom he issued oracles, and who celebrated, in honour of him, the *Lupercalia*. Evander carried the worship and feasts of Pan to Rome.

The Egyptians give a different account of this deity. According to them, he was one of the generals of Osiris, who engaged with Typhon; and whose army being situated in a valley, all the avenues of which were guarded by the enemy, he ordered the soldiers in the night to march with loud acclamations, which being returned in echoes, terrified the enemy, and put them to flight; whence, they say, comes the expression PANIC terror. Polyænus attributes to Pan the invention of the order of battle, of the phalanx, and of the distribution of an army into the right and left wings, or horns, whence, it is said, he derived his horns. The name Pan, which signifies *all*, has led some to make him the symbol of nature. See the articles MYSTERY and MYTHOLOGY.

PANACEA, Πανάκεια, formed from πᾶν *all*, and ἀνέσσει, *I cure*, an universal medicine or remedy for all diseases. The accurate Boerhaave overturns the notion of panaceas; and shews, from the different causes, natures, effects, seats, &c. of diseases, that several may, indeed, be cured by one medicine; but all by none. He observes, that the most universal remedies known, are water, fire, mercury, and opium; and adds, that by these alone, cautiously disguised, some have acquired the reputation of universal physicians.

PANAX, *Ginseng*, in botany, a genus of the diœcia order, belonging to the polygamia class of plants. There are five species, the most remarkable is the *Quinquefolium* or five-leaved Ginseng, supposed to be the same with the Tartarian Ginseng, the figure and description of that plant, which have been sent to Europe, agreeing perfectly with the American plant. For a copious description of this plant, its medical virtues, &c. see the article GINSENG.

PANCREAS, Πανκρεας, formed of πᾶν *all*, and κρεας, *flesh*, in anatomy, a great conglomerate gland; or a body composed of an infinite number of little glands, tied up in the same common membrane; situate at the bottom and hind part of the stomach, and reaching from the duodenum to the spleen. For a full description,

scription, see the System, Part I. For representation, see Plate III. Fig. 4, Letter D.

PANDORA, in mythology, the name of the first woman, according to Hesiod; so called from *παν*, *all*, and *δωρον*, *gift*: because the gods united to confer upon her every quality and endowment that could conduce, as the fable says, to the misery of mankind. Pandora, it is farther said, kept these gifts in a vessel, the cover of which she opened, and they were dispersed over the face of the earth.

PANEL, or **PANNEL**, is more commonly used for a schedule, or roll, containing the names of such jurors as the sheriff returns to pass upon any trial. Hence the impanelling of a jury is the entering of their names, by the sheriff, into a panel, or little schedule of parchment; called also the *panel of assize*, *panellum assise*.

PANTHEON, Πανθεον, thus named from *παν*, *all*, and *θεος*, *God*, in architecture, a temple, or church, of a circular form; dedicated to all the gods, or to all the saints. The pantheon of ancient Rome is of all others the most celebrated, and that whence all the rest take their names. It was built by Agrippa, son-in-law of Augustus, in his third consulate, twenty-five years before Christ: though several antiquarians and artists have supposed that the pantheon existed as long ago as the commonwealth, and that Agrippa only embellished it, and added the portico. To this purpose they allege the authority of Dion Cassius, who, speaking of Agrippa, says, he also finished or perfected the pantheon. It was dedicated by him to Jupiter Ultor, Jupiter the Revenger; and had the name Pantheon on account of the great number of statues of the gods ranged in seven niches all round it; and because built of a circular form, to represent heaven, the residence of the gods. It has but one door, and one window, receiving all its light from the top of its dome. It is one hundred and forty-four feet diameter within, and just as much in height, and of the Corinthian order. Before each niche are two columns of antique yellow marble, fluted, and one entire block. The whole wall of the temple, as high as the grand cornice inclusive, is cased with divers sorts of precious marble, in compartments: and the frieze is entirely of porphyry.

The eruption of Vesuvius, in the reign of Tiberius, damaged the Pantheon very considerably; but it was successively repaired by Domitian, Adrian, and Septimius Severus; and it subsisted in all its grandeur till the incursion of Alaric, in the time of Honorius: on this occasion it was stripped of several of its statues and ornaments of gold and silver. About thirty-nine years after this, Genferic, king of the Vandals, took away part of its marbles and statues; at length pope Boniface IV. obtaining this pantheon of the emperor Phocas, converted it into a church, without any alteration in the building; and dedicated it to the Virgin, and all the martyrs: and it still subsists at Rome, under the title of Notre Dame de la Rotonda. However, in 655, Constantius II. stripped it of its inside and outside brazen coverings, which he transported to Syracuse.

PANTHER, the English name of the species *Pardalis*, belonging to the genus *Felis*, in mammalia. See **PARDALIS**.

PANTOMIME, Παντομιμος, among the ancients, a person who could imitate all kinds of actions and characters by signs and gestures, without speaking.

The pantomimes made a part in the theatrical entertainments of the ancients; their chief employment was to express, in gestures and actions, whatever the chorus sung, changing their countenance and behaviour as the subject of the song varied.—They were very ancient in Greece, being derived from the heroic times, according to some; but, however this may be, they were certainly known in Plato's time. In Rome, it was so late as the time of Augustus before they made their appearance. As to their dress, it was various, being always suited, as near as possible, to that of the person they were to imitate. The crocota was much used among the Roman pantomimes, in which, and other female dresses, they personated women.

We have this account of them in Gibbon's history: "The pantomimes, who maintained their reputation from the age of Augustus to the sixth century, expressed, without the use of words, the various fables of the gods and heroes of antiquity; and the perfection of their art, which sometimes disarmed the gravity of the philosopher, always excited the applause and wonder of the people. The vast and magnificent theatres of Rome were filled by 3000 female dancers, and by 3000 singers, with the masters of the respective chorusses. Such was the popular favour which they enjoyed, that, in a time of scarcity, when all strangers were banished from the city, the merit of contributing to the public pleasures exempted them from a law which was strictly executed against the professors of the liberal arts."

Pantomimes are still very common in England: they differ indeed in some respects from those of antiquity; but they retain the name, and, like these, they consist in the representations of things merely by gestures.

PAPAVER, the **POPPY**: a genus of the monogynia order, belonging to the polyandria class of plants. The corolla is tetrapetalous; the calyx diphyllous; the capsule bilocular, opening at the pores below a persisting stigma.

Species. 1. The somniferum, or somniferous common garden-poppy. There are a great many varieties, some of them extremely beautiful. The white officinal poppy is one of the varieties of this sort: it grows often to the height of five or six feet, having large flowers, both singles and doubles, succeeded by capsules or heads, as large as oranges, each containing about 8000 seeds.

The somniferous quality of the white poppy is well known. This quality resides in the milky juice of the capsule containing the seeds, nor is it evaporated by drying the juice; hence the dried capsules are preserved in the shops for making the syrup. The inspissated juice itself is a kind of opium; and for an account of its virtues, see the article **OPIMUM**. The seeds also make a very agreeable emulsion, but have no soporific virtue.

The liquor, strongly pressed out of the capsules, suffered to settle, clarified with whites of eggs, and evaporated to a due consistence, yields an extract which is about one-fifth or one-sixth of the weight of the heads. This possesses the virtues of opium, but requires to be given in double its dose to answer the same intention, which it is said to perform without occasioning a nausea and giddiness, the usual effects of opium. This extract was first recommended by Mr. Arnot; and a similar one is now received in the Edinburgh Pharmacopœia. It is found very convenient to prepare the syrup from this extract, by dissolving one drachm in two pounds and a half of simple syrup. The *Syrupus papaveris albi*, as directed by both colleges, is an useful anodyne, and often succeeds in procuring sleep where opium fails; it is more especially adapted to children. White poppy heads are also used externally in fomentations, either alone, or more frequently added to the decoction *pro fomento*.

2. The rheas, or wild globular-headed poppy, is common in corn-fields, and flowers in June and July. The capsules of this species, like those of the somniferum, contain a milky juice, of the narcotic quality, but the quantity is very inconsiderable, and has not been applied to any medical purpose; but an extract prepared from them has been successfully employed as a sedative. The flowers have somewhat of the smell of opium, and a mucilaginous taste, accompanied with a slight degree of bitterness.—A syrup of these flowers is directed in the London Pharmacopœia, which has been thought useful as an anodyne and pectoral, and is, therefore, prescribed in coughs and catarrhal affections; but it seems valued rather for the beauty of its colour than for its virtues as a medicine.

PAPER, sheets of a thin matter, made of some vegetable substance. The materials on which mankind have, in different ages, contrived to write their sentiments, have been extremely various; in the early ages they made use of stones, and tables of wood, wax, ivory, &c.

Paper, with regard to the manner of making it, and the materials employed therein, is reducible to several kinds: as Egyptian paper, made of the rush papyrus; bark-paper, made of the inner rind of several trees; cotton-paper; incombustible paper; and European paper, made of linen-rags.

PAPER-Money, is a term frequently made use of for bank-bills, which pass currently in trade instead of gold and silver.

Concerning this species of currency, the national utility of which has been controverted by some, we have the following observations in Dr. Smith's Treatise on the Wealth of Nations: "The substitution of paper in the room of gold and silver money replaces a very expressive instrument of commerce with one much less costly, and sometimes equally convenient. Circulation comes to be carried on by a new wheel, which it costs less both to erect and maintain than the old one.

"When the people of any particular country have such confidence in the fortune, probity, and prudence of a particular banker, as to believe that he is always ready to pay, upon demand, such of his promissory notes as are likely at any time to be presented to him, those notes come to have the same currency as gold and silver money, for the confidence that such money can at any time be had for them.

"A particular banker lends among his customers his own promissory notes, to the amount, we shall suppose, of 100,000*l*. As those notes serve all the purposes of money, his debtors pay him the same interest as if he had lent them so much money. This interest is the source of his gain. Though some of these notes are continually coming back upon him for payment, part of them continue to circulate for months and years together. Though he has generally in circulation, therefore, notes to the amount of 100,000*l*.; 20,000*l*. in gold and silver may frequently be a sufficient provision for answering occasional demands. By this operation, therefore, 20,000*l*. in gold and silver perform all the functions which 100,000*l*. could otherwise have performed. Eighty thousand pounds of gold and silver can, therefore, in this manner, be spared from the circulation of the country; and if different operations of the same kind should, at the same time, be carried on by many different banks and bankers, the whole circulation may be thus conducted with a fifth part only of the gold and silver.

"Let us suppose, for example, that the whole circulating money

ney of some particular country amounted, at a particular time, to 1,000,000l. sterling, that sum being then sufficient for circulating the whole annual produce of their land and labour. Let us suppose, too, that, some time thereafter, different banks and bankers issued promissory notes, payable to the bearer, to the amount of 1,000,000l. reserving in their different coffers 200,000l. for answering occasional demands; there would remain, therefore, in circulation 800,000l. in gold and silver, and 1,000,000l. of bank-notes, or 1,800,000l. of paper and money together. But the annual produce of the land and labour of the country had before required only 1,000,000l. to circulate and distribute it to its proper consumers, and that annual produce cannot be immediately augmented by those operations of banking. One million, therefore, will be sufficient to circulate it after them. The goods to be bought and sold being precisely the same as before, the same quantity of money will be sufficient for buying and selling them. The channel of circulation, if I may be allowed such an expression, will remain precisely the same as before. One million we have supposed sufficient to fill that channel. Whatever, therefore, is poured into it, beyond this sum, cannot run in it, but must overflow. One million eight hundred thousand pounds are poured into it; eight hundred thousand pounds, therefore, must overflow, that sum being over and above what can be employed in the circulation of the country. But, though this sum cannot be employed at home, it is too valuable to be allowed to lie idle. It will therefore be sent abroad, in order to seek that profitable employment which it cannot find at home. But the paper cannot go abroad; because, at a distance from the banks which issue it, and from the country in which payment of it can be exacted by law, it will not be received in common payments. Gold and silver, therefore, to the amount of 800,000l. will be sent abroad, and the channel of home circulation will remain filled with 1,000,000l. of paper, instead of 1,000,000l. of those metals which filled it before.

"But though so great a quantity of gold and silver is thus sent abroad, we must not imagine that it is sent abroad for nothing, or that its proprietors make a present of it to foreign nations. They will exchange it for foreign goods of some kind or other, in order to supply the consumption either of some foreign country, or their own.

"If they employ it in purchasing goods in one foreign country, in order to supply the consumption of another, or in what is called the *carrying trade*, whatever profit they make will be an addition to the nett revenue of their own country. It is like a new fund, created for carrying on a new trade; domestic business being now transacted by paper, and the gold and silver being converted into a fund for this new trade.

"If they employ it in purchasing foreign goods for home consumption, they may either first purchase such goods as are likely to be consumed by idle people who produce nothing, such as foreign wines, foreign silks, &c. or, secondly, they may purchase an additional stock of materials, tools, and provisions, in order to employ an additional number of industrious people, who reproduce, with a profit, the value of their annual consumption.

"So far as it is employed in the first way, it promotes prodigality, increases expence and consumption, without increasing production, or establishing any permanent fund for supporting that expence, and is in every respect hurtful to the society.

"So far as it is employed in the second way, it promotes industry; and though it increases the consumption of the society, it provides a permanent fund for supporting that consumption, the people who consume, reproducing, with a profit, the whole value of their annual consumption. The gross revenue of the society, the annual produce of their land and labour, is increased by the whole value which the labour of those workmen adds to the materials upon which they are employed; and their nett revenue by what remains of this value, after deducting what is necessary for supporting the tools and instruments of their trade.

"That the greater part of the gold and silver which, being forced abroad by those operations of banking, is employed in purchasing foreign goods for home consumption, is, and must be, employed for purchasing those of this second kind, seems not only probable, but almost unavoidable. Though some particular men may sometimes increase their expence very considerably, though their revenue does not increase at all, we may be assured that no class or order of men ever does so: because, though the principles of common prudence do not always govern the conduct of every individual, they always influence that of the majority of every class or order. But the revenue of idle people, considered as a class or order, cannot, in the smallest degree, be increased by those operations of banking. Their expence in general, therefore, cannot be much increased by them, though that of a few individuals among them may, and, in reality, sometimes is. The demand of idle people, therefore, for foreign goods, being the same, or very nearly the same, as before, a very small part of the money which, being forced abroad by those operations of banking, is employed in purchasing foreign goods for home consumption, is likely to be employed in purchasing those for their use. The greater part of it will naturally be destined for the employment of industry, and not for the maintenance of idleness.

"When we compute the proportion of industry which the cir-

culating capital of any society can employ, we must always have regard to those parts of it only which consist in provisions, materials, and finished work: the other, which consists in money, and which serves only to circulate those three, must always be deducted. In order to put industry into motion, three things are requisite: materials to work upon, tools to work with, and the wages or recompence for the sake of which the work is done. Money is neither a material to work upon, nor a tool to work with; and though the wages of the workman are commonly paid to him in money, his real revenue, like that of all other men, consists, not in the money, but in the money's worth; not in the metal pieces, but in what can be got for them.

"The proportion of industry which any capital can employ must evidently be equal to the number of workmen whom it can supply with materials, tools, and a maintenance suitable to the nature of the work. Money may be requisite for purchasing the materials and tools of the work, as well as the maintenance of the workmen; but the proportion of industry which the whole capital can employ is certainly not equal both to the money which purchases, and to the materials, tools, and maintenance which are purchased with it; but only to one or other of these two values, and to the latter more properly than to the former.

"When paper is substituted in the room of gold and silver money, the quantity of the materials, tools, and maintenance, which the whole circulating capital can supply may be increased by the whole value of gold and silver which used to be employed in purchasing them. The whole value of the great wheel of circulation and distribution is added to the goods which are circulated and distributed by means of it. The operation, in some measure, resembles that of the undertaker of some great work, who, in consequence of some improvement in mechanics, takes down his old machinery, and adds the difference between its price and that of the new to his circulating capital, to the fund from which he furnishes materials and wages to his workmen.

"What the proportion is which the circulating money of any country bears to the whole value of the annual produce circulated by means of it, it is perhaps impossible to determine. It has been computed, by different authors, at a fifth, at a tenth, at a twentieth, and at a thirtieth part of that value: but how small soever the proportion which the circulating money may bear to the whole value of the annual produce, as but a part, and frequently but a small part, of that produce, is ever destined for the maintenance of industry, it must always bear a very considerable proportion to that part. When, therefore, by the substitution of paper, the gold and silver necessary for circulation is reduced to perhaps a fifth part of the former quantity, if the value of only the greater part of the other four-fifths be added to the funds which are destined for the maintenance of industry, it must make a very considerable addition to the quantity of that industry, and, consequently, to the value of the annual produce of land and labour.

"An operation of this kind has, within these 25 or 30 years, been performed in Scotland, by the erection of new banking companies in almost every considerable town, and even in some country villages. The effects of it have been precisely those before described. The business of the country is almost entirely carried on by means of the paper of those different banking companies, with which purchases and payments of all kinds are commonly made. Silver very seldom appears, except in the change of a twenty-shilling bank-note, and gold still seldomer. But though the conduct of all those different companies has not been unexceptionable, and has accordingly required an act of parliament to regulate it, the country, notwithstanding, has evidently derived great benefit from their trade. I have heard it asserted, that the trade of the city of Glasgow doubled in about 15 years after the first erection of the banks there; and that the trade of Scotland has more than quadrupled since the first erection of the two public banks at Edinburgh; of which the one, called *The Bank of Scotland*, was established by act of parliament in 1695, the other, called *The Royal Bank*, by royal charter in 1727. Whether the trade, either of Scotland in general, or the city of Glasgow in particular, has really increased in so great a proportion during so short a period, I do not pretend to know. If either of them has increased in this proportion, it seems to be an effect too great to be accounted for by the sole operation of this cause. That the trade and industry of Scotland, however, have increased very considerably during this period, and that the banks have contributed a good deal to this increase, cannot be doubted.

"The value of the silver money which circulated in Scotland before the Union, 1707, and which, immediately after it, was brought into the bank of Scotland in order to be recoined, amounted to 411,171l. 10s. 9d. sterling. No account has been got of the gold coin; but it appears, from the ancient accounts of the mint of Scotland, that the value of the gold annually coined somewhat exceeded that of the silver. There were a good many people, too, upon this occasion, who, from a diffidence of repayment, did not bring their silver into the bank of Scotland; and there was, besides, some English coin which was not called in. The whole value of the gold and silver, therefore, which circulated in Scotland before the Union, cannot be estimated at less than 1,000,000l. sterling. It seems to have constituted almost the whole circulation of that country;

country, for though the circulation of the bank of Scotland, which had then no rival, was considerable, it seems to have made but a very small part of the whole. In the present times, the whole circulation of Scotland cannot be estimated at less than 2,000,000l. of which that part which consists in gold and silver, most probably, does not amount to 500,000l. But though the circulating gold and silver of Scotland have suffered so great a diminution during this period, its real riches and prosperity do not appear to have suffered at all. Its agriculture, manufactures, and trade, on the contrary, the annual produce of its land and labour, have evidently been augmented."

PAPILLÆ, Pyramidales, are little eminences arising from the subcutaneous nerves. These papillæ are always the most numerous and conspicuous in the places of most acute sense, as the tongue, glans of the penis, vagina, labia, œsophagus, ventricle, small intestines, and tips of the fingers and toes, where the cutis they are covered with is extremely thin. In the other parts of the body the cutis is thicker, and the papillæ are much fewer, smaller, &c. These papillæ are supposed to be the immediate organ of feeling.

PAPILLÆ of the Tongue, in anatomy, are little eminences of the tongue, so called from their resemblance to the papillæ of the breast. From the papillary tunic of the tongue arise numerous nervous papillæ, which penetrating the viscous substance over them, terminate under the surface of the tongue. It is by means of these papillæ, that the tongue is supposed to have its faculty of tasting. See the System, Part VII. Sect. 2.

PAPISTS, in ecclesiastical history, are those who acknowledge the Pope to be supreme head of the church, or who profess the popish religion. There are many penal laws in force against the papists; but the most rigid are dispensed with, on their taking the oath of allegiance. See NON-CONFORMISTS.

PARABOLA, in geometry, a figure arising from the section of a cone, when cut by a plane parallel to one of its sides. See CONIC SECTIONS in the System, Part II. Sect. 1.

PARADISE, a term primarily used for the place wherein Adam was seated, during his innocence; and from which he was expelled for disobeying God: this is called, in a stricter manner, the *Terrestrial Paradise*. The word is formed of *παράδεισος*, orchard, a place stored with apples, and all kinds of fruit. Moses calls it the *Garden of Eden*, q. d. garden of delight, from *עֵדֶן*, *edem*, voluptas, pleasure. The critics are in dispute about the precise place of Paradise. Some, as Hardouin, &c. will have it in Judea, in the place where now is the lake Genesareth; others, as Le Clerc, &c. in Syria, towards the springs of the Orontes and Chrysorrhoe; but in neither of those places do we discover any track of the rivers wherewith the Paradise in Moses's description was watered. Calmet and some other ingenious critics have placed the terrestrial Paradise in Armenia, near mount Ararat, where Noah's ark was left: and imagine they there discovered the sources of the four rivers which watered the garden of Eden, viz. Euphrates; Hiddekel, now the Tigris; Gihon, now Araxes; and Pison, now Phazzo. But Sir J. Chardin assures us, in his Travels, that the Phazzo springs out of the mountains of Caucasus, northward of the kingdom of Imereti, and far enough from mount Ararat: beside, that in Armenia we have no signs of the countries of Havilah and Ethiopia, which those rivers washed after their departure from Eden.

There are various other opinions as to this point: Postellus will have Paradise placed under the north pole; grounding his notion upon the ancient tradition of the Egyptians and Babylonians, that the ecliptic, or sun's way, was at first at right-angles to the equator; and so passed over the north pole. Others are against limiting it to any one place, and contend, that it included the whole face of the earth, which was then, as it were, one continued scene of pleasure, till altered upon Adam's transgression. However, both these opinions are equally incompatible with the account in the book of Genesis: others, as Origen, Philo, &c. interpret the scripture relation of Paradise allegorically. But the most common and probable opinion is that of Hopkinson, Huet, Bochart, &c. who place Paradise between the confluence of the Euphrates and Tigris, and their separation. These rivers are two of those wherewith the garden of Eden was watered: Pison was a branch arising out of one of them after their separation; and Gihon another branch arising from the other, on the side of Armenia, or the west: accordingly, Ethiopia, one of the countries which these rivers washed, was incontestibly Arabia Deserta; for Moses calls his wife, who was of this country, an Ethiopian; and Havilah, the other country, must have been the Chusistan in Persia; where were anciently found gold, bdellium, the onyx, &c. mentioned in Moses's description. The great difficulty in this system is, that Moses speaks expressly of four rivers, each of which had its source in the garden of Eden; whereas this gives us only two rivers, which were separated into four branches.

PARADISE is also used in the New Testament, and by Christian writers, for the final habitation of the blessed, or heaven.

It may not be improper, however, in this place to give a description of the paradise of the Mahomedans. The sensuality and absurdity of that impostor must be apparent to all men. Their religion has no consistency in its parts, and the descriptions of the future enjoyments of the faithful are miserable instances of human weakness and folly.

"The paradise of the Mahomedans is said by them to be situated above the seven heavens, or in the seventh, and next under the throne of God; and to express the amenity of the place, they tell us that the earth of it is of the finest wheat-flower, or of the purest musk, or of saffron; and that its stones are pearls and jacinths; the walls of its buildings enriched with gold and silver; and the trunks of all its trees of gold, amongst which the most remarkable is the tree *tuba*, or tree of happiness. They pretend that this tree stands in the palace of Mahommed, though a branch of it will reach to the house of every true believer, loaded with pomegranates, dates, grapes, and other fruits of surprising bigness, and delicious tastes, unknown to mortals. If a man desires to eat of any particular kind of fruit, it will immediately be presented to him; or if he chooses flesh, birds ready dressed will be set before him, and such as he may wish for. They add, that this tree will supply the blessed not only with fruit, but with silk garments also, and beasts to ride on, adorned with rich trappings, all which will burst forth from the fruit; and that the tree is so large, that a person mounted on the fleetest horse would not be able to gallop from one end of its shade to the other in 100 years. Plenty of water being one of its greatest additions to the pleasantness of any place, the Alcoran often speaks of the rivers of paradise as the principal ornament. Some of these rivers are said to flow with water, some with milk, some with wine, and others with honey; all of them have their sources in the root of this tree of happiness; and, as if these rivers were not sufficient, we are told that the garden of this paradise is also watered by a great number of lesser springs and fountains, whose pebbles are rubies and emeralds; their earth of camphor, their beds of musk, and their sides of saffron. But all those glories will be eclipsed by the resplendent and exquisite beauty of the girls of paradise, the enjoyment of whose company will constitute the principal felicity of the faithful. These (they say) are not formed of clay, as mortal woman, but of pure musk; and are, as their prophet often affirms in his Alcoran, free from all the natural defects and inconveniences incident to the sex. Being also of the strictest modesty, they keep themselves secluded from public view in pavilions of hollow pearls, so large that, as some traditions have it, one of them will be no less than 16, or, as others say, 60 miles long, and as many broad. With these the inhabitants of paradise, may taste pleasures in their height; and for this purpose will be endowed with extraordinary abilities, and enjoy a perpetual youth."

PARADISE Lost, the name of a modern epic poem, the first and finest of those composed by Milton.

The subject of this poem is extraordinary; it had never before been attempted, and seemed to be above the efforts of human genius. Angels and devils are not the machinery, but the principal actors in it; so that what would appear marvellous in any other composition, is in this only the natural course of events.—The poet's intention was, as he expresses it himself, to "vindicate the ways of God to men." How far Milton was happy in the choice of his subject, may be questioned. It has led him into difficult ground, though it certainly suited the daring sublimity of his genius. It is a subject for which he alone was fitted; and, in the conduct of it, he has shewn a stretch both of imagination and invention which is perfectly wonderful.

PARADISEA, in ornithology, a genus of birds belonging to the order *Pica*. The beak is covered with a belt or collar of downy feathers at the base; and the feathers on the sides are very long. The Portuguese first found these birds on the island of Gilolo, the Papua islands, and New Guinea; and they were known by the name of *birds of the sun*. The inhabitants of Ternate call them *manuco dewata*, the "bird of God;" whence the name *manuco diata*, used by some naturalists, is derived. The peculiar length and structure of their scapular feathers hinders them from settling, in high winds, on trees; and when they are thrown on the ground by these winds, they cannot rise again. If taken by the natives, they are immediately killed, as their food is not known; and they defend themselves with great courage, with their formidable bills.

The largest bird of Paradise is commonly two feet four inches in length; the head is small; the bill hard and long, of a pale colour. The head and back-part of the neck is lemon-coloured, a little black about the eyes; about the neck, the bird is of the brightest glossy emerald green, soft like velvet; as is also the breast, which is black; the wings are large, and chestnut-coloured; the back-part of the body is covered with long, straight, narrow feathers, of a pale brown colour, similar to the plumes of the ostrich. These feathers are spread when the bird is on the wing: for which reason he can keep very long in the air. On both sides of the belly are two tufts of stiff and shorter feathers, of a golden yellow, and shining. From the rump proceed two long stiff shafts, which are feathered on their extremities.

These birds are not found in Key, an island fifty Dutch miles east of Banda; but they are found at the Aroo islands, lying 15 Dutch miles farther east than Key, during the westerly or dry monsoon; and they return to New Guinea as soon as the easterly or wet monsoon sets in. They come always in a flock of 30 or 40, and are led by a bird which the inhabitants of Aroo call the

P A R

king. This leader is black, with red spots: and constantly flies higher than the rest of the flock, which never forsake him, but settle as soon as he settles; a circumstance that frequently proves their ruin, when the king lights on the ground, whence they are not able to rise, on account of the singular structure and disposition of their plumage. They are likewise unable to fly with the wind, which would ruin their loose plumage; but take their flight constantly against it, cautious not to venture out in hard blowing weather, as a strong wind frequently obliges them to come to the ground. During their flight they cry like starlings. Their note, however, approaches more to the croaking of ravens; which is heard very plainly, when they are in distress from a fresh gale blowing on the back of their plumage. In Aroo, these birds settle on the highest trees, especially on the ficus benjamina of the hortus malabaricus, commonly called the *waringa-tree*. The natives catch them with bird-lime or in nooses, or shoot them with blunt arrows; but though some are still alive when they fall into their hands, the catchers kill them immediately, and sometimes cut the legs off: then they draw out the entrails, dry and fumigate the bodies with sulphur, or smoke only, and sell them at Banda for half a rixdollar each: but at Aroo they may be bought for a spike-nail, or a piece of old iron. Flocks of these birds are often seen flying from one island to the other against the wind. In case they find the wind become too powerful, they fly straight up into the air, till they come to a place where it is less agitated, and then continue their flight. During the eastern monsoon their tails are moulted, so that they have them only during four months of the western monsoon. For representation, see Plate I. Genus 16.

PARADOX, Παραδοξον, in philosophy, a proposition seemingly absurd, as being contrary to some received opinions, but yet true in fact.

The vulgar and illiterate take almost every thing, even the most important, upon the authority of others, without ever examining it themselves. Although this implicit confidence is seldom attended with any bad consequences in the common affairs of life, it has nevertheless, in other things, been much abused; and in political and religious matters has produced fatal effects.

It must be owned, that credulity has done much more mischief in the world than incredulity has done, or ever will do; because the influences of the latter extend only to such as have some share of literature, or affect the reputation thereof: and since the human mind is not necessarily impelled, without evidence, either to belief or unbelief, but may suspend its assent to, or dissent from, any proposition till after a thorough examination; it is to be wished that men of learning, especially philosophers, would not hastily, and by first appearances, determine themselves with respect to the truth or falsehood, possibility or impossibility, of things.

A person who has made but little progress in the mathematics, though in other respects learned and judicious, would be apt to pronounce it impossible that two lines, which were no where two inches asunder, may continually approach towards one another, and yet never meet, though continued to infinity; and yet the truth of this proposition may be easily demonstrated: and many, who are good mechanicks, would be as apt to pronounce the same, if they were told, that though the teeth of one wheel should take equally deep into the teeth of three others, it should affect them in such a manner, that, in turning it any way round its axis, it should turn one of them the same way, another the contrary way, and the third no way at all.

No science abounds more with paradoxes than geometry: thus, that a right-line should continually approach to the hyperbola, and yet never reach it, is a true paradox; and in the same manner a spiral may continually approach to a point, and yet not reach it in any number of revolutions, however great.

PARALLAX, Παραλλαξις, in astronomy, an arch of the heavens intercepted between the true place of a star and its apparent place. See the System, Sect. VII. DEFINITIONS. See also Problems 15, 16, and 17.

PARALLEL, in geometry, is applied to lines, figures, and bodies, which are every where equidistant from each other; or which, though infinitely produced, would never either approach nearer to, or recede farther from, each other. See the System, Part I. Sect. I.

PARALLEL Rays, in optics, are those which keep at an equal distance, in respect to each other, from the visible object, to the eye, which is supposed to be infinitely remote from the object. See the System, Part I. Sect. I.

PARALLEL Sphere, that situation of the sphere wherein the equator coincides with the horizon, and the poles with the zenith and nadir. In this sphere all the parallels of the equator become parallels of the horizon, consequently, no stars ever rise or set, but all turn round in circles parallel to the horizon; and the sun, when in the equinoctial, wheels round the horizon the whole day. After his rising to the elevated pole, he never sets for six months; and after his entering again on the other side of the line, he never rises for six months longer.

PARALLEL Sailing, in navigation, is the sailing under parallel of latitude. Of this there are but three cases. 1. Given, the departure and distance; required, the latitude? The rule for which

P A R

is, as the difference of longitude is to the radius, so is the distance of the co-sine to the latitude. 2. Given, the difference of longitude between two places under the same parallel: required, their distance? The rule is, as radius to difference of longitude, so is co-sine of latitudes to distance. 3. Given, the distance between two places in the same latitude: required, their difference of longitude? The rule is, as the co-sine of latitude to distance, so is radius to difference of longitude. See the System of NAVIGATION, Part II. Sect. I.

PARALLELIPIPED, in geometry, one of the regular bodies, or solids, comprehended under six parallelograms, the opposite ones whereof are similar, parallel, and equal. A parallelepiped is by some defined, a prism whose base is a parallelogram. See the System, Sect. I.

PARALLELOGRAM, in geometry, a quadrilateral right-lined figure, whose opposite sides are parallel and equal to each other. See the System, Part I. Sect. I. and II. Plate I. Fig. 35, 36, 37, and 38.

PARALYSIS, Παράλυσις, formed from *παρελυω*, I unbind, this disease being supposed to unbind the nerves and muscles; in medicine, a disease called *Palsy*. See the System, Genus 36.

PARAPET, Breastwork, in fortification, a defence or screen, on the extreme of a rampart, or other work, serving to cover the soldiers and the cannon from the enemy's fire. See the System, Sect. I. under the article DEFINITION, and Plate II. Fig. 1. Letters x, x.

PARAPHIMOSIS, Παραφimosις, formed of *παρεμω*, much, and *φίμω*, I bind, in medicine, a disorder of the penis, wherein the prepuce is shrunk, and withdrawn behind the glans, so as not to be capable of being brought to cover the same. This happens oftentimes in venereal disorders, where the humours discharged frequently prove so sharp as to cause this retraction. There sometimes arises a necessity, in this case, to snip or cut the prepuce open, otherwise the humours will be pent up under it, and do a great deal of mischief. For description, causes, and cure, see the System, Genus 76.

PARCÆ, goddesses, who, according to the ancient Pagan theology, preside over the periods, or durations, of human lives. These the ancients frequently confounded with the Fates or Destinies; and, in effect, the Parcæ, according to Plato, were the daughters of Necessity and Destiny. The Parcæ were three, Clotho, Lachesis, and Atropos; because all things have their beginning, progress, and end. Hence, the poets tell us, the Parcæ spun the thread of men's lives: that Clotho held the distaff, and drew the thread; Lachesis twirled the spindle, and spun it; and Atropos cut it.

PARDALIS, a species of the genus *Felis*, in mammalia. For description of the genus, see FELIS. For representation, see Plate IV. Genus 13, Species 5, Variety 1.

PARDON, in criminal law, is the remitting or forgiving an offence committed against the king. Laws (says an able writer) cannot be framed on principles of compassion to guilt; yet justice, or the constitution of England, is bound to be administered in mercy; this is promised by the king in his coronation oath; and it is that act of his government, which is the most personal and most entirely his own. The king condemns no man; that rugged task he leaves to his courts of justice: the great operation of his sceptre is mercy. His power of pardoning was said by our Saxon ancestors to be derived *à lege sua dignitatis*: and it is declared in parliament, by stat. 27 Hen. VIII. c. 24, that no other person hath power to pardon or remit any treason or felonies whatsoever; but that the king hath the whole and sole power thereof, united and knit to the imperial crown of this realm.

This is indeed one of the great advantages of monarchy, in general, above any other form of government, that there is a magistrate who has it in his power to extend mercy wherever he thinks it is deserved; holding a court of equity in his own breast, to soften the rigour of the general law, in such criminal cases as merit an exemption from punishment. Pardons (according to some theorists) should be excluded in a perfect legislation, where punishments are mild but certain; that the clemency of the prince seems a tacit disapprobation of the laws. But the exclusion of pardons must necessarily introduce a very dangerous power in the judge or jury; that of construing the criminal law by the spirit instead of the letter; or else it must be holden, what no man will seriously avow, that the situation and circumstances of the offender (though they alter not the essence of the crime) ought to make no distinction in the punishment. In democracies, however, this power of pardon can never subsist; for there nothing higher is acknowledged than the magistrate who administers the laws; and it would be impolitic for the power of judging and of pardoning to centre in one and the same person. This (as the president Montesquieu observes) would oblige him very often to contradict himself, to make and to unmake his decisions: it would tend to confound all ideas of right among the mass of people, as they would find it difficult to tell whether a prisoner were discharged by his innocence, or obtained a pardon through favour. In Holland therefore, if there be no stadtholder, there is no power of pardoning lodged in any other member of the state. But in monarchies the king acts in a superior sphere; and though he regulates

regulates the whole government as the first mover, yet he does not appear in any of the disagreeable or invidious parts of it. Whenever the nation see him personally engaged, it is only in works of legislature, magnificence, or compassion. To him, therefore, the people look up as the fountain of bounty and grace; and these repeated acts of goodness, coming immediately from his own hand, endear the sovereign to his subjects, and contribute, more than any thing, to root in their hearts that filial affection and personal loyalty which are the sure establishment of a prince.

The king may pardon all offences merely against the crown or the public, excepting, 1. That, to preserve the liberty of the subject, the committing any man to prison out of the realm, is, by the *habeas corpus* act, 31 Car. II. c. 2, made a *præmunire*, unpardonable even by the king. Nor, 2, can the king pardon where private justice is principally concerned in the prosecution of offenders: *Non potest ex gratiam facere cum injuria et damno aliorum*. Therefore, in appeals of all kinds (which are the suit, not of the king, but of the party injured) the prosecutor may re-lease; but the king cannot pardon: neither can he pardon a common nuisance, while it remains unredressed, or so as to prevent an abatement of it: though, afterwards, he may remit the fine; because, though the prosecution is vested in the king to avoid the multiplicity of suits, yet (during its continuance) this offence favours more of the nature of a private injury to each individual in the neighbourhood, than of a public wrong. Neither, lastly, can the king pardon an offence against a popular or penal statute, after information brought; for thereby the informer hath acquired a private property in his part of the penalty.

There is also a restriction of a peculiar nature, that affects the prerogative of pardoning, in case of parliamentary impeachments, viz. that the king's pardon cannot be pleaded to any such impeachment, so as to impede the enquiry, and stop the prosecution of great and notorious offenders. Therefore when, in the reign of Charles the Second, the earl of Danby was impeached by the house of commons, of high-treason and other misdemeanors, and pleaded the king's pardon in bar of the same, the commons alleged, "That there was no precedent that ever any pardon was granted to any person impeached by the commons of high-treason, or other high crimes, pending the impeachment;" and thereupon resolved, "That the pardon so pleaded was illegal and void, and ought not to be allowed in bar of the impeachment of the commons of England;" for which resolution they assigned this reason to the house of lords: "That the setting up a pardon to be a bar of an impeachment defeats the whole use and effect of impeachments: for, should this point be admitted, or stand doubted, it would totally discourage the exhibiting any for the future; whereby the chief institution of the preservation of the government would be destroyed." Soon after the revolution, the commons renewed the same claim, and voted, "That a pardon is not pleadable in bar of an impeachment." And at length it was enacted, by the act of settlement, 12 & 13 W. III. c. 2, "That no pardon under the great seal of England shall be pleadable to an impeachment by the commons in parliament." But, after the impeachment has been solemnly heard and determined, it is not understood that the king's royal grace is farther restrained or abridged: for, after the impeachment and attainder of the six rebel lords in 1715, three of them were, from time to time, reprieved by the crown; and at length received the benefit of the king's most gracious pardon.

The effect of such a pardon by the king is to make the offender a new man; to acquit him of all corporal penalties and forfeitures annexed to that offence for which he obtains his pardon; and, not so much to restore his former, as to give him a new, credit and capacity. But nothing can restore or purify the blood, when once corrupted, if the pardon be not allowed till after attainder, but the high and transcendent power of parliament. Yet, if a person attained receives the king's pardon, and afterwards hath a son, that son may be heir to his father; because the father, being made a new man, may transmit new inheritable blood; though, had he been born before the pardon, he could never have inherited at all.

PARENT, a term of relation applicable to those from whom we immediately derive our being.

The duties of parents to legitimate children consist in three particulars: their maintenance, their protection, and their education.

1. The municipal laws of well regulated states have all taken care to enforce the duty of maintenance, though providence has done it more effectually than any laws, by implanting in the breast of every parent that natural *sympathy*, or insuperable degree of affection, which not the deformity of person or mind, nor even the wickedness, ingratitude, and rebellion of children, can totally suppress or extinguish. The civil law obliges the parent to provide maintenance for his child; and if he refuses, *judex de ea cognoscet*: nay, it carries this matter so far, that it will not suffer a parent, at his death, totally to disinherit his child, without expressly giving his reason for so doing; and there are fourteen such reasons reckoned up, which may justify such disinherison.

2. From the duty of maintenance we may easily pass to that of protection; which is also a natural duty, but rather permitted than

enjoined by any municipal laws; nature, in this respect, working so strongly as to need rather a check than a spur.

3. The last duty of parents to their children is that of giving them an education suitable to their station in life: a duty pointed out by reason, and of far the greatest importance of any; for, as Puffendorff very well observes, it is not easy to imagine or allow, that a parent has conferred any considerable benefit upon his child by bringing him into the world, if he afterwards entirely neglects his culture and education, and suffers him to grow up like a mere beast, to lead a life useless to others, and shameful to himself. Yet the municipal laws of most countries seem to be defective in this point, by not constraining the parent to bestow a proper education upon his children. Perhaps they thought it punishment enough to leave the parent, who neglects the instruction of his family, to labour under those griefs and inconveniences which his family, so uninstructed, will be sure to bring upon him. Our laws, though their defects in this particular cannot be denied, have, in one instance, made a wise provision for breeding up the rising generation; since the poor and laborious part of the community, when past the age of nature, are taken out of the hands of their parents, by the statutes for apprenticing poor children, and are placed out by the public in such a manner as may render their abilities, in their several stations, of the greatest advantage to the commonwealth. The rich, indeed, are left at their own option, whether they will breed up their children to be ornaments or disgraces to their family.

PARENTAL, something belonging to the relation of a parent. See PARENT.

PARENTAL Affection, the endearing attachment of parents to their children, including in it love; a desire of doing good to those who, by an act of our own, depend upon us for all that they enjoy. Nature even excites this affection in brutes; but in them it continues only so long as it is necessary for the preservation of their offspring; for, when these are able to provide for themselves, it ceases, and the relation is forgotten. In man, however, though it lessens, or, at least, becomes less anxious as the dependance of the child becomes less, it never entirely ceases, except in some few instances of extreme depravity. Authors, however, have imagined, and Lord Kaimes among the rest, that, after the child is provided for, and no more depends on the parent, all affection would cease, were it not artificially preserved and confirmed by habit. Whether his lordship, in this opinion, be right or wrong, we shall not pretend to say; one thing, however, is certain, that, be it natural or not, it is one of the greatest comforts of life, even when all dependance has ceased. It matters not that there are many instances where this comfort is not felt; human depravity has often obliterated the finest feelings of the mind, and it is not to be wondered at if, in some instances, it do so in the case before us. A good heart certainly can enjoy no greater satisfaction than that arising from grateful returns of kindness and affection to an aged parent. As the vexations which parents receive from their children hasten the approach of age, and double the force of years; so the comforts which they reap from them are a balm to all other sorrows, and disappoint the injuries of time. Parents repeat their lives in their offspring; and their concern for them is so near, that they feel all their sufferings, and taste all their enjoyments, as much as if they regarded their own persons. However strong we may suppose the fondness of a father for his children, yet they will find more lively marks of tenderness in the bosom of a mother: there are no ties of nature to compare with those which unite an affectionate mother to her children, when they repay her tenderness with obedience and love.

Diodorus Siculus also, lib. 34, gives us a surprising instance of the same warm affection. Cambalus, a young gentleman of character and fortune in the city of Mulgeatum, being one day out courting, was waylaid, and very near being robbed and murdered by the banditti who infested that part of the country. Gorgus, the young gentleman's father, happened to come by at the very instant, to whom Cambalus related the danger he was in. The son was on foot, the father on horseback; but no sooner had he heard the melancholy tale, than he leaped from his horse, desired his son to mount, and make the best of his way into the city: but Cambalus, preferring his father's safety to his own, would by no means consent to it; on the contrary, conjured his father to leave him, and take care of himself. The father, struck with the generosity and affection of his son, added tears to entreaties, but all to no purpose. The contest between them is better conceived than described—while bathed in tears, and beseeching each other to preserve his own life, the banditti approached, and stabbed them both.

Among the ancient Greeks, the sentiments of parental affection were exceedingly strong and ardent. The mutual tenderness of the husband and the wife was communicated to their offspring; while the father viewed in his child the charms of its mother, and the mother perceived in it the manly graces of its father. As parental kindness is the most simple and natural expansion of self-love, so there are innumerable instances of it in all countries, savage and civilized.

PARENTHESIS, *ἰσχυρισμός*, formed of *παρά*, inter, between, and *ἰσχύς*, position, q. d. putting between, in grammar, certain intercalary

tercalary words inserted in a discourse, which interrupt the sense or thread, but which seem necessary for the fuller understanding of the subject. See the System, Part II. Chap. IV. Art. PUNCTUATION.

PARIETALIA, *Offa*, in anatomy, the third or fourth bones of the cranium: so called because they form the *parietes* or sides of the head. See the System, Part I. Sect. 2, and Plate I. Fig. 1. Letter *b*.

PARIETES, in anatomy, a term used for the inclosures or membranes that stop up or close the hollow parts of the body; especially those of the heart, the thorax, &c. The parietes of the two ventricles of the heart are of unequal strength and thickness; the left exceeding the right, because of its office, which is to force the blood through all parts of the body; whereas the right only drives it through the lungs.

PARLIAMENT, *Parliamentum*, in England, is the grand assembly of the three estates of the kingdom, consisting of the King, the Lords Spiritual and Temporal, and the Commons, summoned together by the King's authority, to consider of matters relative to the public welfare, and particularly to enact and repeal laws.

ORIGIN AND PREROGATIVE OF PARLIAMENT.

The original or first institution of parliament is one of those matters which lie so far hidden in the dark ages of antiquity, that the tracing of it out is a thing equally difficult and doubtful. The word parliament itself (or colloquium, as some of our historians translate it) is, comparatively, of modern date, derived from the French, and signifying the place where they met and conferred together. It was first applied to general assemblies of the states under Louis VII. in France, about the middle of the 12th century. But it is certain, that, long before the introduction of the Norman language into England, all matters of importance were debated and settled in the great councils of the realm; a practice which seems to have been universal among the northern nations, particularly the Germans; and carried by them into all the countries of Europe, which they overran at the dissolution of the Roman empire. Relics of which constitution, and various modifications and changes, are still to be met with in the diets of Poland, Germany, and Sweden, and were also in the assembly of the estates in France; for what was there called the parliament was only the supreme court of justice, consisting of the peers, certain dignified ecclesiastics, and judges; which neither was in practice, nor was supposed to be in theory, a general council of the realm.

With us in England, this general council hath been held immemorially, under the several names of *micel-fynoth*, or "great council;" *micel-gemote*, or "great meeting;" and more frequently *wittena-gemote*, or "the meeting of wise men." It was also styled in Latin, *commune concilium regni*, *magnum concilium regis*, *curia magna*, *conventus magnatum vel procerum*, *assisa generalis*, and sometimes *communitas regni Angliæ*. We have instances of its meeting to order the affairs of the kingdom, to make new laws, and to amend the old; or, as Fleta expresses it, *novis injuriis emerfis nova constituere remedia*, so early as the reign of Ina, king of the West Saxons, Offa, king of the Mercians, and Ethelbert king of Kent, in the several realms of the heptarchy. And, after their union, the Mirror informs us, that king Alfred ordained for a perpetual usage, that these councils should meet twice in the year, or oftener, if need be, to treat of the government of God's people; how they should keep themselves from sin, should live in quiet, and should receive right. Our succeeding Saxon and Danish monarchs held frequent councils of this sort, as appears from their respective codes of laws: the titles whereof usually speak them to be enacted, either by the king with the advice of his *wittena-gemote*, or wise men, as *Hæc sunt instituta, quæ Edgarus rex consilio sapientum suorum instituit*; or, to be enacted by those sages with the advice of the king, as, *Hæc sunt judicia, quæ sapientes consilio regis Ethelstani instituerunt*; or, lastly, to be enacted by them both together, as, *Hæc sunt institutiones, quas rex Edmundus et episcopi sui cum sapientibus suis instituerunt*.

There is also no doubt but these great councils were occasionally held under the first princes of the Norman line. Glanvil, who wrote in the reign of Henry II. speaking of the particular amount of an amercement in the sheriff's court, says, it had never yet been ascertained by the general assize, or assembly, but was left to the custom of particular counties. Here the general assize is spoken of as a meeting well known, and its statutes or decisions are put in a manifest contradistinction to custom, or the common law. And in Edward III's time an act of parliament, made in the reign of William the Conqueror, was pleaded in the case of the abbey of St. Edmund's-Bury, and judicially allowed by the court.

Hence it indisputably appears, that parliaments, or general councils, are coeval with the kingdom itself. How those parliaments were constituted and composed, is another question, which has been matter of great dispute among our learned antiquarians; and particularly whether the commons were summoned at all; or, if summoned, at what period they began to form a distinct assembly. But without entering into controversies of this sort, it may be sufficient to observe, that it is generally agreed, that in the main, the constitution of parliament, as it now stands, was marked out so long ago as the 17th year of king John, A. D.

1215, in the great charter granted by that prince; wherein he promises to summon all archbishops, bishops, abbots, earls, and great barons, personally; and all other tenants in chief under the crown, by the sheriff and bailiffs; to meet at a certain place, with 40 days notice, to assess aids and scutages when necessary. And this constitution has subsisted in fact at least from the year 1266, 49 Hen. III. there being still extant writs of that date, to summon knights, citizens, and burgesses, to parliament.

We proceed therefore to enquire wherein consists this constitution of parliament, as it now stands, and has stood for upwards of 500 years? and in the prosecution of this enquiry, we shall consider,

First, The manner and time of its assembling.

Secondly, Its constituent parts.

Thirdly, The laws and customs relating to parliament.

Fourthly, The methods of proceeding, and of making statutes, in both houses.

And, lastly, The manner of the parliament's adjournment, prorogation, and dissolution.

I. *As to the manner and time of assembling.* The parliament is regularly to be summoned by the king's writ, or letter, issued out of chancery, by advice of the privy-council, at least 40 days before it begins to sit. It is a branch of the royal prerogative, that no parliament can be convened by its own authority, or by the authority of any, except the king alone. And this prerogative is founded upon very good reason. For supposing it had a right to meet spontaneously, without being called together, it is impossible to conceive that all the members, and each of the houses, would agree unanimously upon the proper time and place of meeting; and if half of the members met, and half absented themselves, who shall determine which is really the legislative body, the part assembled, or that which stays away? It is therefore necessary, that the parliament should be called together at a determinate time and place; and, highly becoming its dignity and independence, that it should be called together by none but one of its own constituent parts: and, of the three constituent parts, this office can only appertain to the king; as he is a single person, whose will may be uniform and steady; the first person in the nation being superior to both houses in dignity; and the only branch in the legislature that has a separate existence, and is capable of performing any act at a time when no parliament is in being. Nor is it an exception to this rule, that, by some modern statutes, on the demise of a king or queen, if there be no parliament in being, the last parliament revives, and is to sit again for six months, unless dissolved by the successor; for this revived parliament must have been originally summoned by the crown.

It is true, that the convention-parliament which restored king Charles II. met above a month before his return; the lords by their own authority, and the commons in pursuance of writs issued in the name of the keepers of the liberty of England, by authority of parliament; and that the said parliament sat till the 29th of December, full seven months after the restoration; and enacted many laws, several of which are still in force. But this was from the necessity of the thing, which supercedes all law; for if they had not so met, it was morally impossible that the kingdom should have been settled in peace. And the first thing done after the king's return was, to pass an act declaring this to be a good parliament, notwithstanding the defect of the king's writs. So that as the royal prerogative was chiefly wounded by their so meeting, and as the king himself, who alone had a right to object, consented to waive the objection, this cannot be drawn into an example in prejudice of the rights of the crown. Besides, we should also remember, that it was at that time a great doubt among the lawyers, whether even this healing act made it a good parliament, and held by very many in the negative; though it seems to have been too a nice a scruple: and yet, out of abundant caution, it was thought necessary to confirm its acts in the next parliament, by statute 13 Car. II. c. 7, et c. 14.

It is likewise true at the time of the Revolution, A. D. 1688, the lords and commons by their own authority, and upon the summons of the prince of Orange (afterwards king William) met in convention, and therein disposed of the crown and kingdom. But it must be remembered, that this assembling was upon a like principle of necessity as at the Restoration: that is, upon a full conviction that king James II. had abdicated the government, and that the throne was thereby vacant; which supposition of the individual members was confirmed by their concurrent resolution, when they actually came together; and, in such a case as the palpable vacancy of a throne, it follows, *ex necessitate rei*, that the form of the royal writs must be laid aside, otherwise no parliament can ever meet again. For let us put another possible case, and suppose, for the sake of argument, that the whole royal line should at any time fail, and then become extinct, which would indisputably vacate the throne; in this situation, it seems reasonable to presume, that the body of the nation, consisting of lords and commons, would have a right to meet to settle the government; otherwise there must be no government at all: and upon this, and no other principle did the convention, in 1688, assemble. The vacancy of the throne was precedent to their meeting without any royal summons, not a consequence of it.

They did not assemble without writ, and then make the throne vacant; but the throne being previously vacant by the king's abdication, they assembled without writ, as they must do if they assembled at all. Had the throne been full, their meeting would not have been regular; but, as it was really empty, such meeting became absolutely necessary. And accordingly it is declared by statute 1 W. & M. st. 1. c. 1. that this convention was really the two houses of parliament notwithstanding the want of writs or other defects of form. So that, notwithstanding these two capital exceptions, which were justifiable only on a principle of necessity, (and each of which, by the way, induced a revolution in the government), the rule laid down is in general certain, that the king only can convoke a parliament, and this by the statute 4 Ed. III. c. 14, he is bound to do, "every year once, and more often if need be," which provision of the statute, though sufficiently explicit in enjoining the calling of a parliament, at least once in a year, was evaded by the construction given to it, by the king, in referring the words *if need be* to the whole provision; and thus by constituting himself the sole judge of the necessity, endeavoured to govern without a parliament, under the pretence that there was no need of one, and by this construction leaving the grievance intended to be redressed in the same state as before. This occasioned the statute 36 Ed. III. c. 10. by which it was enacted, that "for maintenance of the statutes and redress of grievances which daily happen, a parliament shall be holden every year, as another time was ordained by statute." This should also be a new Parliament, and not merely a Session of a former Parliament, as is evident from the usage of the times; for it appears that for some time previous to the 4th Ed. III. a new Parliament sat once at least every year, and frequently oftener; and this continued to be the usage for 69 years after, until Richard II. affected absolute power. *Vide* Rot. Parl. Rymer's *Fœdera*, &c. Hence it appears, that Annual Parliaments are the ancient constitution of England.

The calling of annual Parliaments, however positively enjoined by these statutes, was nevertheless considered as so great a restriction on such of our monarchs as were inclined to govern without parliaments, that they neglected the convoking them, sometimes for a very considerable period, under pretence that there was no need of them. But, to remedy this, by the statute 16 Car. II. c. 1. it is enacted that the sitting and holding of Parliament, shall not be intermitted above three years at the most. And by the statute 1 W. & M. st. 2. c. 2. it is declared to be one of the rights of the people, that for redress of all grievances, and for the amending, strengthening, and preserving the laws, parliaments ought to be held frequently. And this indefinite frequency is again reduced to a certainty by statute 6 W. & M. c. 2. which enacts as the statute of Charles the second, had done before, that a new parliament shall be called within three years after the determination of the former.

II. *The constituent Parts of a Parliament are*, the king's majesty, sitting there in his royal political capacity, and the three estates of the realm; the lords spiritual, the lords temporal, (who sit together with the king in one house,) and the commons, who sit by themselves in another. And the king and these three estates together form the great corporation or body politic of the kingdom, of which the king is said to be *caput, principium, et finis*. For upon their coming together the king meets them, either in person or by representation: without which there can be no beginning of a parliament; and he also has alone the power of dissolving them.

It is highly necessary for preserving the balance of the constitution, that the executive power should be a branch, though not the whole, of the legislature. The total union of them, we have seen, would be productive of tyranny; the total disjunction of them, for the present, would in the end, produce the same effects, by causing that union against which it seems to provide. The legislature would soon become tyrannical, by making continual encroachments, and gradually assuming to itself the rights of the executive power. Thus the long parliament of Charles the first, while it acted in a constitutional manner, with the royal concurrence, redressed many heavy grievances, and established many salutary laws. But when the two houses assumed the power of legislation, in exclusion of the royal authority, they soon after assumed likewise the reins of administration; and, in consequence of these united powers, overturned both church and state, and established a worse oppression than they pretended to remedy. To hinder therefore any such encroachments, the king is himself a part of the parliament; and as this is the reason of his being so, very properly therefore the share of legislation, which the constitution has placed in the crown, consists in the power of rejecting, rather than resolving; this being sufficient to answer the end proposed. For we may apply to the royal negative, in this instance, what Cicero observes of the negative of the Roman tribunes, that the crown has not any power of doing wrong, but merely of preventing wrong from being done. The crown cannot begin of itself any alterations in the present established law: but it may approve or disapprove of the alterations suggested and consented to by the two houses. The legislature therefore cannot abridge the executive power of any rights which it now has by law, without its own consent; since the law must perpetually stand as it now does; unless all the powers will agree to alter it. And herein indeed consists the true excellence of the British government, that all the parts of it form a mutual check

upon each other. In the legislature, the people are a check upon the nobility, and the nobility a check upon the people, by the mutual privilege of rejecting what the other have resolved; while the king is a check upon both, which preserves the executive power from encroachments. And this very executive power is again checked and kept within due bounds by the two houses, through the privilege they have of enquiring into, impeaching, and punishing the conduct (not indeed of the king, which would destroy his constitutional independence) but (which is more beneficial to the public) of his evil and pernicious counsellors.

Thus every branch of our civil polity supports and is supported, regulates and is regulated, by the rest: for the two houses naturally drawing in two directions of opposite interest, and the prerogative in another still different from them both, they mutually keep each other from exceeding their proper limits; while the whole is prevented from separation, and artificially connected together by the mixed nature of the crown, which is a part of the legislative, and the sole executive magistrate. Like three distinct powers in mechanics, they jointly impel the machine of government in a direction different from what either, acting by itself, would have done; but at the same time in a direction partaking of each, and formed out of all; a direction which constitutes the true line of the liberty and happiness of the community.

III. Having considered the constituent parts of the sovereign power, or parliament, each in a separate view, we now proceed to examine the laws and customs relating to parliament, united together and considered as one aggregate body. The power and jurisdiction of parliament, says Sir Edward Coke, is so transcendent and absolute, that it cannot be confined, either for causes or persons, within any bounds. And of this high court he adds, it may be truly said, *Si antiquitatem spectes, est vetustissima; si dignitatem, est honoratissima; si jurisdictionem, est capacissima*. It hath sovereign and unaccountable authority in making, confirming, enlarging, restraining, abrogating, repealing, reviving, and expounding of laws, concerning matters of all possible denominations, ecclesiastical or temporal, civil, military, maritime, or criminal; this being the place where that absolute despotic power, which must in all governments reside somewhere, is entrusted by the constitution of these kingdoms. All mischiefs and grievances, operations and remedies, that transcend the ordinary course of the laws, are within the reach of this extraordinary tribunal. It can regulate or new-model the succession to the crown; as was done in the reign of Henry VIII. and William III. It can alter the established religion of the land; as was done in a variety of instances, in the reigns of king Henry VIII. and his three children. It can change and create afresh even the constitution of the kingdom and of parliaments themselves; as was done by the act of union, and the several statutes for triennial and septennial elections. It can, in short, do every thing that is not naturally impossible; and therefore some have not scrupled to call its power, by a figure rather too bold, the *omnipotence of parliament*. True it is, that what the parliament doth, no authority upon earth can undo. So that it is a matter most essential to the liberties of this kingdom, that such members be delegated to this important trust as are most eminent for their probity, their fortitude, and their knowledge; for it was a known apothegm of the great lord treasurer Burleigh, "That England could never be ruined but by a parliament;" and as Sir Matthew Hale observes, this being the highest and greatest court, over which none other can have jurisdiction in the kingdom, if by any means a misgovernment should any way fall upon it, the subjects of this kingdom are left without all manner of remedy. To the same purpose the present Montesquieu, though we trust too hastily, presages, that as Rome, Sparta, and Carthage, have lost their liberty, and perished; so the constitution of England will in time lose its liberty, and perish; it will perish whenever the legislative power shall become more corrupt than the executive.

It must be owned that Mr. Locke, and other theoretical writers, have held, that "there remains still inherent in the people a supreme power to remove or alter the legislative, when they find the legislative act contrary to the trust reposed in them; for when such trust is abused it is thereby forfeited, and devolves to those who gave it." But however just this conclusion may be in theory, we cannot adopt it, nor argue from it, under any dispensation of government at present actually existing. For this devolution of power, to the people at large, includes in it a dissolution of the whole form of government established by that people; reduces all the members to their original state of equality; and by annihilating the sovereign power, repeals all positive laws whatsoever before enacted. No human laws will therefore suppose a case, which at once must destroy all law, and compel men to build afresh upon a new foundation; nor will they make provision for so desperate an event, as must render all legal provisions ineffectual. So long therefore as the English constitution lasts, we may venture to affirm, that the power of parliament is absolute and without controul.

In order to prevent the mischiefs that might arise, by placing this extensive authority in hands that are either incapable or else improper to manage it; it is provided by the custom and law of parliament, that no one shall sit or vote in either house, unless he be 21 years of age. This is also expressly declared by statute 7 & 8 W. III. c. 25. With regard to the house of commons, doubts

have arisen, from some contradictory adjudications, whether or not a minor was incapacitated from sitting in that house. It is also enacted by statute 7 Jac. I. c. 6. that no member be permitted to enter the house of commons till he hath taken the oath of allegiance before the lord steward or his deputy: and by 30 Car. II. st. 2 & 1 Geo. I. c. 13. that no member shall vote or sit in either house till he hath in the presence of the house, taken the oaths of allegiance, supremacy, and adjuration, and subscribed and repeated the declaration against transubstantiation, and invocation of saints, and the sacrifice of the mass. Aliens, unless naturalized, were likewise by the law of parliament incapable to serve therein: and now it is enacted by statute 12 & 13 W. III. c. 2. that no alien, even though he be naturalized, shall be capable of being a member of either house of parliament. And there are not only these standing incapacities; but if any person is made a peer by the king, or elected to serve in the house of commons by the people, yet may the respective houses, upon complaint of any crime in such person, and proof thereof, adjudge him disabled and incapable to sit as a member, and this by the law and custom of parliament.

For as every court of justice hath laws and customs for its direction, some the civil and canon, some the common law, others their own peculiar laws and customs; so the high court of parliament hath also its own peculiar law, called the *lex et consuetudo parliamenti*; a law which Sir Edward Coke observes is *ab omnibus querenda, a multis ignorata, a paucis cognita*. It will not therefore be expected that we should enter into the examination of this law with any degree of minuteness: since, as the same learned author assures us, it is much better to be learned out of the rolls of parliament and other records, and by precedents and continual experience, than can be expressed by any one man. It will be sufficient to observe, that the whole of the law and custom of parliament has its origin from this one maxim, "That whatever matter arises concerning either house of parliament, ought to be examined, discussed, and adjudged in that house to which it relates, and not elsewhere. Hence, for instance, the lords will not suffer the commons to interfere in settling the election of a peer of Scotland; the commons will not allow the lords to judge of the election of a burgess; nor will either house permit the subordinate courts of law to examine the merit of either case. But the maxims upon which they proceed, together with the method of proceeding, rest entirely in the breast of the parliament itself; and are not defined and ascertained by any particular stated laws.

Privilege of parliament was principally established, in order to protect its members not only from being molested by their fellow-subjects, but also more especially from being oppressed by the power of the crown. If therefore all the privileges of parliament were once to be set down and ascertained, and no privilege to be allowed but what was so defined and determined, it were easy for the executive power to devise some new case, not within the line of privilege, and under pretence thereof to harrass any refractory member, and violate the freedom of parliament. The dignity and independence of the two houses are therefore in a great measure preserved by keeping their privileges indefinite. Some, however, of the more notorious privileges of the members of either house, are privilege of speech, of person, of their domestics, and of their lands and goods. As to the first, privilege of speech, it is declared by the statute 1 W. & M. st. 2. c. 2. as one of the liberties of the people, "That the freedom of speech, and debates, and proceedings in parliament, ought not to be impeached or questioned in any court or place out of parliament." And this freedom of speech is particularly demanded of the king in person, by the speaker of the house of commons, at the opening of every new parliament.

All the former privileges of parliament which derogated from the common law are now at an end, save only as to the freedom of the member's person; which in a peer (by the privilege of peerage) is for ever sacred and inviolable; and in a commoner (by the privilege of parliament) for forty days after every prorogation, and forty days before the next appointed meeting: which is now in effect as long as the parliament subsists, it seldom being prorogued for more than eight days at a time. As to all other privileges which obstructed the ordinary course of justice, they were restrained by the statutes 12 W. III. c. 3. 2 & 3 A. c. 18. and 11 Geo. II. c. 24. and are now totally abolished by statute 10 G. III. c. 50. which enacts, that any suit may at any time be brought against any peer or member of parliament, their servants, or any other person entitled to privilege of parliament; which shall not be impeached or delayed by pretence of any such privilege, except that the person of a member of the house of commons shall not thereby be subjected to any arrest or imprisonment. Likewise, for the benefit of commerce, it is provided by statute 4 Geo. III. c. 33. that any trader, having privilege of parliament, may be served with legal process for any just debt, (to the amount of 100l.): and unless he makes satisfaction within two months, it shall be deemed an act of bankruptcy; and that commissions of bankruptcy may be issued against such privileged traders in like manner as against any other.

IV. We proceed next to consider the method of making laws, which is much the same in both houses; and we shall treat it very briefly, beginning with the house of commons. But first we must premise, that for dispatch of business, each house of parliament has its speaker. The speaker of the house of lords, whose office it is to

preside there, and manage the formality of business, is the lord chancellor, or keeper of the king's great seal, or any other appointed by the king's commission: and if none be so appointed, the house of lords (it is said) may elect. The speaker of the house of commons is chosen by the house; but must be approved by the king. And herein the usage of the two houses differs, that the speaker of the house of commons cannot give his opinion, or argue any question in the house; but the speaker of the house of lords, if a lord of parliament, may. In each house the act of majority binds the whole: not, as at Venice, and many other senatorial assemblies, privately, or by ballot. This latter method may be serviceable, to prevent intrigues and unconstitutional combinations; but it is impossible to be practised with us, at least in the house of commons, where every member's conduct is subject to the future censure of his constituents, and therefore should be openly submitted to their inspection.

To bring a bill into the house, if the relief sought by it is of a private nature, it is first necessary to prefer a petition; which must be presented by a member, and usually sets forth the grievance desired to be remedied. This petition, when founded on facts that may be in their nature disputed) is referred to a committee of members, who examine the matter alledged, and accordingly report it to the house; and then (or otherwise, upon the mere petition) leave is given to bring in the bill. In public matters, the bill is brought in upon the motion made to the house, without any petition at all.

The persons directed to bring in the bill, present it in a competent time to the house, drawn out on paper, with a multitude of blanks, or void spaces, where any thing occurs that is dubious, or necessary to be settled by the parliament itself; (such, especially, as the precise date of times, the nature and quantity of penalties, or of any sums of money to be raised) being indeed only the skeleton of the bill. In the house of lords, if the bill begins there, it is (when of a private nature) referred to two of the judges, who examine and report the state of the facts alledged, to see that all necessary parties consent, and to settle all points of technical propriety. This is read a first time, and at a convenient distance a second time; and after each reading the speaker opens to the house the substance of the bill, and puts the question, whether it shall proceed any farther. The introduction of the bill may be originally opposed, as the bill itself may at either of the readings; and, if the opposition succeeds, the bill must be dropped for that session; as it must also, if opposed with success in any of the subsequent stages.

After the second reading, it is committed; that is, referred to a committee: which is either selected by the house in matters of small importance; or else, upon a bill of consequence, the house resolves itself into a committee of the whole house. A committee of the whole house is composed of every member; and to form it, the speaker quits the chair, (another member being appointed chairman), and may sit and debate as a private member. In these committees the bill is debated clause by clause, amendments made, the blanks filled up, and sometimes the bill entirely new modelled. After it has gone through the committee, the chairman reports it to the house with such amendments as the committee have made; and then the house reconsiders the whole bill, and the question is repeatedly put upon every clause and amendment. When the house hath agreed or disagreed to the amendments of the committee, and sometimes added new amendments of its own, the bill is then ordered to be engrossed, or written in a strong gross hand, on one or more long rolls, (or presses) of parchment sewed together. When this is finished, it is read a third time, and amendments are sometimes then made to it; and if a new clause be added, it is done by tacking a separate piece of parchment on the bill, which is called a *rider* . The speaker then again opens the contents; and, holding it up in his hands, puts the question whether the bill shall pass. If this is agreed to, the title to it is then settled; which used to be a general one for all the acts, passed in the session, till in the fifth year of Henry VIII. distinct titles were introduced for each chapter. After this, one of the members is directed to carry it to the lords, and desire their concurrence; who, attended by several more, carries it to the bar of the house of peers, and there delivers it to their speaker, who comes down from his wool-sack to receive it.

It there passes through the same form as in the other house, (except engrossing, which is already done); and, if rejected, no more notice is taken, but it passes *sub silentio*, to prevent unbecoming alterations; but if it is agreed to, the lords send a message by two masters in chancery (or sometimes two of the judges) that they have agreed to the same: and the bill remains with the lords, if they have made no amendment to it. But if any amendments are made, such amendments are sent down with the bill to receive the concurrence of the commons. If the commons disagree to the amendments, a conference usually follows between members deputed from each house; who for the most part settle and adjust the difference; but, if both houses remain inflexible, the bill is dropped. If the commons agree to the amendments, the bill is sent back to the lords by one of the members, with a message to acquaint them therewith. The same forms are observed *mutatis mutandis*, when the bill begins in the house of lords. But, when an act of grace or pardon is passed, it is first signed by his majesty, and then read once only in each of the houses, without any new engrossing or amendment. And when both houses have done with any bill, it always is deposited

sited in the house of peers, to wait the royal assent; except in the case of a bill of supply, which after receiving the concurrence of the lords, is sent back to the house of commons.

The royal assent may be given two ways; 1. In person; when the king comes to the house of peers, in his crown and royal robes, and sending for the commons to the bar, the titles of all the bills that have passed both houses are read; and the king's answer is declared by the clerk of the parliament in Norman-French: a badge, it must be owned, (now the only one remaining) of conquest; and which one could wish to see fall into total oblivion; unless it be reserved as a solemn memento to remind us that our liberties are mortal, having been once destroyed by a foreign force. If the king consents to a public bill, the clerk usually declares, *Le roy le veut*, "The king wills it so to be;" if to a private bill, *Soit fait comme il est desire*, "Be it as it is desired;" if the king refuses his assent, it is in the gentle language of *Le roy s'avisera*, "The king will advise upon it." When a bill of supply is passed, it is carried up and presented to the king by the speaker of the house of commons; and the royal assent is thus expressed, *Le roy remercie ses loyal subjects, accepte leur benevolence, et aussi le veut*; "The king thanks his loyal subjects, accepts their benevolence, and wills it so to be." In case of an act of grace, which originally proceeds from the crown, and has the royal assent in the first stage of it, the clerk of the parliament thus pronounces the gratitude of the subject: *Les prelates, seigneurs, et commons, en ce present parliament assemblees, au nom de tous vus autres subjects, remercient tres humblement votre majeste, et prient a Dieu vous donner et sante bonne vie et longue*; "The prelates, lords, and commons, in this present parliament assembled, in the name of all your other subjects, most humbly thank your majesty, and pray to God to grant you in health and wealth long to live." By the statute 33 Hen. VIII. c. 21. the king may give his assent by letters patent under his great seal, signed with his hand, and notified in his absence to both houses assembled together in the upper house. And when the bill has received the royal assent in either of these ways, it is then, and not before, a statute or act of parliament.

An act of parliament, thus made, is the exercise of the highest authority that this kingdom acknowledges upon the earth. It hath power to bind every subject in the land, and the dominions thereunto belonging; nay, even the king himself, if particularly named therein. And it cannot be altered, amended, dispensed with, suspended, or repealed, but in the same forms and by the same authority of parliament: for it is a maxim in law, that it requires the same strength to dissolve, as to create, an obligation. It is true, it was formerly held, that the king might in many cases dispense with penal statutes: but now, by statute 1 W. and M. st. 2. c. 2. it is declared, that the suspending or dispensing with laws by regal authority, without consent of parliament, is illegal.

V. There remains only, in the last place, to add a word or two concerning the manner in which parliaments may be *adjourned*, *prorogued*, or *dissolved*. An *adjournment* is no more than a continuance of the session from one day to another; as the word itself signifies; and this is done by the authority of each house separately every day; and sometimes for a fortnight or a month together, as at Christmas or Easter, or upon other particular occasions. But the adjournment of one house is no adjournment of the other. It hath also been usual, when his majesty hath signified his pleasure that both or either of the houses should adjourn themselves to a certain day, to obey the king's pleasure so signified, and to adjourn accordingly. Otherwise, besides the indecorum of a refusal, a prorogation would assuredly follow; which would often be very inconvenient to both public and private business. For prorogation puts an end to the session; and then such bills as are only begun and not perfected, must be resumed *de novo*, (if at all) in a subsequent session; whereas, after an adjournment, all things continue in the same state as at the time of the adjournment made, and may be proceeded on without any fresh commencement. A *prorogation* is the continuance of the parliament from one session to another; as an adjournment is a continuation of the session from day to day. This is done by the royal authority, expressed either by the lord chancellor in his Majesty's presence, or by commission from the crown, or frequently by proclamation. Both houses are necessarily prorogued at the same time; it not being a prorogation of the house of lords or commons, but of the parliament. The session is never understood to be at an end until a prorogation; though unless some act be passed, or some judgment given in parliament, it is in truth no session at all. And formerly the usage was, for the king to give the royal assent to all such bills as he approved at the end of every session, and then to prorogue the parliament, though sometimes only for a day or two; after which all business then depending in the houses was to be begun again. Which custom obtained so strongly that it once became a question, Whether giving the royal assent to a single bill did not of course put an end to the session? And though it was then resolved in the negative, yet the notion was so deeply rooted, that the statute 1 Car. I. c. 7. was passed to declare, that the king's assent to that and some other acts should not put an end to the session; and even so late as the reign of Charles II. we find a proviso frequently tacked to a bill, that his Majesty's assent thereto should not determine the session of parliament. But it now seems to be allowed, that a prorogation must be expressly made, in order

to determine the session. And if at the time of an actual rebellion, or imminent danger of invasion, the parliament shall be separated by adjournment or prorogation, the king is empowered to call them together by proclamation, with 14 days notice of the time appointed for their reassembling. A *dissolution* is the civil death of the parliament; and this may be effected three ways: 1. By the king's will, expressed either in person or by representation. For as the king has the sole right of convening the parliament, so also it is a branch of the royal prerogative, that he may (whenever he pleases) prorogue the parliament for a time, or put a final period to its existence. If nothing had a right to prorogue or dissolve a parliament but itself, it might happen to become perpetual. And this would be extremely dangerous if at any time it should attempt to encroach upon the executive power; as was fatally experienced by the unfortunate king Charles I. who, having unadvisedly passed an act to continue the parliament then in being till such time as it should please to dissolve itself, at last fell a sacrifice to that inordinate power which he himself had consented to give them. It is therefore extremely necessary that the crown should be empowered to regulate the duration of these assemblies, under the limitations which the English constitution has prescribed: so that, on the one hand, they may frequently and regularly come together for the dispatch of business and redress of grievances; and may not, on the other, even with the consent of the crown, be continued to an inconvenient or unconstitutional length. 2. A parliament may be dissolved by the demise of the crown. This dissolution formerly happened immediately upon the death of the reigning sovereign; for he being considered in law as the head of the parliament, (*caput, principium, et finis*), that failing, the whole body was held to be extinct. But the calling a new parliament immediately on the inauguration of the successor being found inconvenient, and dangers being apprehended from having no parliament in being in case of a disputed succession, it was enacted by the statutes 7 and 8 W. III. c. 15. and 6 Ann. c. 7. that the parliament in being shall continue for six months after the death of any king or queen, unless sooner prorogued or dissolved by the successor: that if the parliament be, at the time of the king's death, separated by adjournment or prorogation, it shall notwithstanding assemble immediately: and that if no parliament is then in being, the members of the last parliament shall assemble, and be again a parliament. 3. Lastly, a parliament may be dissolved or expire by length of time. For if either the legislative body were perpetual, or might last for the life of the prince who convened them as formerly, and were so to be supplied, by occasionally filling the vacancies with new representatives; in these cases, if it were once corrupted, the evil would be past all remedy; but when different bodies succeed each other, if the people see cause to disapprove of the present, they may rectify its fault in the next. A legislative assembly also, which is sure to be separated again, (whereby its members will themselves become private men, and subject to the full extent of the laws which they have enacted for others), will think themselves bound, in interest as well as duty, to make only such laws as are good. The utmost extent of time that the same parliament was allowed to sit, by the statute of 6 W. & M. c. 3. was *three years*; after the expiration of which, reckoning from the return of the first summons, the parliament was to have no longer continuance. By the statute 1 Geo. I. st. 2. c. 38. (in order, professedly, to prevent the great and continued expences of frequent elections, and the violent heats and animosities consequent thereupon, and for the peace and security of the government then just recovering from the late rebellion), this term was prolonged to *seven years*; and, what alone is an instance of the vast authority of parliament, the very same house that was chosen for three years, enacted its own continuance for seven. So that, as our constitution now stands, the parliament must expire, or die a natural death, at the end of every seventh year, if not sooner dissolved by the royal prerogative. We shall conclude this article with an account of some general forms not taken notice of under any of the above heads. In the house of lords, the princes of the blood sit by themselves on the sides of the throne; at the wall on the king's right hand, the two archbishops sit by themselves on a form. Below them, the bishops of London, Durham, and Winchester, and all the other bishops, sit according to the priority of their consecration. On the king's left hand the lord treasurer, lord president, and lord privy-seal, sit upon forms above all dukes, except the royal blood; then the dukes, marquises, and earls, according to their creation. Across the room are wool-sacks, continued from an ancient custom; and the chancellor, or keeper, being generally the speaker of the house of lords, sits on the first wool-sack before the throne, with the great seal or mace lying by him; below these are forms for the viscounts and barons. On the other wool-sacks are seated the judges, masters in chancery, and king's council, who are only to give their advice in point of law: but they all stand up till the king gives them leave to sit. The commons sit promiscuously; only the speaker has a chair at the upper end of the house, and the clerk and his assistant sit at the table near him. And his majesty's ministers, who are members of the house of commons, sit on the right hand of the speaker, and the bench on which they sit is generally denominated the *Treasury Bench*. When a member of the house of commons speaks, he stands up uncovered, and directs his speech to the speaker only. If what he says be answered by another,

P A R

another, he is not allowed to reply the same day, unless personally alluded to: but when the commons, in order to have a greater freedom of debate, have resolved themselves into a committee of the whole house, every member may speak to a question as often as he thinks necessary. In the house of lords they vote, beginning at the puisne, or lowest baron, and so up orderly to the highest, every one answering, *Content* or *Not content*. In the house of commons they vote by *ayes* and *noes*; and if it be dubious which are the greater number, the house divides. If the question be about bringing any thing into the house, the *ayes* go out; but if it be about any thing the house already has, the *noes* go out. In all divisions the speaker appoints four tellers, two of each opinion. In a committee of the whole house, they divide by changing sides, the *ayes* taking the right and the *noes* the left of the chair; and then there are but two tellers.

The *High Court of PARLIAMENT* is the supreme court of the kingdom, not only for the making, but also for the execution of laws; by the trial of great and enormous offenders, whether lords or commons, in the method of parliamentary impeachment.—As for acts of parliament to attain particular persons of treason or felony, or to inflict pains and penalties, beyond or contrary to the common law, to serve a special purpose, we speak not of them; being to all intents and purposes new laws, made *pro re nata*, and by no means an execution of such as are already in being. But an impeachment before the lords by the commons of Great Britain, in parliament, is a prosecution of the already known and established law, and has been frequently put in practice; being a presentment to the most high and supreme court of criminal jurisdiction by the most solemn grand inquest of the whole kingdom. A commoner cannot, however, be impeached before the lords for any capital offence, but only for high misdemeanors; a peer may be impeached for any crime. And they usually (in case of an impeachment of a peer for treason) address the crown to appoint a lord high steward, for the greater dignity and regularity of their proceedings: which high steward was formerly elected by the peers themselves, though he was generally commissioned by the king; but it hath of late years been strenuously maintained, that the appointment of an high steward in such cases is not indispensably necessary, but that the house may proceed without one. The articles of impeachment are a kind of bills of indictment, found by the house of commons, and afterwards tried by the lords; who are in cases of misdemeanors considered not only as their own peers, but as the peers of the whole nation. This is a custom derived to us from the constitution of the ancient Germans; who in their great councils sometimes tried capital accusations relating to the public: *Licet apud concilium accusare quoque, et discrimen capitis intendere*. And it has a peculiar propriety in the English constitution; which has much improved upon the ancient model imported hither from the continent. For though in general the union of the legislative and judicial power ought to be most carefully avoided, yet it may happen that a subject, intrusted with the administration of public affairs, may infringe the rights of the people, and be guilty of such crimes as the ordinary magistrate either dares not or cannot punish. Of these the representatives of the people, or house of commons, cannot properly judge; because their constituents are the parties injured, and can therefore only impeach. But before what court shall this impeachment be tried? Not before the ordinary tribunals, which would naturally be swayed by the authority of so powerful an accuser. Reason therefore will suggest, that this branch of the legislature, which represents the people, must bring its charge before the other branch, which consists of the nobility, who have neither the same interests, nor the same passions, as popular assemblies. This is a vast superiority which the constitution of this island enjoys over those of the Grecian or Roman republics; where the people were at the same time both judges and accusers. It is proper that the nobility should judge, to insure justice to the accused: as it is proper that the people should accuse, to insure justice to the commonwealth. And therefore, among other extraordinary circumstances attending the authority of this court, there is one of a very singular nature, which was insisted on by the house of commons in the case of the earl of Danby, in the reign of Charles II. and is now enacted by statute 12 and 13 W. III. c. 2. that no pardon under the great seal shall be pleadable to an impeachment by the commons of Great Britain in parliament.

PARNASSUS, in geography and mythology, a mountain in Greece, consecrated by the poets, to the muses, thence called *Parnassides*, to Apollo and to Bacchus. It is described as having two summits, between which arises the Castalian fountain. The Greeks call this mountain *Licaoura*.

PARODY, a popular maxim, adage, or proverb.

PARODY, is also a poetical pleasantry, consisting in applying the verses written on one subject, by way of ridicule, to another; or in turning a serious work into a burlesque, by affecting to observe as near as possible the same rhymes, words, and cadences.

The parody was first set on foot by the Greeks; from whom we borrow the name. It comes near to what some of our late writers call *travesty*. Others have more accurately distinguished between a parody and burlesque; and they observe, that the change of a single word may parody a verse; or of a single letter a word. Thus, in the last case, Cato exposed the inconstant disposition of

P A R

Marcus Fulvius Nobilior, by changing Nobilior into Mobilior. Another kind of parody consists in the mere application of some known verse, or part of a verse of a writer, without making any change in it, with a view to expose it. A fourth instance is that of writing verses in the taste and style of authors little approved. The rules of parody regard the choice of a subject, and the manner of treating it. The subject should be a known and celebrated work: as to the manner it should be by an exact imitation, and an intermixture of good natural pleasantries.

PAROXYSM, *παροξυσμος*, formed from *παρεμ* much, and *ζωω* acute, in medicine, the severe fit of a disease, under which it grows higher, or exasperates; as of the gout, &c. *Paroxysm* is sometimes also used for the access or return of a disease that intermits; as an ague.

PARROT, in ornithology, the English name of the genus *Psittacus*. For description of the Genus, see *PSITTACUS*: for representation, see Plate I. Genus 5.

PARSNIP, in botany, the English name of the genus *Pastinaca*. For description of the Genus, see *PASTINACA*.

PARSON and VICAR. A parson, *persona ecclesiae*, is one that hath full possession of all the rights of a parochial church. He is called parson, *persona*, because by his person the church which is an invisible body, is represented; and he is in himself a body corporate, in order to protect and defend the rights of the church (which he personates) by a perpetual succession. He is sometimes called the *rector* or *governor* of the church: but the appellation of *parson* (however it may be depreciated by familiar, clownish, and indiscriminate use) is the most legal, most beneficial, and most honourable title that a parish-priest can enjoy; because such a one (Sir Edward Coke observes) and he only, is said *vicem seu personam ecclesiae gerere*. A parson has, during his life, the freehold in himself of the parsonage-house, the glebe, the tithes, and other dues. But these are sometimes appropriated; that is to say, the benefice is perpetually annexed to some spiritual corporation, either sole or aggregate, being the patron of the living; whom the law esteems equally capable of providing for the service of the church as any single private clergyman.

The appropriating corporations, or religious houses, were wont to depute one of their own body to perform divine service, and administer the sacraments, in those parishes of which the society was thus the parson. This officiating minister was in reality no more than a curate, deputy, or viceregent of the appropriator, and therefore called *vicarius*; or, "vicar." His stipend was at the discretion of the appropriator, who was, however, bound of common right to find somebody, *qui illi de temporalibus, episcopo de spiritualibus, debeat respondere*. But this was done in so scandalous a manner, and the parishes suffered so much by the neglect of the appropriators, that the legislature was forced to interpose: and accordingly it is enacted, by statute 15 Ric. II. c. 6. that in all appropriations of churches the diocesan bishop shall ordain (in proportion to the value of the church) a competent sum to be distributed among the poor parishioners annually; and that the vicarage shall be sufficiently endowed. It seems the parish were frequently sufferers, not only by the want of divine service, but also by withholding those alms for which, among other purposes, the payment of tithes was originally imposed; and therefore in this act a pension is directed to be distributed among the poor parochians as well as a sufficient stipend to the vicar. But he, being liable to be removed at the pleasure of the appropriator, was not likely to insist too rigidly on the legal sufficiency of the stipend; and therefore, by statute 4 Hen. IV. c. 12. it is ordained, that the vicar shall be a secular person, not a member of any religious house; that he shall be vicar perpetual, not removable at the caprice of the monastery; and that he shall be canonically instituted and inducted, and be sufficiently endowed, at the discretion of the ordinary; for these three express purposes, to do divine service, to inform the people, and to keep hospitality. The endowments, in consequence of these statutes, have usually been by a portion of the glebe or land belonging to the parsonage, and a particular share of the tithes, which the appropriators found it most troublesome to collect, and which are therefore generally called *parson's tithes*; the greater or predial tithes, being still reserved to their own use. But one and the same rule was not observed in the endowment of all vicarages. Hence, some are more liberally, and some more scantily endowed: and hence the tithes of many things, as wood in particular, are in some parishes rectorial, and in some vicarial tithes.

The distinction therefore of a parson and vicar is this: The parson has for the most part the whole right to all the ecclesiastical dues in his parish; but a vicar has generally an appropriator over him, entitled to the best part of the profits, to whom he is in effect perpetual curate, with a standing salary. Though in some places the vicarage has been considerably augmented by a large share of the great tithes; which augmentations were greatly assisted by the statute 27 Car. II. c. 8. enacted in favour of poor vicars and curates, which rendered such temporary augmentations (when made by the appropriators) perpetual.

When a vicar is instituted, he, besides the usual forms, takes, if required by the bishop, an oath of perpetual residence; for the maxim of law is, that *vicarius non habet vicarium*: and as the non-residence of the appropriators was the cause of the perpetual establishment of vicarages, the law judges it very improper for them to defeat the end

of their constitution, and by absence to create the very mischief which they were appointed to remedy: especially as, if any profits are to arise from putting in a curate and living at a distance from the parish, the appropriator, who is the real parson, has undoubtedly the elder title to them. When the ordinary is also the patron, and confers the living, the presentation and institution are one and the same act, and are called a *collation to a benefice*. By institution or collation the church is full, so that there can be no fresh presentation till another vacancy, at least in the case of a common patron: but the church is not full against the king till induction; nay, even if a clerk is instituted upon the king's presentation, the crown may revoke it before induction, and present another clerk. Upon institution also the clerk may enter on the parsonage-house and glebe, and take the tithes; but he cannot grant or let them, or bring an action for them, till Induction. See INDUCTION.

For the rights of a parson or vicar, in his tithes and ecclesiastical dues, see TITHES. As to his duties, they are so numerous, that it is impracticable to recite them here with any tolerable conciseness or accuracy; but the reader who has occasion may consult *Bp. Gibson's Codex*, and *Burn's Ecclesiastical Law*. We shall therefore only just mention the article of residence, upon the supposition of which the law doth stile every parochial minister an incumbent. By statute 21 Hen. VIII. c. 13. persons willingly absenting themselves from their benefices, for one month together, or two months in the year, incur a penalty of *5l.* to the king, and *5l.* to any person that will sue for the same; excepting chaplains to the king, or others therein mentioned, during their attendance in the household of such as retain them; and also except all heads of houses, magistrates, and professors in the universities, and all students under forty years of age residing there *bona fide*, for study. Legal residence is not only in the parish, but also in the parsonage-house; for it hath been resolved, that the statute intended residence, not only for serving the cure and for hospitality, but also for maintaining the house, that the successor also may keep hospitality there.

We have seen that there is but one way whereby one may become a parson or vicar; there are many ways by which one may cease to be so. 1. By death. 2. By cession, in taking another benefice; for by statute 21 Hen. VIII. c. 13. if any one having a benefice of *6l. per annum*, or upwards, in the king's books, (according to the present valuation), accepts any other, the first shall be adjudged void, unless he obtains a dispensation; which no one is entitled to have but the chaplains of the king and others therein mentioned, the brethren and sons of lords and knights, and doctors and bachelors of divinity and law, admitted by the universities of this realm. And a vacancy thus made for want of a dispensation, is called *cession*. 3. By consecration; for, as was mentioned before, when a clerk is promoted to a bishopric, all his other preferments are void the instant that he is consecrated. But there is a method, by the favour of the crown, of holding such livings, *in commendam*. *Commenda*, or *ecclesia commendata*, is a living commended by the crown to the care of a clerk, to hold till a proper pastor is provided for it. This may be temporary for one, two, or three years, or perpetual, being a kind of dispensation to avoid the vacancy of the living, and is called a *commenda retinere*. There is also *commenda recipere*, which is to take a benefice *de novo* in the bishop's own gift, or the gift of some other patron consenting to the same; and this is the same to him as institution and induction are to another clerk. 4. By resignation. But this is of no avail till accepted by the ordinary, into whose hands the resignation must be made. 5. By deprivation, either by canonical censures or in pursuance of divers penal statutes, which declare the benefice void, for some non-feasance or neglect, or else some malefeasance or crime; as for simony; for maintaining any doctrine in derogation of the king's supremacy, or of the thirty-nine articles, or of the book of common-prayer; for neglecting after institution to read the liturgy and articles in the church, or make the declaration against popery, or take the abjuration-oath; for using any other form of prayer than the liturgy of the church of England; or for absenting himself 60 days in one year from a benefice belonging to a popish patron, to which the clerk was presented by either of the universities; in all which, and similar cases, the benefice is *ipso facto* void, without any formal sentence of deprivation.

PARTICLE, in physiology, the minute part of a body, an assemblage of which constitutes all natural bodies. In the new philosophy, particle is often used in the same sense with atom in the ancient Epicurean philosophy, and corpuscle in the latter. Some writers, however, distinguish them; making particle an assemblage or composition of two or more primitive and physically indivisible corpuscles or atoms; and corpuscle, or little body, an assemblage or mass of several particles, or secondary corpuscles. The distinction, however, is of little moment; and, as to most purposes of physics, particle may be understood as synonymous with corpuscle. Particles are then the elements of bodies: it is the various arrangement and texture of these, with the difference of the cohesion, &c. that constitute the various kinds of bodies, hard, soft, liquid, dry, heavy, light, &c. The smallest particles or corpuscles cohere with the strongest attractions, and always compose bigger particles of weaker cohesion; and many of these cohering compose bigger particles, whose vigour is still weaker; and thus on for divers successions, till the progression end in the

biggest particles, whereon the operations in chemistry, and the colours of natural bodies, depend, and which, by cohering, compose bodies of sensible bulks.

The cohesion of the particles of matter, according to the Epicureans, was effected by hooked atoms; the Aristotelians thought it managed by rest, that is, by nothing at all. But Sir Isaac Newton shews it is done by means of a certain power, whereby the particles mutually attract or tend towards each other, which is still perhaps giving a fact without the cause. By this attraction of the particles he shows that most of the phenonoma of the lesser bodies are affected, as those of the heavenly bodies are by the attraction of gravity. See ATTRACTION and COHESION.

ORGANIC PARTICLES, are those small moving bodies which are imperceptible without the help of glasses; for besides those animals which are perceptible to the sight, some naturalists reckon this exceeding small species as a separate class, if not of animals properly so called, at least of moving bodies, which are found in the semen of animals, and which cannot be seen without the help of the microscope. In consequence of these observations, different systems of generation have been proposed concerning the spermatic worms of the male and the eggs of the female. In the second volume of Buffon's Natural History, several experiments are related, tending to shew that those moving bodies which we discover by the help of glasses in the male semen are not real animals, but organic, lively, active, and indistructible molecules, which possess the property of becoming a new organized body similar to that from which they were extracted. Buffon found such bodies in the female as well as in the male semen; and he supposes that the moving bodies which he observed with the microscope in infusions of the germs of plants are likewise vegetable organic molecules. Needham, Wrisberg, Spallanzani, and several other writers on the animal oecconomy, have pursued the same tract with M. de Buffon.

Some suppose that these organic molecules in the semen answer no purpose but to excite the venereal desire: but such an opinion cannot be well founded; for eunuchs, who have no seminal liquor are nevertheless subject to venereal desire. With respect to the beautiful experiments which have been made with the microscope on organic molecules, M. Bonnet, that learned and excellent observer of nature, remarks that they seem to carry us to the farthest verge of the sensible creation, did not reason teach us that the smallest visible globule of seminal liquor is the commencement of another universe, which, from its infinite smallness, is beyond the reach of our best microscopes.—*Animalcules*, properly so called, must not be confounded with the wonderful organic particles of Buffon. See ANIMALCULE.

PARTING, in chemistry, an operation by which gold and silver are separated from each other. As these two metals resist equally well the action of fire and of lead, they must therefore be separated by other methods. This separation could not be effected if they were not soluble by different menstruums.

Nitrous acid, marine acid, and sulphur, which cannot dissolve gold, attack silver very easily; and therefore these three agents furnish methods of separating silver from gold, or of the operation called *parting*.

Parting by nitrous acid is the most convenient, and therefore most used, and even almost the only one employed by goldsmiths and coiners. Wherefore it is called simply *parting*. That made with the marine acid is only made by cementation, and is known by the name of *concentrated parting*. Lastly, parting by sulphur is made by fusion, which the chymists call the *dry way*, and is therefore called *dry parting*.

PARTNERSHIP, is a contract among two or more persons, to carry on a certain business, at their joint expence, and share the gain or loss which arises from it. Of this there are four kinds.

1. Occasional joint trade, where two or more merchants agree to employ a certain sum in trade, and divide the gain or loss so soon as the adventure is brought to an issue. This kind of contract being generally private, the parties concerned are not liable for each other. If one of them purchase goods on trust, the furnisher, who grants the credit through confidence in him alone, has no recourse in case of his insolvency, against the other partners. They are only answerable for the share of the adventure that belongs to the insolvent partner. If it be proposed to carry the adventure further than originally agreed on, any partner may withdraw his interest; and, if it cannot be separated from the others, may insist that the whole may be brought to an issue. See System of ARITHMETIC, Article XIV.

2. Standing companies, which are generally established by written contract between the parties, where the stock, the firm, duration, the division of the gain or loss, and other circumstances, are inserted.

All the partners are generally authorized to sign by the firm of the company, though this privilege may be confined to some of them by particular agreement. The firm ought only to be subscribed at the place where the copartnery is established. If a partner has occasion, when absent, to write a letter relating to their affairs, he subscribes his own name on account of the company. When the same partners carry on business at different places, they generally choose different firms for each. Houses that have been

long established, often retain the old firm, though all the original partners be dead or withdrawn.

The powers of each partner are, in general, discretionary; but they ought not to act, in matters of importance, without consulting together, when there is an opportunity. No partner is liable to make good the loss arising from his judging wrong in a case where he had authority to act. If he exceeds his power, and the event prove unsuccessful, he must bear the loss; but if it prove successful, the gain belongs to the company: yet if he acquiesces in the company immediately of what he has done, they must either acquiesce therein, or leave him the chance of gain, as well as the risk of loss.

All debts contracted under the firm of the company are binding on the whole partners, though the money was borrowed by one of them for his private use, without the consent of the rest: and if a partner exceeds his power, the others are nevertheless obliged to implement his engagements, though they may render him responsible for his misbehaviour. Although the sums to be advanced by the partners be limited by the contract, if there be a necessity for raising more money to answer emergencies or pay the debts of the company, the partners must furnish what is necessary, in proportion to their shares. A debt to a company is not cancelled by the private debts of the partner; and, when a partner becomes insolvent, the company is not bound for his debts beyond the extent of his share. The debts of the company are preferable, on the company's effects, to the private debts of the partners.

Partnership is generally dissolved by the death of a partner: yet, when there are more partners than two, it may, by agreement, subsist among the survivors. Sometimes it is stipulated, that, in case of the death of a partner, his place shall be supplied by his son, or some other person agreed on. The contract ought to specify the time and manner in which the surviving partners shall reckon with the executors of the deceased for his share of the stock, and a reasonable time allowed for that purpose.

When a partnership is dissolved, there are often outstanding debts that cannot be recovered for a long time, and effects that cannot easily be disposed of. The partnership, though dissolved in other respects, still subsists for the management of their outstanding affairs; and the money arising from them is divided among the partners, or their representatives, when it is recovered. But as this may protract the final settlement of the company's affairs to a very inconvenient length, other methods are sometimes used to bring them to a conclusion, either in consequence of the original contract, or by agreement at the time of dissolution. Sometimes the debts and effects are sold by auction; sometimes they are divided among the partners; and when there are two partners, one divides them into shares, as equal as possible, and the other chooses either share he thinks best. If a partner withdraws, he continues responsible for his former partners till it be publicly known that he hath done so. A deed of separation, registered at a public office, is sufficient presumption of such notoriety.

3. Companies, where the business is conducted by officers. There are many Companies of this kind in Britain, chiefly established for purposes which require a larger capital than private merchants can command. The laws with respect to these companies when not confirmed by public authority, are the same as the former, but the articles of their agreement usually very different. The capital is condescended on, and divided into a certain number of shares, whereof each partner may hold one or more, but is generally restricted to a certain number. Any partner may transfer his share; and the company must admit his assignee as a partner. The death of the partners has no effect on the company. No partner can act personally in the affairs of the company: but the execution of their business is intrusted to officers, for whom they are responsible; and, when the partners are numerous, the superintendency of the officers is committed to directors chosen annually, or at other appointed times, by the partners.

4. Companies incorporated by authority. A royal charter is necessary to enable a company to hold lands, to have a common seal, and enjoy the other privileges of a corporation. A charter is sometimes procured, in order to limit the risk of partners; for in every private company, the partners are liable for the debts, without limitation; in incorporated societies they are only liable for their shares in the stock of the society. The incorporation of societies is sometimes authorised by act of parliament; but this high authority is not necessary, unless for conferring exclusive privileges.

Mr. Paley says, "I know of nothing upon the subject of partnership that requires explanation, but how the profits are to be divided where one partner contributes money and the other labour, which is a common case.

"Rule. From the stock of the partnership deduct the sum advanced, and divide the remainder between the monied partner and the labouring partner, in the proportion of the interest of the money to the wages of the labour, allowing such a rate of interest as money might be borrowed for upon the same security, and such wages, as a journeyman would require for the same labour and trust.

"Example. A advances 1000*l.* but knows nothing of the business: B produces no money, but has been brought up to the business, and undertakes to conduct it. At the end of the year the stock and effects of the partnership amount to 1200*l.* conse-

quently there are 200*l.* to be divided. Now nobody would lend money upon the event of the business succeeding, which is A's security, under the 6 per cent. therefore A must be allowed 120*l.* for the interest of his money. B before he engaged in the partnership, earned 30*l.* a-year in the same employment: his labour therefore, ought to be valued at 30*l.* and the 200*l.* must be divided between the partners in the proportion of 60 to 30; that is, A must receive 133*l.* 6*s.* 8*d.* and B 66*l.* 13*s.* 4*d.* If there be nothing gained, A loses his interest, and B his labour, which is right. If the original stock be diminished, by this rule B loses his labour as before; whereas A loses his interest and part of the principal: for which eventual disadvantage A is compensated by having the interest of his money computed at 6 per cent. in the division of the profits when there is any. It is true that the division of the profit is seldom forgotten in the constitution of the partnership; and is therefore commonly settled by express agreement; but these agreements, to be equitable, should pursue the principle of the rule here laid down. All partners are bound by what any one of them does in the course of the business; for *quoad hoc*, each partner is considered as an authorised agent for the rest."

PARTRIDGE, in ornithology, the English name of the genus *Tetrao*. For description, see *TETRAO*: for representation, see Plate III. Genus 54.

The partridge is so valuable at the table, that a great many ways of taking it have been invented by sportsmen, all of which succeed from the natural folly and timidity of the animal. The places partridges delight in most are corn-fields, especially whilst the corn grows, for under that cover they shelter and breed; neither are those places unfrequented by them when the corn is cut down, by reason of the grain they find there, especially in wheat-stubble, the height of which they delight in, being to them as a covert or shelter. When the wheat stubble is much trodden by men or beasts, they then betake themselves to the barley stubble, provided it be fresh and untrodden; and they will in the furrows, amongst the clots, branches, and long grass, hide both themselves and coveys, which are sometimes twenty in number; nay, thirty in a covey.

When the winter-season is arrived, and the stubble-fields are ploughed up, or over-soiled with cattle, partridges resort into the upland meadows, and lodge in the dead grass, or fog under hedges, amongst mole-hills, or under the roots of trees; sometimes they resort to coppices and underwoods, especially if any cornfields are adjacent, or where there is grown broom, brakes, fern, &c.

In the harvest-time, when every field is full of men and cattle, in the day-time they are found in the fallow-fields which are next adjoining to the corn-fields, where they lie lurking till evening or morning, and then they feed among the sheaves of corn.

When their haunts are known, according to the situation of the country and season of the year, the next care must be to find them out in their haunts, which is done several ways. Some do it by the eye only; and this art can never be taught, but learned by frequent experience, the colour of the birds being so like that of the earth at a distance, that no eye but a very conversant one could distinguish them. When they are once seen, the business is to keep the eye upon them, and then to keep in continual motion. They are a very lazy bird, and by this means will let a person almost tread upon them; though if the person stand still to eye them, they will rise immediately, though they be at a considerable distance.

Another method of discovering them, is by going to their haunts very early in the morning, or at the close of the evening, which is called the *jucking* time. The noise of the cock partridge is to be attended to at this time, and is very loud and earnest. The hen will soon come up to the cock after her making the noise, which she does by way of answer; and when they have got together, their chattering will discover them. Thus they may always be found at these times. But there is a yet better method of finding this bird, which is by the *call*. The business, in order to have success in this way, is carefully to learn the notes of the partridge and be able to imitate all the several sounds. When perfect in this, the person is to go to the haunts morning and evening, and placing himself in some place where he can see the birds without being seen by them, he is to listen to their calling; and when they are heard, he is to answer in the same notes, doubling again as they do: by continuing this, they may be brought so near, that the person lying down on his back may count their whole number. Having in this manner found where the birds are, the next care is to catch them.

They are so foolish, that it is extremely easy to take them in *nets*. In order to this, there needs no more than the going out, provided with two or three nets, with meshes somewhat smaller than those of the pheasant nets, and walking round about the covey, a net is to be fixed so as to draw over them, on pulling a line at a distance. All this may be easily done; for so long as the sportsman continues moving about, and does not fix his eye too intensely upon them, they will let him come near enough to fix the net, without moving. If they lie so straggling, that one net will not cover them, then two or three must be fixed in the same manner. The sportsman may then draw the nets over them, and they will

land
s A's
d Col.
rtner-
about
vidual
is, A
e no-
ich is
loss
of the
d by
n the
divi-
f the
gree-
e the
d by
for
t fur

emus
see

ways
ceel
aces
com
r are
wn,
ble,
rt or
n or
pro-
ows,
em-
nay,

are
the
ges.
hey
elds
cc.
tle,
ext
or

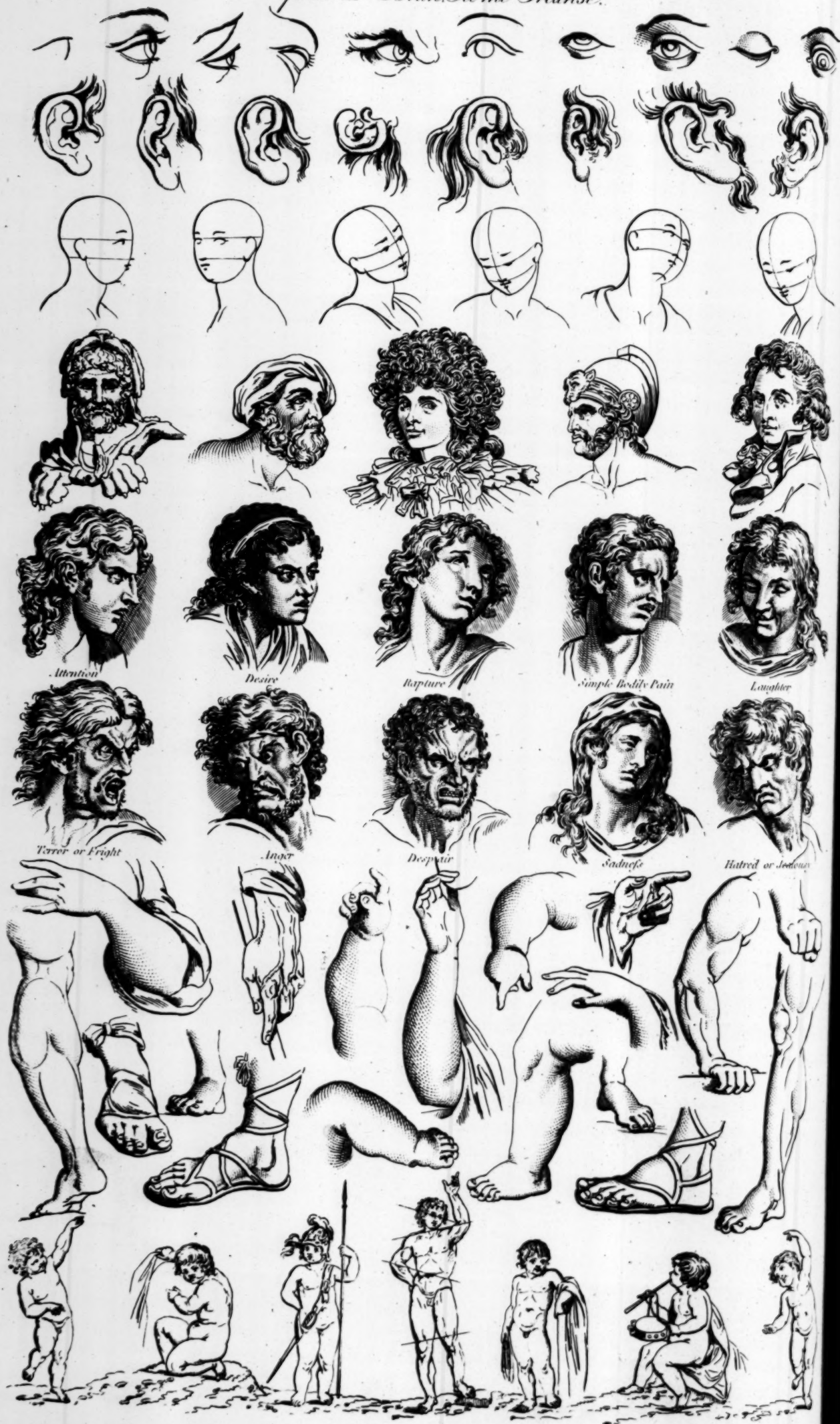
the
em
the
tre-
the
uld
s to
on.
son
eye
er-

nts
ien
to
en
ich
er,
be
ng
ave
ge
in
nd
out
ey
as
nat
m-
ext

in
ut,
an
a
t a
ts.
ely
et,
not
n-
ey
ill

Introductory Principles of Drawing with a representation of the Passions.
from Le Brun. See the Treatise.

Plate 1



will often lie still with the nets upon them till he comes up to fright them; then they will rise, and be entangled in the net.

A second method of taking them is with *bird-lime*; this is done by means of wheat-straws. These must be large, and cut off between knot and knot; they must be well lined with the best and strongest bird-lime, and the sportsman must carry a great number out with him. Having found a field where there are partridges, he is to call; and if they answer, he is then to stick up the limed straws in rows across two or three lands, and going backward, call again to them, leading them on in the road where the straws are: they will follow one another like a flock of chickens, and come out to the call; and will in their way run upon the straws, and liming themselves they will daub one another by crowding together, so that very few of them will be able to escape.

But there is yet a pleasanter way of taking them than this, that is, by *driving* of them. In order to this, an engine is to be made of canvas stuffed with straw, to represent a horse; this horse and nets are to be taken to the haunts of the partridges, and the nets being placed slanting or slopewise in the lower part of the field, the sportsman is to take the wind in his back and get above them, driving them downwards; his face is to be covered with something green or blue, and placing the horse before him, he is to go towards them slowly and gently; and by this means they will be raised on their legs, but not on their wings, and will run before the horse into the nets. If in the way they go into a wrong path, the horse is to be moved to face them; and they will thus be driven back again, and driven every way the sportsman pleases.

PARUS, or **TITMOUSE**, in ornithology, a genus belonging to the order of passerines. The bill is very entire, covered at the basis with hairs; the tongue is truncated and hairy. There are 14 species; of which the following is the most remarkable.

The *cœruleus*, or blue titmouse, is a very beautiful bird. The bill is short and dusky: the crown of the head of a fine blue; from the bill to the eyes is a black line; the forehead and cheeks white; the back of a yellowish green; the lower side of the body yellow; the wings and tail blue, the former marked transversely with a white bar; the legs of a lead colour. They frequent gardens, and do great injury to fruit trees, by bruising the tender buds in search of the insects which lie under them. It breeds in holes of walls, and lays 12 or 14 eggs. For classification, see the System. For representation, see Plate III. Genus 43.

PASQUIN, a mutilated statue at Rome, in a corner of the palace of the Ursini. It takes its name from a cobbler of that city called *Pasquin*, famous for his sneers and gibes, and who diverted himself by passing his jokes on all that went through that street. After his death, as they were digging up the pavement before his door, they found in the earth the statue of an ancient gladiator, well cut, but maimed and half spoiled: this they set up in the place where it was found, and by common consent named it *Pasquin*. Since that time all satires are attributed to that figure; and are either put into its mouth, or pasted upon it, as if they were written by *Pasquin redivivus*; and these are addressed by *Pasquin* to *Marsorio*, another statue at Rome. When *Marsorio* is attacked, *Pasquin* comes to his assistance, and, when *Pasquin* is attacked, *Marsorio* assists him in his turn; that is, the people make the statues speak just what they please.

PASQUINADE, or **PASQUIL**, is properly a satirical libel, fastened to the statue of *Pasquin*. Hence, by extension, the term becomes used for any satire, lampoon, or sneer upon the public, or upon the ruling powers. There is this difference between a *pasquinade* and *satire*; that the end of the latter is to correct and reform; whereas that of the former is only to scoff and expose.

PASSAGE, in commerce, or right of passage, is an imposition which some princes exact by their offices or farmers, in certain narrow close places of their territories, either by land or sea, on all vessels, vehicles, and carriages of all kinds; and even sometimes on persons, as passengers coming in or going out of ports, &c. The *passage of the Sound*, (that famous strait, which carries us out of the German into the Baltic sea, is the most celebrated *passage* in Europe. The dues thereof belong to the king of Denmark, and are paid at Elsinore or Cronenburg.

Birds of PASSAGE, are such as only come to us at certain seasons, and disappear again; being supposed to pass the sea to some other climate. Among the *birds of passage* are the stork, swallow, nightingale, martin, woodcock, quail, hooded crow, cuckoo, wryneck, several species of the pigeon and thrush, snipe, curlew, several species of sand-piper, long-legged plover, land rail, several species of grebe, divers, terns, mergansers, many species of ducks, &c.

PASSERES, the name of an order in the second class of Zoology called *AVES*. For the characteristic description, and the classification of the respective genera belonging to this order, see the system of *ORNITHOLOGY*, Sect. IV.

PASSIONS, in moral philosophy, are certain motions of the soul, which make it pursue what appears to be good, and avoid whatever threatens evil. On the just regulation and subordination of the passions depends in a great measure the happiness of mankind.

External Signs of Emotions and PASSIONS. So intimately connected are the soul and body, that every agitation in the former produces a visible effect upon the latter. There is at the same time,

a wonderful uniformity in that operation; each class of emotions and passions being invariably attended with an external appearance peculiar to itself. These external appearances, or signs, may not improperly be considered as a natural language, expressing to all beholders emotions and passions as they arise in the heart. Hope, fear, joy, grief, are displayed externally: the character of a man is often to be read in his face; and beauty, which makes so deep an impression, is known to result, not so much from regular features and a fine complexion, as from good-nature, good-sense, sprightliness, sweetness, or other mental quality, expressed upon the countenance. Though perfect skill in that language be rare, yet what is generally known is sufficient for the ordinary purposes of life. The external expressions of passion form a language understood by all, by the young as well as the old, by the ignorant as well as the learned: we talk of the plain and legible characters of that language; for undoubtedly we are much indebted to experience, in deciphering the dark and more delicate expressions. Where then shall we apply for a solution of this intricate problem, which seems to penetrate deep into human nature? Undoubtedly if the meaning of external signs be not derived to us from sight, nor from experience, there is no remaining source whence it can be derived but from nature.

We may then venture to pronounce, with some degree of confidence, that man is provided by nature with a sense or faculty that lays open to him every passion by means of its external expressions. And we cannot entertain any reasonable doubt of this, when we reflect, that the meaning of external signs is not hid even from infants: an infant is remarkably affected with the passions of its nurse expressed on her countenance; a smile cheers it, a frown makes it afraid: but fear cannot be without apprehending danger: and what danger can the infant apprehend, unless it be sensible that its nurse is angry? We must therefore admit, that a child can read anger in its nurse's face; of which it must be sensible intuitively; for it has no other means of knowledge. We do not affirm, that these particulars are clearly apprehended by the child; for to produce clear and distinct perceptions, reflection and experience are requisite: but that even an infant, when afraid, must have some notion of its being in danger, is evident.

That we should be conscious intuitively of a passion from its external expressions, is conformable to the analogy of nature: the knowledge of that language is of too great importance to be left upon experience; because a foundation so uncertain and precarious, would prove a great obstacle to the formation of societies. Wisely therefore is it ordered, and agreeable to the system of Providence, that we should have nature for our instructor.

Manifold and admirable are the purposes to which the external signs of passion are made subservient by the Author of our nature.

Dissocial passions, being hurtful by prompting violence and mischief are noted by the most conspicuous external signs, in order to put us upon our guard: thus anger and revenge, especially when sudden, display themselves on the countenance in legible characters. The external signs, again, of every passion that threatens danger, raise in us the passion of fear: which frequently operating without reason or reflection, moves us by a sudden impulse to avoid the impending danger.

Of all the external signs of passion, those of affliction or distress are the most illustrious with respect to a final cause, and deservedly merit a place of distinction. They are illustrious by the singularity of their contrivance; and also by inspiring sympathy, a passion to which human society is indebted for its greatest blessing, that of providing relief for the distressed. A subject so interesting, deserves a leisurely and attentive examination. The conformity of the nature of man to his external circumstances, is in every particular wonderful: his nature makes him prone to society; and society is necessary to his well-being, because in a solitary state he is a helpless being, destitute of support, and in his distresses destitute of relief: but mental support, the shining attribute of society, is of too great moment to be left dependent upon cool reason; it is ordered more wisely, and with greater conformity to the analogy of nature, that it should be enforced even instinctively by the passion of sympathy. Here sympathy makes a capital figure; and contributes, more than any other means, to make life easy and comfortable. But the benevolence of our nature gives a very different direction to the painful passion of sympathy, and to the desire involved in it; instead of avoiding distress, we fly to it in order to afford relief; and our sympathy cannot be otherwise gratified than by giving all the succour in our power. Thus external signs of distress, though disagreeable, are attractive; and the sympathy they inspire is a powerful cause, impelling us to afford relief, even to a stranger, as if he were our friend or relation.

It is a noted observation, that the deepest tragedies are the most crowded; which in a partial view will be thought an unaccountable bias in human nature. Love of novelty, desire of occupation, beauty of action, make us fond of theatrical representations; and when once engaged, we must follow the story to the conclusion, whatever distress it may create. But we generally become wise by experience; and when we foresee what pain we shall suffer during the course of the representation, is it not surprising that persons of reflection do not avoid such spectacles altogether? And yet one who has scarce recovered from the distress of a deep tragedy, resolves

P A S

resolves coolly and deliberately to go to the very next, without the slightest obstruction from self-love. The whole mystery is explained by a single observation: That sympathy, though painful, is attractive; and attaches us to an object in distress, instead of prompting us to fly from it. And by this curious mechanism it is, that persons of any degree of sensibility are attracted by affliction still more than by joy.

To conclude: the external signs of passion are a strong indication, that man, by his very constitution, is framed to be open and sincere. A child, in all things obedient to the impulses of nature, hides none of its emotions; the savage and clown, who have no guide but pure nature, expose their hearts to view, by giving way to all the natural signs. And even when men learn to dissemble their sentiments, and when behaviour degenerates into art, there still remain checks, that keep dissimulation within bounds, and prevent a great part of its mischievous effects; the total suppression of the voluntary signs during any vivid passion begets the utmost uneasiness, which cannot be endured for any considerable time: this operation becomes indeed less painful by habit; but luckily the involuntary signs cannot, by any effort, be suppressed nor even dissembled. An absolute hypocrisy, by which the character is concealed and a fictitious one assumed, is made impracticable; and nature has thereby prevented much harm to society. We may pronounce therefore, that Nature, herself sincere and candid, intends that mankind should preserve the same character, by cultivating simplicity and truth, and banishing every sort of dissimulation that tends to mischief.

Influence of PASSION with respect to our Perceptions, Opinions, and Belief. So intimately are our perceptions, passions, and actions connected, it would be wonderful if they should have no mutual influence. That our actions are too much influenced by passion, is a known truth; but it is not less certain, though not so well known, that passion hath also an influence upon our perceptions, opinions, and belief. For example, the opinions we form of men and things are generally directed by affection: An advice given by a man of figure hath great weight; the same advice from one in a low condition is despised or neglected: a man of courage under-rates danger; and to the indolent the slightest obstacle appears unsurmountable.

There is no truth more universally known, than that tranquillity and sedateness are the proper state of mind for accurate perception and cool deliberation; and for that reason, we never regard the opinion even of the wisest man, when we discover prejudice or passion behind the curtain. Passion has such influence over us, as to give a false light to all its objects. Agreeable passions prepossess the mind in favour of their objects; and disagreeable passions, not less against their objects: A woman is all perfection in her lover's opinion, while in the eye of a rival beauty she is awkward and disagreeable: when the passion of love is gone, beauty vanishes with it;—nothing left of that genteel motion, that sprightly conversation, those numberless graces which formerly, in the lover's opinion, charmed all hearts. To a zealot every one of his own sect is a saint, while the most upright of a different sect are to him children of perdition: the talent of speaking in a friend, is more regarded than prudent conduct in any other. Nor will this surprise any one acquainted with the world; our opinions, the result frequently of various and complicated views, are commonly so slight and wavering, as ready to be susceptible of a bias from passion.

With that natural bias another circumstance concurs, to give passion an undue influence on our opinions and belief; and that is a strong tendency in our nature to justify our passions as well as our actions, not to others only, but even to ourselves. That tendency is peculiarly remarkable with respect to disagreeable passions: by its influence, objects are magnified or lessened, circumstances supplied or suppressed, every thing coloured and disguised, to answer the end of justification. Hence the foundation of self-deceit, where a man imposes on himself innocently, and even without suspicion of a bias.

We proceed to illustrate the foregoing observations by proper examples:

Gratitude, when warm, is often exerted upon the children of the benefactor; especially where he is removed out of reach by death or absence. The passion in this case being exerted for the sake of the benefactor, requires no peculiar excellence in his children: but the practice of doing good to these children produces affection for them, which never fails to advance them in our esteem. By such means, strong connections of affection are often formed among individuals, upon the slight foundation now mentioned.

Envy is a passion, which, being altogether unjustifiable, cannot be excused but by disguising it under some plausible name. At the same time, no passion is more eager than envy, to give its object a disagreeable appearance: it magnifies every bad quality, and fixes on the most humbling circumstances:

Cassius. I cannot tell what you and other men
Think of this life; but for my single self,
I had as lief not be, as live to be
In awe of such a thing as I myself,
I was born as free as Caesar, so were you:
We both have fed as well; and we can both
Endure the winter's cold as well as he.
For once, upon a raw and gusty day,

P A S

The troubled Tyber chafing with his shores,
Caesar says to me, "Dar'st thou, Cassius, now
Leap in with me into this angry flood,
And swim to yonder point?—Upon the word,
Accoutred as I was, I plunged in,
And bid him follow; so indeed he did.
The torrent roar'd, and we did buffet it
With lusty sinews; throwing it aside,
And stemming it with hearts of controversy.
But ere we could arrive the point propos'd
Caesar cry'd, Help me, Cassius, or I sink.
I, as Æneas, our great ancestor,
Did from the flames of Troy upon his shoulder
The old Anchises bear; so from the waves of Tiber
Did I the tired Caesar: and this man
Is now become a god; and Cassius is
A wretched creature, and must bend his body
If Caesar do but carelessly nod on him.
He had a fever when he was in Spain;
And when the fit was on him, I did mark
How he did shake. 'Tis true, this god did shake;
His coward lips did from their colour fly:
And that same eye, whose bend doth awe the world,
Did lose its lustre; I did hear him groan;
Ay, and that tongue of his, that bade the Romans
Mark him, and write his speeches in their books,
Alas! it cry'd—Give me some drink, Titinius,—
Like a sick girl. Ye gods, it doth amaze me,
A man of such a feeble temper should
So get the start of the majestic world,
And bear the palm alone.

Julius Caesar, act 1. sc. 3.

When by great sensibility of heart, or other means, grief becomes immoderate, the mind, in order to justify itself, is prone to magnify the cause; and if the real cause admit not of being magnified, the mind seeks a cause for its grief in imagined future events:

Bushy. Madam, your Majesty is much too sad:
You promis'd, when you parted with the king,
To lay aside self-harming heaviness,
And entertain a cheerful disposition.

Queen. To please the king, I did; to please myself,
I can not do it. Yet I know no cause
Why I should welcome such a guest as grief;
Save bidding farewell to so sweet a guest
As my sweet Richard: yet again, methinks,
Some unborn sorrow, ripe in Fortune's womb,
Is coming tow'rd me, and my inward soul
With something trembles, yet at nothing grieves,
More than with parting from my lord the king.

Richard II. act 2. sc. 5.

Shakespeare exhibits beautiful examples of the irregular influence of passion in making us believe things to be otherwise than they are. King Lear, in his distress, personifies the rain, wind, and thunder; and in order to justify his resentment, believes them to be taking part with his daughters:

Lear. Rumble thy bellyful, spit fire, spout rain,
Nor rain, wind, thunder, fire, are my daughters.
I tax not you, ye elements, with unkindness;
I never gave you kingdoms, call'd you children:
You owe me no subscription. Then let fall
Your horrible displeasure.—Here I stand your brave;
A poor, infirm, weak, and despis'd old man!
But yet I call you servile ministers,
That have with two pernicious daughters join'd
Your high-engender'd battles, 'gainst a head
So old and white as this. Oh? oh? 'tis foul!

Act 3. sc. 2.

Hamlet, swelled with indignation at his mother's second marriage, was strongly inclined to lessen the time of her widowhood, the shortness of the time being a violent circumstance against her; and he deludes himself by degrees into the opinion of an interval shorter than the real one:

Hamlet. That it should come to this!
But two months dead! nay, not so much; not two—
So excellent a king, that was, to this,
Hyperion to a satyr: so loving to my mother,
That he permitted not the wind of heav'n
Visit her face too roughly. Heaven and Earth!
Must I remember—why, she would hang on him,
As if increase of appetite had grown
By what it fed on: yet, within a month—
Let me not think—Frailty, thy name is Woman!
A little month! or ere those shoes were old,
With which she follow'd my poor father's body,
Like Niobe, all tears—why she, even she—
(O heav'n! a beast, that wants discourse of reason,
Would have mourn'd longer)—married with mine uncle,
My father's brother; but no more like my father,
Than I to Hercules. Within a month!—
Ere yet the salt of most unrighteous tears
Had left the flushing in her gauled eyes,
She married—Oh, most wicked speed! to post
With such dexterity to incestuous sheets!
It is not, nor it cannot come to good.
But break, my heart, for I must hold my tongue.

Act 1. sc. 3.

The power of passion to falsify the computation of time is remarkable in this instance: because time, which hath an accurate measure, is less obsequious to our desires and wishes, than objects which have no precise standard of less or more.

Good news are greedily swallowed upon very slender evidence; our wishes magnify the probability of the event, as well as the veracity of the relater; and we believe as certain, what is best is doubtful:

Quintus

Quel, che l'huom vede, amor li fa invisibile
E l'invisibil fa veder amore.
Questo creduto fu, che l'miser stolo
Dar facile credenza a' quel, che vuole.

Orlando. *Furios. cant. 1. st. 56.*

For the same reason, bad news gains also credit upon the slightest evidence: fear, if once alarmed, has the same effect with hope, to magnify every circumstance that tends to conviction. Shakespeare, who shews more knowledge of human nature than any of our philosophers, hath in his *Cymbeline* represented this bias of the mind; for he makes the person who alone was affected with the bad news, yield to evidence that did not convince any of his companions. And Othello is convinced of his wife's infidelity from circumstances too slight to move any person less interested. It is certain however, that wonders and prodigies are swallowed by the vulgar, upon evidence that would not be sufficient to ascertain the most familiar occurrence. It has been reckoned difficult to explain that irregular bias of mind; but we are now made acquainted with the influence of passion upon opinion and belief: a story of ghosts or fairies, told with an air of gravity and truth, raiseth an emotion of wonder, and perhaps of dread; and these emotions imposing on a weak mind, impress upon it a thorough conviction contrary to reason. Opinion and belief are influenced by propensity as well as by passion. An innate propensity is all we have to convince us that the operations of nature are uniform.

Language of PASSION. Among the particulars that compose the social part of our nature, a propensity to communicate our opinions, our emotions, and every thing that affects us is remarkable. Bad fortune and injustice affect us greatly; and of these we are so prone to complain, that if we have no friend nor acquaintance to take part in our sufferings, we sometimes utter our complaints aloud, even where there are none to listen. But this propensity operates not in every state of mind. A man immoderately grieved, seeks to afflict himself, rejecting all consolation: immoderate grief accordingly is mute: complaining is struggling for consolation.

It is the wretch's comfort still to have
Some small reserve of near and inward woe,
Some unsuspected hoard of inward grief,
Which they unseen may wail, and weep, and mourn,
And gluton-like alone devour. *Mourning Bride, act 1. sc. 1.*

When grief subsides, it then, and no sooner, finds a tongue: we complain, because complaining is an effort to disburden the mind of its distress. This observation is finely illustrated by a story which Herodotus records, *b. 3.* Cambyzes, when he conquered Egypt, made Psamenitus the king prisoner; and for trying his constancy, ordered his daughter to be dressed in the habit of a slave, and to be employed in bringing water from the river; his son also was led to execution with a halter about his neck. The Egyptians vented their sorrow in tears and lamentations: Psamenitus only with a downcast eye, remained silent. Afterward meeting one of his companions, a man advanced in years, who, being plundered of all, was begging alms; he wept bitterly, calling him by his name, Cambyzes, struck with wonder, demanded an answer to the following question: "Psamenitus, thy master Cambyzes is desirous to know, why, after thou hadst seen thy daughter so ignominiously treated, and thy son led to execution, without exclaiming or weeping, shouldst thou be so highly concerned for a poor man, no way related to thee?" Psamenitus returned the following answer: "Son of Cyrus, the calamities of my family are too great to leave me the power of weeping; but the misfortunes of a companion, reduced in his old age to want of bread, is a fit subject for lamentation."

Surprise and terror are silent passions, for a different reason: they agitate the mind so violently, as for a time to suspend the exercise of its faculties, and among others the faculty of speech. Love and revenge, when immoderate, are not more loquacious than immoderate grief. But when these passions become moderate, they set the tongue free, and, like moderate grief, become loquacious. Moderate love, when unsuccessful, is vented in complaints; when successful, is full of joy expressed by words and gestures.

Figurative expression, being the work of an enlivened imagination, cannot be the language of anguish or distress. Otway, sensible of this, has painted a scene of distress in colours finely adapted to the subject: there is scarce a figure in it, except a short and natural simile with which the speech is introduced. Belvidera talking to her father of her husband.

Think you saw what pass'd at our last parting:
Think you beheld him, like a raging lion,
Pacing the earth, and tearing up his steps,
Fate in his eyes, and roaring with the pain
Of burning fury; think you saw his one hand
Fix'd on my throat, while the extended other
Grasp'd a keen threat'ning dagger: oh! 'twas thus
We last embrac'd, when, trembling with revenge,
He dragg'd me to the ground, and at my bosom
Presented horrid death; cried out, my friends!
Where are my friends? swore, wept, rag'd, threaten'd, lov'd;
For he yet lov'd, and that dear love preserv'd me
To this last trial of a father's pity.
I fear not death, but cannot bear a thought
That that dear hand should do th' unfriendly office.
If I was ever then your care, now hear me:
Fly to the senate, save the promis'd lives
Of his dear friends, ere mine be made the sacrifice.

Venice Preserved, act. 3

To preserve the foresaid resemblance between words and their meaning, the sentiments of active and hurrying passions ought to be dressed in words where syllables prevail that are pronounced short or fast; for these make an impression of hurry and precipitation. Emotions, on the other hand, that rest upon their objects are best expressed by words where syllables prevail that are pronounced long or slow. A person affected with melancholy, has a languid and slow train of perceptions. The expression best suited to that state of mind, is where words, not only of long, but of many syllables, abound in composition; and for that reason, nothing can be finer than the following passage.

In those deep solitudes, and awful cells,
Where heav'nly-pensive Contemplation dwells,
And ever-musing Melancholy reigns. *POPE. Eloisa to Abelard.*

In general, the language of violent passion ought to be broken and interrupted. Soliloquies ought to be so in a peculiar manner: language is intended by nature for society; and a man when alone, though he always clothes his thoughts in words, seldom gives his words utterance, unless when prompted by some strong emotion; and even then by starts and intervals only. Shakespeare's soliloquies may be justly established as a model; for it is not easy to conceive any model more perfect. Of his many incomparable soliloquies, the two following only shall be quoted, being different in their manner.

Hamlet. Oh, that this too, too solid flesh would melt,
Thaw and resolve itself into a dew!
Or that the Everlasting had not fix'd
His canon 'gainst self-slaughter! O God! O God!
How weary, stale, flat, and unprofitable
Seem to me all the uses of this world!
Fie on't! O fie! 'tis an unweeded garden,
'That grows to seed! things rank and gross in nature
Possess it merely. *Hamlet, act 1. sc. 3.*

"Ford. Humph! ha! is this a vision? is this a dream? do I sleep? Mr. Ford, awake; awake, Mr. Ford; there's a hole made in your best coat, Mr. Ford! this 'tis to be married! this 'tis to have linen and buck baskets! Well, I will proclaim myself what I am; I will now take the leacher, he is at my house; he cannot 'scape me; 'tis impossible he should; he cannot creep into a halfpenny purse, nor into a pepper-box. But lest the devil that guides him should aid him, I will search impossible places; tho' what I am I cannot avoid, yet to be what I would not, shall not make me tame."

Merry Wives of Windsor, act 3. sc. last.

These soliloquies are accurate and bold copies of nature: in a passionate soliloquy one begins with thinking aloud; and the strongest feelings only are expressed; as the speaker warms, he begins to imagine one listening, and gradually slides into a connected discourse. How far distant are soliloquies generally from these models? So far indeed as to give disgust instead of pleasure. The first scene of *Iphigenia in Tauris* discovers that princess, in a soliloquy, gravely reporting to herself her own history. There is the same impropriety in the first scene of *Alcestes*, and in the other introductions of Euripides, almost without exception. Nothing can be more ridiculous: it puts one in mind of a most curious device in Gothic paintings, that of making every figure explain itself by a written label issuing from its mouth. Soliloquies upon lively or interesting subjects, but without any turbulence of passion, may be carried on in a continued chain of thought. If, for example, the nature and sprightliness of the subject prompt a man to speak his thoughts in the form of a dialogue, the expression must be carried on without break or interruption, as in a dialogue between two persons; which justifies Falstaff's soliloquy upon honour.

"What need I be so forward with Death, that calls not on me? Well, 'tis no matter, Honour pricks me on. But how if Honour prick me off, when I come on? how then? Can Honour set a leg? No. Or an arm? No. Or take away the grief of a wound? No. Honour hath no skill in surgery then? No. What is Honour? a word.—What is that word honour? Air; a trim reckoning.—Who hath it? He that dy'd a Wednesday. Doth he feel it? No. Doth he hear it? No. Is it insensible then? Yea, to the dead. But will it not live with the living? No. Why? Detraction will not suffer it. Therefore I'll none of it; Honour is a mere scutcheon: and so ends my catechism. *First Part, Henry IV. act 5. sc. 2.*

And even without dialogue, a continued discourse may be justified, where a man reasons in a soliloquy upon an important subject; for if in such a case it be at all excusable to think aloud, it is necessary that the reasoning be carried on in a chain; which justifies that admirable soliloquy in *Hamlet* upon life and immortality, being a serene meditation upon the most interesting of all subjects. And the same consideration will justify the soliloquy that introduces the 5th act of Addison's *Cato*.

PASSIONS, in medicine, make one of the non-naturals, and produce very sensible effects. Joy, anger, and fear, are the principal. In the two first, the spirits are hurried with too great vivacity; whereas in fear or dread, they are, as it were curbed and concentrated: whence we may conclude, that they have a very bad effect upon health; and therefore it will be best to keep them within bounds as much as possible, and to preserve an inward serenity, calmness, and tranquillity.

PASSIVE, a term of relation, implying a thing to suffer, or undergo the action of some other; which in respect hereof, is denominated

nominated *active*. In all generations, philosophers conceive a *active* power, and a *passive*. The Chymists divide their principles, or elements, into *active* and *passive*. *Passive* are such as have no active force inherent in themselves, and which only act by being joined with some of the others. Such are phlegm and earth; some say also salt, and, in effect, all but sulphur, or fire, which they will have the only principles of action and motion in the universe.

Passive Obedience, a political doctrine which has been much misrepresented, and is, of course, very obnoxious to the friends of freedom. Some nonjurors, in the end of the last and in the beginning of the passing century, imagining that monarchy is the only lawful form of government, and that hereditary monarchy is the only lawful species of that government, have coupled with *passive obedience* the ridiculous notion of a divine, hereditary indefeasible right of certain families to govern with despotic sway all other families of the same nation. See *NONJURORS*. The absurdity of this notion needs not to be dwelt upon; but it may not be improper to observe, that it has nothing to do with *passive obedience*.

As taught by the ablest reasoners, who think that they are supported by holy scripture, *passive obedience* is as much a duty under republican as under monarchical governments; and it means no more, but that private individuals are bound by the most solemn moral ties not to resist the supreme power wheresoever placed in any nation. The supreme power can only be the legislature; and no man or body of men, who have not the power of enacting and abrogating laws can, on this principle, claim *passive obedience* from any subject. Whether the principle be well or ill founded, the absurdity which commonly attaches to the phrase *passive Obedience*, originates from the mistaken loyalty of the adherents of the house of Stuart, who to aggravate the illegality of the revolution, were wont to represent James II. as supreme over both houses of parliament, and of course over all law. That such reveries were foolish, we need no other evidence than the statute-book, which shews, that in the office of legislation, the king, lords, and commons, are co-ordinate; and that when any of these powers shall take upon itself to counteract the other two, the duty of *passive obedience* will oblige the subject to support the legislature. That resistance to the legislature, if lawful on any occasion, can be so only to oppose the most violent tyranny, has been shown by Mr. Hume with great cogency of argument, and is indeed a proposition self-evident. That it can never be lawful on any occasion, Bishop Berkley endeavoured to prove by a chain of reasoning which it would be difficult to break. We enter not into the controversy, but refer our readers to *Hume's Essays* and *Berkley's Passive Obedience and Nonresistance*, or as it was intitled by a late editor, *the Measure of Submission to civil Government*. We shall only observe, that there is a great difference between *active* and *passive obedience*; and that many who consider themselves bound on no account whatever to resist the supreme power, would yet suffer death rather than do an immoral action in obedience to any law of earthly origin.

PASSOVER, פֶּסַח, a solemn feast, celebrated among the Jews on the fourteenth day of the moon next after the vernal equinox. This feast was called by the ancient Latins and Greeks, *pascha*, not from פֶּסַח, *I suffer*, as Chrysostom, Irenæus, and Tertullian, weakly imagine, but from the Hebrew *pesahh*, *passage, leap*; the design of the feast being to commemorate the destroying angel's passing over the houses of the Israelites, when he entered in and destroyed the first-born in those of the Egyptians. Exod. xii. 27.

Many erroneously imagine that it was in memory of their passing the Red Sea that the *passover* was instituted; though it is certain the feast was held, and had its name, before the Israelites took a step of their way out of Egypt, and consequently several days before their passing the red Sea. Besides the *passover* celebrated on the fourteenth of the first month, there was a second *passover* held on the fourteenth of the second month after the equinox, instituted by God in favour of travellers, and sick persons, who could not attend at the first, nor be at Jerusalem on the day. The Greeks, and even some of the catholic doctors, from the thirteenth, eighteenth, and nineteenth chapters of St. John, take occasion to conclude, that Jesus anticipated the day marked for the *passover* in the law; but the authority of the three evangelists seems to evince the contrary. See Whitby's Dissertation on this subject, in an appendix to the fourteenth chapter of St. Mark.

PASTIME, a sport, amusement, or diversion. Pastimes of some kind seem to be absolutely necessary, and to none more than to the man of study; for the most vigorous mind cannot bear to be always bent. Constant application to one pursuit, if it deeply engage the attention, is apt to unhinge the mind, and to generate madness; of which the Don Quixote of Cervantes, and the astronomer of Johnson, are two admirably-conceived instances. But though pastime as necessary to relieve the mind, it indicates great frivolity when made the business of life: and yet the rich and the great, who are not obliged to labour for the means of subsistence, too often rove from pastime to pastime with as constant assiduity as the mechanic toils for his family, or as the philosopher devotes himself to the cultivation of science. When those pastimes tend to give elasticity to the mind or strength to the body, such conduct is not only allowable, but praise-worthy; but when they produce effects the reverse of these, it is both hurtful and criminal.

PASTINACA, the *PARSNEP*: A genus of the digynia order, belonging to the pentandria class of plants; and in the natural method ranking under the 43th order, *Umbellatæ*. The fruit is an elliptical compressed plane; the petals are involuted and entire. There are only two species of this genus; the principal of which is the *pastinaca sativa*, or garden-parsnep: which is an exceeding fine esculent root. It is propagated by sowing the seeds in February or March, in a rich mellow soil, which must be deep dug that the roots may be able to run deep without hindrance.

It is a common practice to sow carrots at the same time, upon the same ground with parsneps: and if the carrots are designed to be drawn young, there is no harm in it. The parsneps, when they are grown up a little, must be thinned to a foot distance, and carefully kept clear of weeds. They are finest tasted just at the season when the leaves are decayed: and such as are desirous to eat them in spring should have them taken up in autumn, and preserved in sand. When the seeds are to be saved, some very strong and fine plants should be left four feet distant; and towards the end of August, or in the beginning of September, the seeds will be ripe: they must then be carefully gathered, and dried on a coarse cloth. They should always be sown the spring following, for they do not keep well.

Hints have been given and experiments made by agricultural societies, respecting parsneps, in order to raise them for winter food to cattle. It has long been a custom in some parts of Britany, to sow parsneps in the open field for the food of cattle; as we are informed by the first volume of the transactions of a society instituted in that province, for the encouragement of the economical and commercial interests of their country. "It is of great importance (say they) that parsneps should be universally cultivated; because they afford an excellent and wholesome food for all kinds of cattle during the winter, and may be used to great advantage to fatten them. Our hogs have no other food in all that season, and our bullocks and oxen thrive well upon it. Our cows fed with parsneps give more milk than with any other winter fodder, and that milk yields better butter than the milk of cows nourished with any other substance. Our horses fatten with this food; though some pretend that it renders them less mettlesome, and hurts their legs and eyes. Cattle eat these roots raw at first sliced lengthwise and when they begin not to relish them, they are cut in pihes, put into a large copper, pressed down there, and boiled with only so much water as fills up the chasms between them. They then eat very greedily, and continue to like them.

PASTORAL something that relates to shepherds, *pastores*. The poets represent the innocence of a *pastoral* life, and *pastoral* manners, in the most agreeable light. We must not imagine them so beautiful in nature as in their descriptions. Most authors, except the English, esteem *pastoral* of the dramatic kind; and decline it a dramatic piece, wherein the persons are clad like nymphs and shepherds, and act their own amours. The scene is always in the fields or the woods; whence Tasso calls *pastoral*, *lavola boscareccia*. It is certain this kind of *pastoral* fable, composed according to the rules of the stage, was unknown among the ancients. The Greeks and Latins have indeed introduced shepherds in their eclogues; but these eclogues had nothing theatrical in them; nor were the shepherds ever brought upon the stage. This kind of dramatic *pastoral* is as yet but little known among us: nor have we any thing considerable under the title of *pastorals*, but country pieces after the manner of the eclogues or idyllions of the ancients. Every *pastoral*, even in this last-view, should have a little plot or fable, which may deserve the title of a *pastoral scene*. It must be simple, and but one, yet not so as refuse all digressions, provided they be but short. This rule of the plot is every where observed by Virgil.

Pastoral life may be considered in three different views; either such as it now actually is; when the state of shepherd is reduced to be a mean, servile, and laborous state; when their employments are become disagreeable, and their ideas gross and low: or such as we may suppose it once to have been, in the more early and simple ages, when it was a life of ease and abundance; when the wealth of men consisted chiefly in flocks and herds, and the shepherd, though unrefined in his manners, was respectable in his state; or, lastly, such as it never was, and never can in reality be, when, to the ease, innocence, and simplicity of the early ages, we attempt to add the polished taste, and cultivated manners, of modern times. Of these three states, the first is too gross and mean, the last too refined and unnatural, to be made the ground-work of *pastoral* poetry. Either of these extremes is a rock upon which the poet will split, if he approach too near it. We shall be disgusted if he gives us too much of the servile employments and low ideas of actual peasants, as Theocritus is censured for having sometimes done; and if, like some of the French and Italian writers of pastorals, he makes his shepherds discourse as if they were courtiers and scholars, he then retains the name only, but wants the spirit of *pastoral* poetry.

PASTRY, that branch of cookery which is chiefly taken up in making pies, pasties, cakes, &c. Dr. Cullen observes, that paste is very hard and digestible without butter; and even with it is apt to produce heart-burn and ascendency. Perhaps this is increased by burned butter, from a certain sensibility in the stomach, which occasions

cations all empyreumatic oils to be long retained, and so turn rancous and acrid.

PASTURE Ground, is properly that which is not cultivated; that is, it is neither meadow, nor arable; but reserved for the feeding of cattle. The best domains are those consisting in *pasture*; they need no tilling. Holland is a country abounding much in *pasture*: *Pasture-land* is of such advantage to husbandry, that many prefer it even to corn-land, because of the small hazard and labour that attend it, and as it lays the foundation for most of the profit that is expected from the arable land; because of the manure the cattle afford which are fed upon it. Where dung is not to be bought, as is often the case in places distant from large towns, the farmer is forced to proportion his arable to his *pasture* land, in such a manner that the cattle fed on the latter may be sufficient for a supply of dung, so necessary for producing the fruits of the former. For the management, and particularly the most approved methods of watering and draining *pasture-land*, see *System of AGRICULTURE*, Sect. XIX. For the best manure, see Sect. II.

PATELLA, in anatomy, a bone which covers the fore part of the joint of the knee; called also *mola*, *rotula*, and popularly the *knee-pan*. See the *System*, Part I. and Plate I. Fig. 1. letter *f*.

PATHETICI, in anatomy, the fourth of the ten pair of nerves, which arise from a small medullary chord that is behind the testes: they pass down on the sides of the medulla oblongata, and proceeding under the dura mater, by the sides of the cella turcica, they go through the foramen lacerum, and are wholly spent on the obliquus major. See the *System*, Part II. Sect. II.

The *pathetici*, are the smallest nerves of the brain; and have their name *pathetic*, from their serving to move the eyes in the various passions: and they are by some also called *amatorii*, from the great use made thereof by lovers in ogling, &c. See the *System*, Part VI. Sect. VI.

PATRIARCH, *patriarcha*, formed of *patrias*, family, and *archon*, chief, one of those first fathers who lived towards the beginning of the world, and who became famous by a long line of descendants. Abraham, Isaac, and Jacob, and his twelve sons, are the *patriarchs* of the Old Testament. Seth, Enoch, &c. were antediluvian *patriarchs*. Long life and number of children were the blessings of the *patriarchs*. The *patriarchal* government consisted of the fathers of families, and their first-born after them, exercising all kinds of ecclesiastical and civil authority, in their respective households: and to this government, which continued till the time of the Israelites dwelling in Egypt, some have ascribed an absolute and despotic power, extending even to the punishment by death. In proof of this, they alledge the curse pronounced by Noah upon Canaan. Gen. ix. 25. but it is replied that in this affair Noah seems to have acted rather as a prophet than a *patriarch*. Another instance of supposed despotic power is Abraham's turning Hagar and Ishmael out of his family, Gen. xxi. 9. &c. but this furnishes no evidence of any singular authority vested in the *patriarchs* as such, and peculiar to those ages. The third instance alledged to the same purpose is that of Jacob's denouncing a curse upon Simeon and Levi, Gen. xlix. 7, which is maintained by others to be an instance of prophetic inspiration more than of *patriarchal* authority. The fourth instance is that of Judah with regard to Tamar, Gen. xxxvii. 24. with regard to which it is observed, that Jacob the father of Judah, was still living; that Tamar was not one of his own family; and that she had been guilty of adultery, the punishment of which was death, by burning, and that Judah on this occasion might speak only as a prosecutor. Jennings's Jewish Antiq. vol. 1. p. 1. &c.

On the whole, however, it is difficult to say which of these opinions are most agreeable to truth. Men who believe the origin of civil government, and the obligation to obedience, to arise from a supposed original contract, either real or implied, will be naturally led to weaken the authority of the *patriarchs*: and those again who esteem government to be a divine institution, will be as apt to raise that authority to the highest pitch that either reason or scripture will permit them. It cannot be denied, that authority existed in fathers, and descended to their first-born, in the first ages of the world; and it is neither unnatural nor improbable to imagine, that the idea of hereditary power and hereditary honours was first taken from this circumstance. But whether authority has descended through father and son in this way to our times, is a circumstance that cannot in one instance be asserted, and can be denied in a thousand. The real source of the dignity and of the authority of modern times seems to have been, skill in the art of war, and success in the conduct of conquests.

PATRIMONY, *patrimonium*, a right or estate, which a person inherits from his ancestors. The name *patrimony* was also given to the effects or revenues, wherewith a church or religious house was endowed. In which sense, authors still say, the *patrimony* of the church of Rimini, of Milan, &c.

The church of Rome, in the time of the fall of the Roman empire, acquired considerable territories, partly by purchase, and partly by the generosity of princes, &c. not only in Italy, but also in Sicily and other remoter parts of Europe. These were called the *patrimony of St. Peter*, which were afterwards augmented by the benefactions of Pepin, king of France, who added the exarchate of Ravenna: and by Charlemagne, who gave to the pope

several towns and provinces, which belong at this time to the estate of the church, over which the pontiff exercises sovereign authority. To make what belonged to the churches the more respected, they usually gave their patrimonies the names of the saints they held in the highest veneration. Thus the church of Ravenna called its inheritance the *patrimony of St. Apollinaris*; that of Milan the *patrimony of St. Ambrose*.

PATRIOTISM, a love of one's country, which is one of the noblest passions that can warm and animate the human breast. It includes all the limited and particular affections to our parents, children, friends, neighbours, fellow-citizens, and countrymen. It ought to direct and limit their more confined and partial actions within their proper and natural bounds, and never let them encroach on those sacred and first regards we owe to the great public to which we belong. Were we solitary creatures, detached from the rest of mankind, and without any capacity of comprehending a public interest, or without affections leading us to desire and pursue it, it would not be our duty to mind it, nor criminal to neglect it. But as we are parts of the public system, and are not only capable of taking in large views of its interests, but by the strongest affections connected with it, and prompted to take a share of its concerns, we are under the most sacred ties to prosecute its security and welfare with the utmost ardour, especially in times of public trial. Rome, Athens, and Lacedæmon, owed their existence and glory to *patriotism*, founded on noble principles, and supported by distinguishing virtues. But the most perfect *patriotism* is that which comprehends the rights of mankind in general. The author of the Spirit of Laws seems to have been actuated by sentiments of universal *patriotism*.

PATRONAGE, or **ADVOWSON**, a sort of incorporeal hereditament, consisting in the right of presentation to a church or ecclesiastical benefice. See the Article **ADVOWSON**.

PAVO, the **PEACOCK**, in ornithology; a genus belonging to the order of gallinæ. The head is covered with feathers which bend backwards; the feathers of the tail are very long, and beautifully variegated with eyes of different colours. There are three species.

1. The *cristatus*, or common peacock of English authors, has a compressed crest and solitary spurs. It is a native of India; and we are assured, that they are still found in a wild state in the islands of Ceylon and Java. So beautiful a bird could not long be permitted to be a stranger in the more distant parts: for so early as the days of Solomon, we find, among the articles imported in his Tarshish navies, apes and peacocks. A monarch so conversant in all branches of natural history, "who spoke of trees, from the cedar of Lebanon, even unto the hyssop that springeth out of the wall; who spoke also of beasts and of fowls," would certainly not neglect furnishing his officers with instructions for collecting every curiosity in the countries they voyaged to, which gave him a knowledge that distinguished him from all the princes of his time. Ælian relates, that they were brought into Greece from some barbarous country; and were held in such high esteem, that a male and female were valued at Athens at 1000 drachmæ, or 32l. 5s. 10d. Their next step might be to Samos; where they were preserved about the temple of Juno, being the birds sacred to the goddess: and Gellius, in his *Noctes Atticæ*, c. 16. commends the excellency of the Samian peacocks. It is therefore probable, that they were brought here originally for the purpose of superstition, and afterwards cultivated for the uses of luxury. We are also told, when Alexander was in India, he found vast numbers of wild ones on the banks of the Hyarotis; and was so struck with their beauty, as to appoint a severe punishment on any person that killed them. For representation, see Plate III. Genus 47.

Peacock's crests, in ancient times, were among the ornaments of the kings of England. Ernald de Aclent was fined to king John in 140 palfries, with sack-buts, lorains, gilt spurs, and peacock's crests, such as would be for his credit.

2. The *bicalcaratas* has a small crest and double spurs. It is a native of China.

3. The *muticus* has a sharp-pointed crest, and no spurs; the orbits of the eyes are red.

PAVO, *Peacock*, in astronomy, a constellation of the southern hemisphere, unknown to the ancients, and not visible in our northern parts of the world, containing fourteen stars; see the *SYSTEM*, Sect. VIII.

PEACE, in our law books, &c. is restrained to a quiet and inoffensive carriage towards the king, and his people. Lamb. Eirenarch. Where any man stands in danger of harm from another, and makes oath thereof before a justice of the peace, he must be secured by good bond, which is called *binding to the peace*. Any justice of the peace may, *ex officio*, bind all those to keep the peace, who, in his presence, make any affray; or threaten to kill or beat another, or contend together with hot and angry words: or go about with unusual weapons or attendance; to the terror of the people: and all such as he knows to be common barretors; and such as are brought before him by the constable for a breach of the *peace* in his presence, and all such persons, as, having been before bound to the *peace*, have broken it and forfeited their recognizances. Also wherever any private man hath just cause to fear that another will burn his house, or do him a corporal injury, by killing, imprisoning,

P E A

ing, or beating him; or that he will procure others so to do; he may demand surety of the *peace* against such person; and every justice of the peace is bound to grant it, if he who demands it will make oath, that he is actually under fear of death or bodily harm; and will shew that he has just cause to be so, by reason of the other's menaces, attempts, or having lain in wait for him; and will also farther swear that he does not require such surety out of malice or mere vexation. This is called *swearing the peace* against another; and if the party does not find sureties, as the justice in his discretion shall require, he may immediately be committed till he does. A recognizance for keeping the *peace*, when given, may be forfeited by any actual violence, or even an assault, or menace to the person of him who demanded it, if it be a special recognizance; or, if the recognizance be general, by any unlawful action whatsoever, that either is, or tends to, a breach of the *peace*. Blackst. Com. b. iv. p. 251, &c.

PEACH-Tree, in botany, the English name of the genus *amygdalus*. For description of the genus and several species, see *AMYGDALUS*.

PEACOCK, in ornithology, the English name of the genus *pavo*. For description of the genus, see *PAVO*, &c.

PEAR-Tree, in botany, the English name of the genus *Pyrus*. For description of the genus, &c. see *PYRUS*.

PEARCH, or **PERCH**, in ichthyology, the English name of the genus *Perca*. For the description of the genus, &c. see *PERCA*. For the method of angling for perch, and the baits, seasons, &c. see the Article *ANGLING*.

PEARL, in natural history, a hard, white, shining body, usually roundish, found in a testaceous fish resembling an oyster. Pearls, though esteemed of the number of gems by our jewellers, and highly valued, not only at this time, but in all ages, proceed only from a distemper in the creature that produces them, analogous to the bezoars, and other stony concretions in several animals of other kinds.

M. Reaumur has a very curious piece on the subject of the formation both of the shells and pearls, in the Memoirs of the French Academy, anno 1717. He observes, that pearls are formed like other stones in the animals; as those, e. gr. in the bladder, kidneys, &c. and that they are apparently the effects of a disease of the fish. In effect, they are all formed of a juice extravasated out of some broken vessels, and detained, and fixed, among the membranes. To evince the possibility of this, he shews that the shells of sea-fish, as well as those of snails, &c. are wholly formed of a glutinous stony matter, issuing out of the body of the animal. Now it is no wonder that an animal, which has vessels wherein circulates a sufficient quantity of stony juice to build, thicken, and extend a shell, should have enough to form stones also, in case the juice, destined for the growth of the shell, shall chance to overflow, and burst forth in any cavity of the body, or among the membranes. The vessels which conveyed that juice being broken, there is formed a little mass or collection of the juice, which, hardening, becomes a pearl of the same colour with the part of the shell to which it corresponds. These circumstances seem effectually to determine the formation of pearls, and to establish the new system beyond contradiction.

The fish in which these are usually produced is the East-Indian pearl-oyster, as it is commonly called. Besides this shell, there are many others that are found to produce pearls; as the common oyster, the muscle, and several others; the pearls of which are often very good; but those of the true Indian berberi, or pearl-oyster, are in general superior to all. The small or the seed-pearls, also called *ounce-pearls*, from their being sold by the ounce and not by tale, are vastly the most numerous and common: but, as in diamonds, among the multitudes of small ones, there are smaller numbers and larger found, so in pearls there are larger and larger kinds; but as they increase in size, they are proportionably less frequent; this is one reason of their great price. We have Scotch pearls frequently as big as a little tare, some as big as a large pea, and some few the size of a horse-bean; but these are usually of a bad shape, and of little value in proportion to their weight. Philip II. of Spain had a pearl perfect in its shape and colour, and of the size of a pigeon's egg. The finest, and what is called the true shape of the pearl, is a perfect round; but if pearls of a considerable size are the shape of a pear, as is not unfrequently the case, they are not less valued, as they serve for ear-rings and other ornaments. All pearls are formed of the matter of the shell, and consist of a number of coats spread with perfect regularity, one over another, in the manner of the several coats of an onion, or like the several strata of the stones, found in the bladders or stomachs of animals, only much thinner.

Manner of fishing for pearls, in the East Indies. There are two seasons of pearl fishing in the year; the first in March and April, the second in August and September. The more rain there falls in the year, the more plentiful are the fisheries. In the opening of the season, there appears sometimes two hundred and fifty barks on the banks; in the larger barks are two divers; in the smaller, one. Each bark puts off from shore before sun-rise, by a land breeze, which never fails; and returns again by a sea breeze, which succeeds it about noon. As soon as the barks are arrived at the place where the fish lie, and have cast anchor, each diver binds a

P E A

stone six inches thick, and a foot long under his body; which is to serve him as ballast, and prevent its being driven away by the motion of the water, and to enable him to walk more steady among the waves. Besides this, they tie another very heavy stone to one foot, whereby they are soon sunk to the bottom of the sea; and as the oysters are usually strongly fastened to the rocks, they arm their fingers with leather mittens, to prevent their being wounded in scraping them violently off; and some even carry an iron rake for the purpose. Lastly, each diver carries down with him a large net, in manner of a sack, tied to his neck by a long cord, the other end whereof is fastened to the side of the bark. The sack is intended for the reception of the oysters gathered from the rock, and the cord is to pull up the diver, when his bag is full, or when he wants air. In this equipage he precipitates himself, sometimes above sixty feet under water. As he has no time to lose there, he is no sooner arrived at the bottom than he begins to run from side to side, sometimes on sand, sometimes on a clayey earth, and sometimes among the points of rocks; tearing off the oysters he meets with, and cramming them into his budget. At whatever depth the divers be, the light is so great that they easily see whatever passes in the sea, with great clearness. And to their consternation, they sometimes see monstrous fishes, from which all their address in mudding the water, &c. will not always save them; but they become their prey.

The best divers will keep under water near a quarter of an hour; during which time, they hold their breath without the use of oils, or any other liquors; only acquiring the habit by long practice. When they find themselves straightened, they pull the rope to which the bag is fastened, and hold fast by it with both hands; when the people in the bark, taking the signal, heave them up into the air, and unload them of their fish, which is sometimes five hundred oysters, sometimes not above fifty. Some of the divers need a moment's respite to recover breath; others jump in again instantly, continuing this violent exercise, without intermission, for many hours. On the shore they unload their barks, and lay their oysters in an infinite number of little pits, dug four or five feet square, in the sand; raising heaps of sand over them to the height of a man, which at a distance, look like an army ranged in battle. In this condition they are left, till the rain, wind, and sun, have obliged them to open, which soon kills them. Upon this the flesh rots and dries, and the pearls, thus disengaged, tumble into the pit upon taking the oysters out. After clearing the pits of the grosser filth, they sift the sand several times, to separate the pearls. But what care soever they take herein, they always lose a great many. After cleaning and drying the pearls, they are passed through a kind of sieve according to their sizes. The smallest are sold as seed pearls; the rest are put up to auction, and sold to the highest bidder.

Manner of fishing for pearls in the West-Indies. The season for fishing there is usually from October to March. In this time there set out from Cartagena ten or twelve barks, under the convoy of a man of war called l'Armada. Each bark has two or three slaves for divers. Among the barks there is one called Capitana; to which all the rest are obliged to bring at night what they have caught in the day, to prevent frauds. The divers never live long, by reason of the great hardships they sustain; continuing sometimes under water above a quarter of an hour. The method is the same as in the East India fisheries. The Indians esteemed pearls before the discovery of America; and when the Spaniards arrived there, they found great quantities stored up, which the Americans set great value on. But they were almost all imperfect, and their water yellow and smoaky, because they used fire in opening the fishes.

The Manner of fishing for pearls in Panama in South America. The pearl fishery is carried on in the islands of the gulph of Panama. The greatest parts of the inhabitants employ such of their negroes in it as are good swimmers. These slaves plunge and replunge in the sea in search of pearls, till this exercise has exhausted their strength or their spirits.

Every negro is obliged to deliver a certain number of oysters. Those in which there are no pearls, or in which the pearl is not entirely formed, are not reckoned. What he is able to find beyond the stipulated obligation, is considered as his indisputable property; he may sell it to whom he pleases; but commonly he cedes it to his master at a moderate price.

Sea monsters, which abound more about the islands where pearls are found than on the neighbouring coasts, render this fishing dangerous. Some of these devour the divers in an instant. The manta fish, which derives its name from its figure, surrounds them, rolls them under its body, and suffocates them. In order to defend themselves against such enemies, every diver is armed with a poniard: the moment he perceives any of these voracious fish, he attacks them with precaution, wounds them, and drives them away. Notwithstanding this, there are always some fishermen destroyed, and a great number crippled.

The pearls of Panama are commonly of a very fine water. Some of them are even remarkable for their size and figure: these were formerly sold in Europe. Since art has imitated them, and the passion for diamonds has entirely superseded or prodigiously diminished the use of them, they have found a new mart more advantageous than the first. They are carried to Peru, where they are in great estimation.

This branch of trade has, however, infinitely less contributed to give reputation to Panama, than the advantage which it hath long enjoyed of being the mart of all the productions of the country of the Incas that are destined for the old world. These riches, which are brought hither by a small fleet, were carried, some on mules, others by the river Chagre, to Porto Bello, that is situated on the northern coast of the isthmus, which separates the two seas.

PEASANT, a hind, one whose business is in rural labour. It is amongst this order of men that a philosopher would look for innocent and ingenuous manners. The situation of the peasantry is such, as secludes them from the devastations of luxury and licentiousness; for when the contagion has once reached the recesses of rural retirement, and corrupted the minds of habitual innocence, that nation has reached the summit of vice, and is hastening to that decay which has always been the effect of vicious indulgence. The peasantry of this country still, in a great measure, retain that simplicity of manners, and rustic innocence, which ought to be the characteristic of this order of society; and in many parts, their condition is such as, were all its advantages sufficiently known, would create envy in the minds of those who have toiled through life amidst the bustle of the world, in quest of that happiness which it could not confer,

O fortunatos nimium, sua si bona norint,

Agricolae.

Virgil.

In other countries the peasants do not enjoy the same liberty as they do in our own, and are consequently not so happy. In all feudal governments they are abject slaves, entirely at the disposal of some petty despot. This was the case in Poland, where the native peasants were subject to the most horrid slavery, though those descended of the Germans, who settled in Poland during the reign of Boleslaus the Chaste and Cassimir the Great, enjoyed very distinguished privileges. Amongst the native slaves, too, those of the crown were in a better condition than those of individuals.

PEAT, a well known inflammable substance, used in many parts of the world as fuel. There are two species:

1. A yellowish-brown or black peat, found in moorish grounds in Scotland, Holland, and Germany. When fresh, it is of a viscid consistence, but hardens by exposure to the air. It consists, according to Kirwan, of clay mixed with calcareous earth and pyrites; sometimes also it contains common salt. While soft it is formed into oblong pieces for fuel, after the pyritaceous and stony matters are separated. By distillation it yields water, acid, oil, and volatile alkali; the ashes containing a small proportion of fixed alkali; and being either white or red, according to the proportion of pyrites contained in the substance.

2. The second species is found near Newbury in Berkshire. In the Philosophical Transactions for the year 1757, we have an account of this species; the substance of which is as follows:

Peat is a composition of the branches, twigs, leaves, and roots of trees, with grass, straw, plants, and weeds, which having lain long in water, is formed into a mass so soft as to be cut with a sharp spade. The colour is a blackish brown, and it is used in many places for firing. There is a stratum of this peat on each side of the Kennet, near Newbury in Berks, which is from about a quarter to half a mile wide, and many miles long. The depth below the surface of the ground is from one foot to eight. Great numbers of entire trees are found lying irregularly in the true peat. They are chiefly oaks, alders, willows, and firs, and appear to have been torn up by the roots: many horses heads, and bones of several kinds of deer; the horns of the antelope, the heads and tusks of boars, and the heads of beavers, are also found in it. Not many years ago an urn, of a light brown colour, large enough to hold about a gallon, was found in the peat-pit in Speen moor, near Newbury, at about 10 feet from the river, and four feet below the level of the neighbouring ground. Just over the spot where the urn was found, an artificial hill was raised about eight feet high; and as this hill consisted both of peat and earth, it is evident that the peat was older than the urn. From the side of the river several semicircular ridges are drawn round the hill, with trenches between them. The urn was broken to shivers by the peat-diggers who found it, so that it could not be critically examined; nor can it be known whether any thing was contained in it.

Peat ashes, properly burnt for a manure, are noble improvers both of corn and grass land: but the substance from which they should be got is an under stratum of the peat, where the fibres and roots of the earth, &c. are well decayed. Indeed the very best are procured from the lowest stratum of all. This will yield a large quantity of very strong ashes, in colour (when first burnt) like vermilion, and in taste very salt and pungent. Great care and caution should be used in burning these ashes, and also in preserving them afterwards. The method of burning them is much the same as burning charcoal. The peat must be collected into a large heap, and covered so as not to flame out, but suffered to consume slowly, till the whole substance is burnt to an ash. The ashes thus burnt are held in most esteem; but the peat ashes burnt in common firing are in many places used for the same purposes, and sold at the same price.

Peat ashes are found excellent in sweetening four meadow

No. 125.

land, destroying rushes, and other bad kinds of grass, and in their stead producing great quantities of natural grass. They burn great quantities of peat-ashes in some parts of Berkshire and Lancashire, and esteem them one of the best dressings for their spring crops.

PEBBLES, *calculi*, in natural history, the name of a genus of fossils, distinguished from the flints and homochroa, by their having a variety of colours. These are defined to be stones, composed of a chrySTALLINE matter, debased by earths of various kinds in the same species, and then subject to veins, clouds, and other variegations. usually formed by incrustations around a central nucleus, but sometimes the effect of a simple concretion, and veined like the agates, by the disposition which the motion of the fluid they were formed in gave their differently coloured substances.

PECCANT, in medicine, an epithet given to the humours of the body, when they offend either in quantity or quality, i. e. when they are either morbid, or in too great abundance. Most diseases arise from peccant humours, which are either to be corrected by alteratives and specifics, or else to be evacuated.

PECORA, the fifth order of the class of *Mammalia*. For description of several Genera, see them as they occur in the order of the Alphabet. For representation of the most remarkable species of each Genus, see Plate IX. Order 5.

PECTORAL Medicines, or simply PECTORALS, are remedies proper to strengthen and relieve the breast, or medicines intended against diseases of the breast or lungs. Their ordinary intention is either to attenuate, or to thicken the humours of those parts, which cause coughing, &c. and render them fit to be expectorated or spit out.

PEDANT, a schoolmaster, or pedagogue, who professes to instruct and govern youth, and teach them the humanities and the arts.

PEDANT is also used for a rough unpolished man of letters, who makes an impertinent use of the sciences, and abounds in unseasonable criticisms and observations. Dacier defines a pedant, a person who has more reading than good sense. Pedants are people ever armed with quibbles and syllogisms; they breathe nothing but disputation and chicanery, and pursue a proposition to the last limits of logic. Malebranche describes a pedant, as a man full of false erudition, who makes a parade of his knowledge, and is ever quoting some Greek or Latin author, or hunting back to a remote etymology. St. Evremont says, that to paint the folly of a pedant, we must represent him as turning all conversation to some one science or subject which he is best acquainted with. There are pedants of all conditions, and of all robes. Wicquefort says, an ambassador, always attentive to formalities and decorums, is nothing else but a political pedant.

PEDANTRY, or PEDANTISM, the quality or manner of a pedant. To swell up little and low things, to make a vain show of science, to heap up Greek and Latin without judgment; to tear those to pieces who differ from us, about a passage in Suetonius, or the etymology of a word, to stir up all the world against a man for not admiring Cicero enough, to be interested for the reputation of an ancient as if he were our next of kin, form what we properly call pedantry.

PEDILUVIUM, or BATHING of the FEET. The uses of warm bathing in general, and of the pediluvium in particular, are so little understood, that they are often preposterously used, and sometimes as injudiciously abstained from.

In the Edinburgh Medical Essays, we find an ingenious author's opinion of the warm pediluvium, notwithstanding that of Borelli, Boerhaave, and Hoffman to the contrary, to be, That the legs becoming warmer than before, the blood in them is warmed: this blood rarifying, distends the vessels; and, in circulating, imparts a great degree of warmth to the rest of the mass; and as there is a portion of it constantly passing through the legs, and acquiring new heat there, which heat is in the course of circulation communicated to the rest of the blood, the whole mass rarifying, occupies a larger space, and of consequence circulates with greater force. The volume of the blood being thus increased, every vessel is distended, and every part of the body feels the effects of it; the distant parts a little later than those first heated. The benefit obtained by a warm pediluvium is generally attributed to its making a derivation into the parts immersed, and a revulsion from those affected, because they are relieved; but the cure is performed by the direct contrary method of operating, viz. by a greater force of circulation through the parts affected, removing what was stagnant or moving too sluggishly there. Warm bathing is of no service where there is an irresoluble obstruction, though, by its taking off from a spasm in general, it may seem to give a moment's ease; nor does it draw from the distant parts, but often hinders by pushing against matter that will not yield with a stronger impetus of circulation than the stretched and diseased vessels can bear: so that where there is any suspicion of scirrhus, warm bathing of any sort should never be used. On the other hand, where obstructions are not of long standing, the impacted matter is not obstinate, warm baths may be of great use to resolve them quickly. In recent colds with slight humoral peripneumonies, they are frequently an immediate cure. This they effect by increasing the force of the circulation, opening the skin, and driving freely through the lungs that lentor which stagnated or moved slowly in them. As thus conducting

to the resolution of obstructions, they may be considered as short and safe fevers; and in using them we imitate nature, which by a fever often carries off an obstructing cause of a chronic ailment. Borelli, Boerhaave, and Hoffman, are all of opinion, that the warm pediluvium acts by driving a larger quantity of blood into the parts immersed. But arguments must give way to facts: the experiments related in the Medical Essays seem to prove, to a demonstration, that the warm pediluvium acts by rarifying the blood.

A warm pediluvium, when rightly tempered, may be used as a safe cordial, by which circulation can be roused, or a gentle fever raised; with this advantage over the cordials and sudorifics, that the effect of them may be taken off at pleasure.

Pediluvia are sometimes used in the small-pox; but Dr. Stevenson thinks their frequent tumultuous operations render that suspected, and at best of very doubtful effect: and he therefore prefers Monf. Martin of Laufanne's method of bathing the skin, not only of the legs, but of the whole body, with a soft cloth dipped in warm water every four hours, till the eruption: by which means the pustules may become universally higher, and consequently more safe.

PEDLAR, a travelling foot-trader. See HAWKER. Among the British and French the pedlars are despised, but it is otherwise in certain countries. In Spanish America, the business is so profitable, that it is thought by no means dishonourable; and there are many gentlemen in Old Spain, who, when their circumstances are declining, send their sons to the Indies to retrieve their fortunes in this way. Almost all the commodities of Europe are distributed through the southern continent of America by means of these pedlars.

PEDICLE, *pediculus*, in botany, *foot-stalk*: that little stalk whereby the leaf, fruit, or flower is sustained, and connected by its branch or stem. Flowers will keep fresh a long time after gathering, by immersing their pedicles in water. The great secret of preserving fruits for the winter is to seal up their pedicles with wax. Cherries with the shortest pedicle are esteemed the best. The pistil of the flower sometimes becomes the pedicle of the fruit. See the SYSTEM, Sect. II.

PEDICULUS, the LOUSE, in entomology, a Genus of insects belonging to the order of Aptera. It has six feet, two eyes, and a sort of sting by the mouth; the feelers are as long as the thorax; and the belly is depressed and sublobated. In order to know the true history and manner of breeding of these creatures, Mr. Leewenhoeck put two female lice into a black stocking, which he wore night and day. He found, on examination, that in six days one of them had laid above 50 eggs; and, upon dissecting it, he found as many yet remaining in the ovary: whence he concludes, that in twelve days it would have laid 100 eggs. These eggs naturally hatch in six days, and would then probably have produced 50 males, and as many females: and these females coming to their full growth in 18 days, might each of them be supposed after 12 days more, to lay 100 eggs; which eggs, in six days more, might produce a brood of 5000; so that in eight weeks, one louse may see 5000 of its own descendants. Signior Rhedi, who has more attentively observed these animals than any other author, has given several engravings of the different species of lice found on different animals. Men, he observes, are subject to two kinds; the common louse, and the crab-louse. He observes, also, that the size of the lice is not at all proportioned to that of the animal which they infest; since the starling has them as large as the swan. For further description, see Microscopic Objects; for representation in the natural size, and as it appears when magnified, see Plate II. Fig. 3. For a copious description of this insect. See the Article LOUSE.

PEDUNCLE, among botanists, expresses that little stalk which grows from the trunk or branches of a plant, and supports the parts of fructification, the flower and the fruit, or either.—See the SYSTEM, Sect. II.

PEER, in general, signifies an equal, or one of the same rank and station: hence in the acts of some councils, we find these words, *with the consent of our peers, bishops, abbots, &c.* Afterwards the same term was applied to the vassals or tenants of the same lord, who were called peers, because they were all equal in condition, and obliged to serve and attend him in his courts; and peers in *fiefs*, because they all held fiefs of the same lord. The term peer is now applied to those who are impanelled in an inquest upon a person for convicting or acquitting him of an offence laid to his charge; and the reason why the jury is so called, is because, by the common law and the custom of this kingdom, every person is to be tried by his peers or equals; a lord by the lords, and a commoner by commoners. See the Article JURY.

PEER of the Realm, a noble lord who has a seat and vote in the House of Lords, which is also called the *House of Peers*. See NOBILITY. The right of peerage seems to have been originally territorial; that is, annexed to lands, honours, castles, manors, and the like; the proprietors and possessors of which were (in right of those estates) allowed to be peers of the realm, and were summoned to parliament to do suit and service to the king; and when the land was alienated, the dignity passed with it as an ap-

pendant. Thus, the bishops sit in the house of lords, in right of succession to certain ancient baronies annexed, or supposed to be annexed, to their episcopal lands: and though they are lords of parliament, they are not properly of the degree of nobility, their blood is not ennobled, nor their peerage hereditary: and, therefore, they are tried not by peers, but by a common jury: and when one of the nobility is tried by his peers in parliament, the spiritual lords must withdraw and make their proxies.

But afterwards, when alienations became frequent, the dignity of peerage was confined to the lineage of the party ennobled, and instead of territorial, became personal. Peers are now created by writ or patent. The creation by writ, or the king's letter, is a summons to attend the house of peers, by the style or title of that barony which the king is pleased to confer; that by patent is a royal grant to a subject of any dignity or degree of peerage. The creation by writ is more ancient, but a man is not ennobled thereby, unless he takes his seat in the house of lords: and, therefore, the most usual, because the surest way, is to grant the dignity by patent, which insures to a man and his heirs, according to the limitations thereof, though he never makes use of it. Creation by writ, however, has one advantage over that by patent; for a person created by writ holds the dignity to him and his heirs, without any words to that purport in the writ: but in letters patent, there must be words to direct the inheritance; or else the dignity endures only to the grantee for life. A peer cannot lose his nobility but by death or attainder, and though some have said, that if a baron waste his estate, so that he is not able to support the degree, the king may degrade him; yet it is expressly held by later authorities, that a peer cannot be degraded but by act of parliament.

Peers of the realm are by their birth hereditary counsellors of the crown, and may be called together by the king to impart their advice, in all matters of importance to the realm, either in time of parliament, or when there is no parliament in being; and it is usually considered as the right of each particular peer of the realm to demand an audience of the king, and to lay before him, with decency and respect, such matters as he shall judge of importance to the public weal. The claims of peerage may be hereafter easily settled, since, by a standing order of the house of lords, May, 1767, the heralds are directed to take exact accounts, and preserve regular entries of all peers and peeresses of England, and their respective descendants; and it is required that an exact pedigree of each peer and his family, shall, on the day of his first admission, be delivered to the house, by Garter, the principal king at arms. As to the privileges of peers, see NOBILITY and PARLIAMENT.

The house of lords have a right to take cognizances originally of all public accounts, and to enquire into any misapplication, or default in the distribution of public monies; or of any other mismanagement whatsoever. Towards the latter end of the reign of king Charles the First, the house of lords asserted their jurisdiction of hearing appeals from the chancery, which they do upon a paper petition, without any writ directed from the king; and for this their foundation is, that they are the great court of the king, and that therefore the chancery is derived out of it, and by consequence that a petition will bring the cause and record before them. This was much controverted by the commons, in the reign of Charles the Second, but is now pretty well submitted to, because it has been thought too much, that the chancellor should bind the whole property of the kingdom without appeal.

As we have noblemen of several ranks, so we may have noble women, or Peeresses, and these may be by creation, descent, or marriage; and first king Henry VIII. made Ann Bullen, marchioness of Pembroke: king James I. created the lady Compton, wife to Sir Thomas Compton, countess of Buckingham, in the life-time of her husband, without any addition of honour to him; and also the same king made the lady Finch viscountess of Maidstone, and afterwards countess of Winchelsea, to her and the heirs of her body: and king George I. made the lady Schulemberg duchess of Kendal. A woman noble by creation or descent, marrying one under the degree of nobility, still remaineth noble, but if she be noble by marriage only, she loseth her dignity if she marry afterwards a commoner; though not if the second husband is noble, and inferior in dignity to the first husband; and by the courtesy of England, women noble by marriage always retain their nobility. A countess or baroness may not be arrested for debt or trespass; for though in respect of their sex they cannot sit in parliament, they are nevertheless peers of the realm, and shall be tried by their peers, &c.

PEERAGE, the dignity of a *peer*, attached to a duchy, earldom, barony, or the like. The king of England confers peerage at pleasure. King George the First offered his parliament to resign that branch of his prerogative, and to have the number of peers limited. The reason insisted, was the inconvenience accruing to the state from an arbitrary and immoderate use thereof; the prince having it in his power to throw what number of his creatures he pleases into the upper house of parliament. The twelve peers, created at once in a late reign, was a main argument in behalf of the peerage bill. It is recorded, as a saying of king Charles, that if his friends could but secure him a house of commons, he would put his whole troop of guards into the upper house, but he would have the peers.

SYSTEM OF PEERAGE.

THE PROGRESS AND INCREASE OF BARONIAL HONOURS IN ENGLAND.

THE origin of Nobility in Europe is by some referred to the Goths; who, after they had seized on a part of Europe, rewarded their Captains with Titles of Honour, to distinguish them from the common people. That the Barons of England were powerful before the Conquest, is clear from Harold Earl of Kent being able to seize the crown, upon the death of Edward the Confessor; but their greatest power arose from WILLIAM the Conqueror, who, not considering the trouble they might give his descendants, gave English manors in a very profuse manner to his followers, with extensive powers; to Hugh Lupus, his nephew, in 1070, he gave the title and Earldom of Chester, to hold as he held the crown (by the sword) to enable him to keep the Welch in awe. He was the first hereditary Earl, and exercised sovereign authority over it 40 years, and during that time created 8 Barons. The whole county of Durham, with the title of Earl of Northumberland, he gave to Walcher, the Bishop, in 1076; one of whose successors was hardy enough to take up arms against Richard I. by whom he was defeated and taken prisoner; and upon the Pope's demanding his enlargement, as a son of the Church, the King sent the Bishop's armour (upon which he wrote, "See if this be thy Son's Coat") to Rome, which silenced his Holiness.

Notwithstanding William gave them such power, he admitted upwards of twenty to the dignity of Earl, (Earles, or Earldermen, and sometimes Aldermen, and other names) which title was known among the Saxons, and even the Romans; but they were officary, and their offices not hereditary, till the Norman Conquest: Earldoms then began to be feudal, hereditary, and patrimonial. At first they descended to heirs general, but from the time of Edward I. they have usually been limited to heirs-male. Those who were then made Earls were frequently of the Blood-royal; for which reason our monarchs call them in all public writings, *Our most dear Cousin*. This was the greatest dignity in England for above 300 years, till Edward III. created his son Duke of Cornwall.

WILLIAM RUFUS conferred the dignity of Earl but on four families.

HENRY I. only five.

Indeed STEPHEN's situation obliged him to indulge his adherent's, on fifteen of whom he bestowed the title; and MAUD, his opponent, advanced three others, amongst whom was the Earl of Hereford in 1141, being the first created by Patent; the general rule being by writ of summons.

HENRY II. added nine Peers during his reign, among whom was Malcolm King of Scotland, created Earl of Huntingdon 1154; and Ranulph de Blundeville, Duke of Bretagne, created Earl of Richmond 1187.

RICHARD I. made only six Peers, among whom was Otho, Duke of Saxony, created Earl of York, June 24, 1190. He was the first King of England, who carried in his shield *Three Lions passant*, and in his reign coats of arms came to be hereditary in families, they owing their origin to the Croisades. After gaining a complete victory over the French at Gylfors in 1193, he took the motto, *Dieu & Mon Droit*.

JOHN created eight Peers, among whom was Guy de Thouars, Duke of Bretagne, created Earl of Richmond 1216. He granted the privilege to the Baron of Kinsale, of being covered in the presence of his Sovereign.

The long reign of Henry III. produced eight Barons and fourteen fresh created Earls; among whom was Richard Plantagenet, the King's brother, esteemed the richest subject in Europe, and on that account elected King of the Romans, who had no higher title than that of Earl of Cornwall. The great Edmund Plantagenet, a prince of the blood (who had 2000 men in his retinue) was only Earl of Lancaster.

Before the 49th of Henry III. (1265.) the ancient Parliaments consisted of the Archbishops, Bishops, Abbots, Earls, and Barons; which last title Edward the Confessor introduced out of Normandy; from which time the title of Thane (signifying the same degree of persons) began to grow out of use. The title of Baron was by no means so honourable at first, as it has become since; the citizens of London, and other places, having anciently been styled Barons; but it was the most general and universal title of Nobility; for originally every one of the Peers of superior rank had also a barony annexed to his own titles. But it hath sometimes happened, that when an ancient Baron hath been raised to a new degree of Peerage, in the course of a few generations the two titles have descended differently; one perhaps to the male descendants, the other to the heirs-general; whereby the earldom, or other superior title, hath subsisted without a barony: and there are many modern instances, where Earls and Viscounts have been created, without annexing a barony to their own honours: so that the rule doth not hold universally, that all Peers are Barons.

In the Conqueror's time, according to Dugdale, "he who had not 40 hides of land, or 3840 acres, was not reputed a Baron." Yet Camden, speaking of the same time, says, "they were accounted Barons who held their lands by an entire Barony, which is 13 Knights fees and a third," supposed to have been equal to 4 or 5000 pounds *per ann.* present money. It is possible, the former may speak of the qualification of the Lesser Barons, who held of the

Greater Barons, by military service, in capite; and the latter of the Greater Barons, or kings chief tenants, who held of him in capite by barony. All the King's Barons, or free Tenants, who had jurisdiction over their homagers, were anciently entitled to sit in the Great Council, or Parliament. The Lesser Barons being very numerous, and the Greater Barons very powerful, both by their attendants and their own number, in a parliament at Oxford in 1258, overawed Henry III. into concessions, which in a great measure stripped him of his power; and a few years afterwards, in 1265, they defeated him and his son at Lewes, where he was made prisoner by the Barons, headed by Simon de Montfort, Earl of Leicester. The victors themselves being now afraid of the consequence of such another tumultuous meeting, instead of keeping to the old form, summoned not all, but only those of the Greater Barons, who were of their party; and instead of the lesser Barons, who used also to come with large retinues, they ordered the Sheriffs in each country to cause two Knights in every Shire to be chosen; and one or two Burgesses for each Borough, to represent the body of the people residing in those counties and boroughs. The king, recovering his liberty, not only followed their precedent, but is supposed to have gone farther; and to be the first who sent Writs of Summons to some that were not Barons by tenure, to sit *Inter Barones*, on account of their quality or prudence. This new mode of calling some Barons to parliament, omitting others, and adding whatever the King pleased to the number, tended too much to increase the power of the crown not to be followed by Edward I. and his successors. The Barons by Tenure, were by these means effectually humbled. Their seats in Parliament were become a matter of grace, not of right; and, from this time, properly, were no ways necessary either to the commencement or continuance of a Peerage; than which there cannot be a greater absurdity. Camden says, that Henry III. reckoned 150 Baronies in England; meaning, no doubt, Greater Baronies; but the method above-mentioned lessened the number, or rather made it uncertain.

EDWARD I. in 25 years, created one hundred and sixty-one Barons, and but three Earls. There were several in this and the following reigns that had Summons to Parliament, without actual creation. He instituted the degree of Knights Bannerets.

EDWARD II. created fifty-seven Barons, and but six Earls; three of whom were of Blood-royal. He suppressed the order of Knights Templars, in June 1308.

EDWARD III. first conferred the title of Duke, which he did in 1335, on his son EDWARD the BLACK PRINCE, who was created Duke of Cornwall; and in 1359, Edward conferred the same dignity on his cousin Henry Plantagenet, son of the great Earl of Lancaster, the father of Blanch, wife of John of Gaunt. He also, in 1362, created his son Lionel, Duke of Clarence, and John of Gaunt, Duke of Lancaster, on the death of the above Henry, his father-in-law, to whom, by right of his wife, he was heir. It should be remembered, that Edward III. 1328, was the first of our Kings who assumed the title of King of France, dropping that of Duke of Aquitaine (as Henry III. had before quitted that of Normandy) and at the same time quartered the Fleurs-de-lis with the arms of England. So long as the title of Duke made a conspicuous part of their own style, it is no wonder that they did not attempt bestowing it upon subjects.

The title of Duke, however, was conferred very sparingly for many ages after; and seldom on any that were not somehow allied to the crown; as was Mowbray Duke of Norfolk, descended from Thomas de Brotherton, in whose right the Dukes of Norfolk now quarter the Royal Arms of England. De la Pole, Duke of Norfolk, was also allied to the crown; and Stafford, Duke of Buckingham, was descended from Humphrey, Duke of Gloucester; on which account, the late Earls of Stafford quartered the Royal Arms of England and France, within a silver border; which arms are also quartered by the Earls of Huntingdon and Leicester, as being descended from legitimate sons of the Kings of England; passing unnoticed the natural children of later Sovereigns. Charles Brandon, Duke of Suffolk, married the Queen Dowager of France, sister to Henry VIII. and Grey, Duke of Suffolk, married the only daughter by that marriage. Seymour, Duke of Somerset, was uncle to Edward VI.—Villiers, Duke of Buckingham, was the first Duke not allied to the crown, except Dudley, Duke of Northumberland, whose son, Lord Guilford, had married Lady Jane Grey, to whom Edward I. bequeathed the crown.

EDWARD III. crowned William de Montacute Earl of Salisbury, King of the Isle of Man, in October 1343; and besides the four Dukes already mentioned, he conferred the dignity of Baron on fifty-five, and of Earl on twenty-two in the course of fifty years reign. In 1330 he instituted the order of the Garter, whose number of Knights should not exceed 26, including the Sovereign. During this reign 51 received this noble order; which since has become so eminent, that there is no royal or princely family in Europe, but has, at one time or other, since its institution, thought it an honour to be admitted into the number of its companions.

RICHARD II. his grandson, bestowed, in 1397, the first title of Dukes of Norfolk on Mary Plantagenet, and that of Duke on eight. He twice conferred the titles of Marquis, first on Robert de Vere, whom he created Marquis of Dublin and Duke of Ireland (English titles) in 1385; and in 1387, first created a Baron by Pa-

P E E R A G E.

tent in John de Beauchamp, Baron Beauchamp; besides those, he created eleven Earls and eleven Barons. At his coronation, a Champion is first mentioned to have been introduced in the ceremony.

A Barony by Patent goes to the heir-male, being almost universally so limited; but a Barony by Writ, now goes to the heirs general; and, in case of more female heirs than one, it becomes in abeyance: when the king may make his option, and grant it to which of them he thinks fit.

HENRY IV. during a reign of 13 years and a half, created one Duke, five Earls, and eleven Barons, and instituted the order of the Bath in 1399.

HENRY V. who reigned 9 years and a half, created three Dukes and five Earls.

HENRY VI. whose reign extended to 38 years and a half, created eight Dukes, two Marquisses, twelve Earls, three Viscounts (the first of whom was John Beaumont, Viscount Beaumont, in 1439), and thirty-two Barons.

EDWARD IV. in a troublesome reign of 14 years, created five Dukes, two Marquisses, seventeen Earls, two Viscounts, and twenty-one Barons. He was the first Sovereign of England, that in his Seal, or in his Coin, is crowned with an arch diadem.

EDWARD V's short reign produced no new creation.

RICHARD III. who reigned not quite 3 years, created one Duke, three Earls, and one Viscount.

On the accession of HENRY VII. the number of Peers were reduced in all to fifty; consisting of the Dukes of Norfolk and Suffolk, the Marquis of Dorset, fifteen Earls, one Viscount, and about thirty Barons. Besides the Duke of Buckingham, and the Earl of Devonshire, the Viscount Beaumont, and the Lady Hungerford restored soon after. His creations were few, being too intent in destroying their power to increase their number. Blood Royal excepted, he made but one Duke, Jasper de Hatfield, his father's brother, Duke of Bedford; and but one Marquis, Berkley, Marquis of Berkley. He created but two Earls, Stanley Earl of Derby, and De Chandew Earl of Bath: no more than one Viscount, with eleven Barons, in a reign of 23 years. At his death there were the Duke of Buckingham, the Marquis of Berkley, ten or eleven Earls, no Viscounts, and about thirty Barons.

HENRY VIII. besides Margaret, Countess of Salisbury, of the Blood Royal, created only two Dukes, Brandon Duke of Suffolk, and Fitzroy Duke of Richmond and Somerset. One Marquis, Courtenay Marquis of Exeter; Anne Bulleyn, Marchioness of Pembroke: fourteen Earls, four Viscounts, and about thirty Barons. He restored the Duke of Norfolk and Lord Berkley, and received the title of Lord D'Arcy, which had been in abeyance. His reign was long, (37 years) and there were several attainders. At his death there were no more than one Duke, Suffolk; one Marquis, Dorset, fifteen Earls; one Viscount, and about 33 Barons: by which it appears, that the increase of lay Peers in his time was but small, much less than one might have expected, considering how greatly he had added to the property of the laity, and how much he had reduced the Ecclesiastical Bench. In the room of twenty-five parliamentary Abbots and two priors, he added only six to the number of Bishops. Five of the sees erected by him still remain, that of Westminster had only one Bishop, and continued but nine years.

EDWARD VI. in his short reign of but 7 years, created Seymour, Duke of Somerset; Grey, Duke of Suffolk; Dudley, Duke of Northumberland; Parre, Marquis of Northampton; and Paulet, Marquis of Winchester. The title of Earl he conferred five times, that of Viscount once, and made eight Barons, besides restoring the Lords Stafford and D'Arcy, and summoning Lord Russell in his father's life time. At his decease there were the Dukes of Suffolk and Northumberland, the Marquisses of Northampton and Winchester, fifteen Earls, one Viscount, and about thirty-seven Barons.

MARY, who reigned 5 years, restored the Howards to the Dukedom of Norfolk, the Courtenays to the Marquisate of Exeter, and the Percy's to the Earldom of Northumberland. She granted the privilege of being covered in her presence to the Earl of Suffex, who had been her general, but conferred no title above that of Viscount. Her creations were Brown, Viscount Montacute; and five Barons.

ELIZABETH, who reigned about 44 years, found, at her accession, one Duke, Norfolk; one Marquis, Winchester; fifteen Earls, two Viscounts, and thirty-eight Barons, in all fifty-seven Peers. She created no more than five Earls, one Viscount, and eighteen Barons: she restored the Marquis of Northampton, and Lords Dacre of the South, and Stourton; and the Seymour and Dudley families to the Earldoms of Hertford and Warwick. At her death the number of Peers was nearly the same as at her accession; she leaving one Marquis, Winchester; sixteen Earls, two Viscounts, and about thirty-seven Barons; in all fifty-six peers. Queen Elizabeth had too much of the wisdom of her grandfather; to set up a power he had pulled down: she did not even ennoble Sir Nicholas Bacon, father of her Lord Chancellor, who was her Lord Keeper; and rather chose to confer the honour of the Garter on Sir Philip Sidney, who refused the crown of Poland at her request, than make him a Peer; she conferred no higher title than that of Baron Hunsdon on Henry Cary, her first cousin; and his

cousin Henry, who was a great favourite with her, and carried the news of her death to King James, had his peerage from him.

JAMES I. her successor, who reigned 22 years, was fond of giving titles: he made, indeed, exclusive of the blood-royal, but two dukes; Stuart, Duke of Richmond; and Villers, Duke of Buckingham. The title of Marquis he conferred but once, which was on George Villers, afterwards Duke of Buckingham; but that of Earl twenty-seven times, Viscount thirteen times, and Baron forty-nine times. The Earls of Arundel, Southampton, and Essex, and the Lord Paget, were restored in the first year of his reign; and Villers, the Duke of Buckingham's mother, was made a Countess for life in 1618; and the widow of Sir Moyle Finch, Viscountess Maidstone, 1623. Besides James's vanity and the probable motive of attaching the great commoners to himself and his family, another reason may be given for his being so lavish of his honours. In Scotland, where he was bred, nobility was a thing of less consequence and splendour than in this part of the island. The peers there always sat in the same assembly with the Commons by whom they might at any time be out-voted and controlled: and, however ancient and honourable their families might be, they were, in general, much inferior to the English Lords in point of fortune. In a political view, the King was right in multiplying the Peers. The national wealth was increased, the Commons were rather too great, and the House of Peers wanted to be strengthened. Perhaps, in some instances, his favours might have been bestowed more discreetly. The most exceptionable part of his conduct in this matter, seems to have been the giving away the titles of some of the most illustrious English families, who had the misfortune of being under attainder. His giving the title of Devonshire, first, to Lord Montjoy; and then to Lord Cavendish, deprived the Courtenays of enjoying their ancient honours. Again, by his giving the title of Westmoreland to the Fanes, the Nevilles, Lords Abergavenay, have hitherto been cut off from being restored to their ancient honour of Earl of Westmoreland. The Greys, Earls of Stamford, in like manner, are deprived of being reinstated to their title of Marquis, by James making Sackville, Lord Buckhurst, Earl of Dorset. The Howards were spared; yet the Earl of Arundel, fearing lest his title of Norfolk might be given away, obtained the favour of being created Earl of that county in the next reign; and the Seymours had the good fortune to see Carr, who had got their title of Somerset, die without male issue, by which means those two most noble families were restored to their ancient titles, and the honour of peerage. During the reign of James, in 1611, he instituted the order of Barons, which at first was not intended to exceed 200, but he exceeded that number by five or six. His son Charles I. increased them to 250 and Charles II. made near 430. Till about the revolution the number was upon the increase, but has fluctuated very much ever since; however, their number at present is upwards of 520. When James died, the lay-peerage consisted of the Duke of Buckingham, the Marquis of Winchester, forty-two Earls, eleven Viscounts, one Viscountess, about forty-eight Barons, and Lady Despencer. So that, in this reign, the number was almost doubled, being advanced from about fifty-six to one hundred and five.

CHARLES I. whose troublesome reign continued 24 years, besides the Duke of York his son, the Prince Rupert his nephew, Duke of Cumberland, he created the Dukes of Dudley, Dukes of Buckingham; and James Stuart, Duke of Richmond; the Earls of Worcester, Hertford, and Newcastle, Marquisses of those places; and the Earl of Kingston, Marquis of Dorchester. He conferred the title of Earl or Countess on thirty-seven persons, the title of Viscount on nine, and seventy-six Barons and Baronesses. He instituted the order of Nova-Scotia Baronets in 1625, from which time to the Union there were 230 created; but their number is now greatly reduced. At the time of his untimely death, there were two Dukes, four Marquisses, six Earls, seven Viscounts, and sixty Barons; in all one hundred and thirty-three Peers, exclusive of the Royal Family.

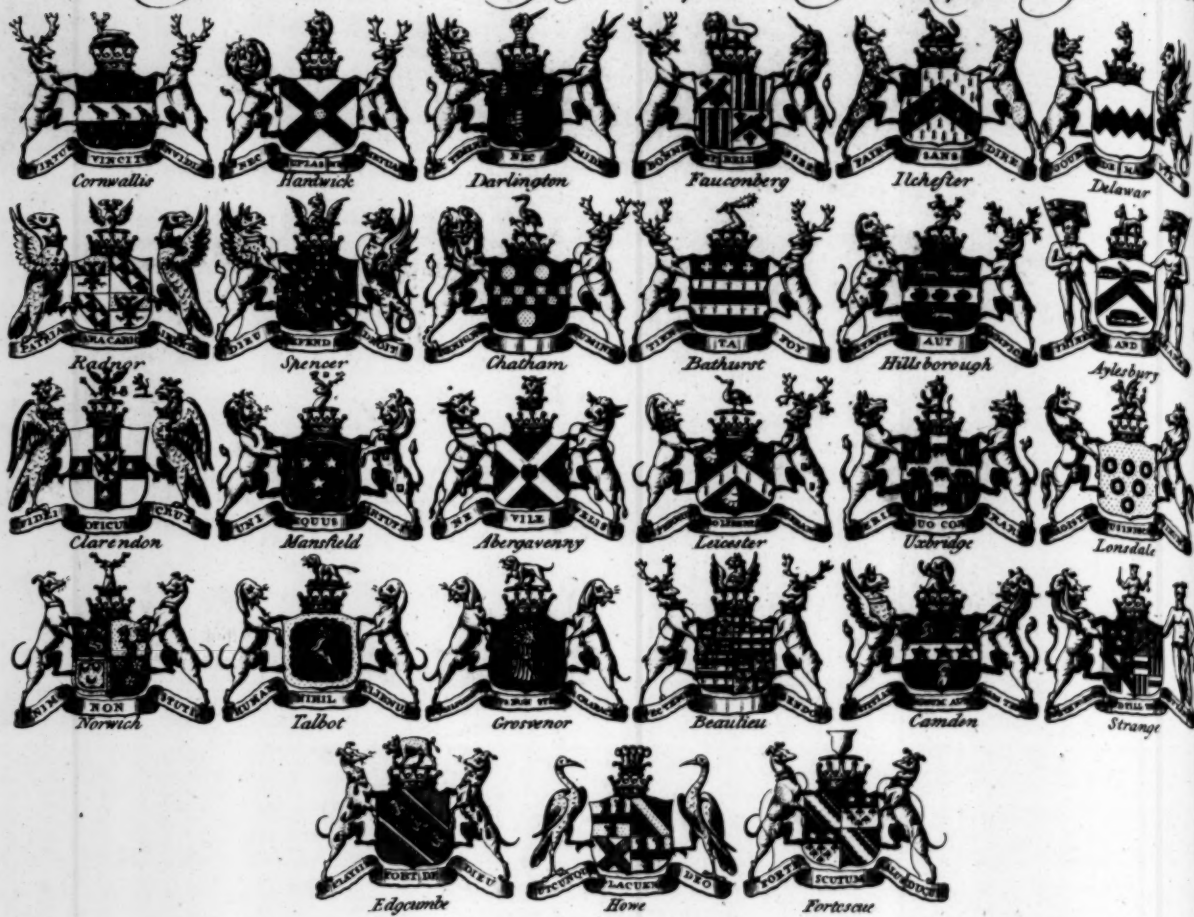
CHARLES II. at his restoration, had only five left, having made two Earls and four Barons during his exclusion, and restored Norfolk and Somerset dukedoms: during his reign, he created two of his mistresses Duchesses, and six of their offspring Dukes; which, with ten others, made eighteen Dukes, one Marquis, forty-one Earls, three Countesses, nine Viscounts, two Viscountesses, fifty-five Barons, and Baronesses, in all one hundred and thirty-seven Peers and Peeresses, including those by Writ of Summons. He granted the Barons Coronets, whose equipages before could not be distinguished from commoners; many of whom, as being descendants of Knights of the Garter and Bath, were equally entitled to supporters, as some Baronets are by grants from the Crown.

JAMES II. whose reign was but 4 years, added, one Duke (Berwick); one Marquis (Powys); two Earls, two Countesses, and five Barons.

WILLIAM III. and MARY, who reigned 13 years, being unable to gratify all the great men who were concerned in the Revolution, had recourse to the raising powerful Earls to the title of Duke, and powerful Barons to that of Earl. They created eight Dukes, two Marquisses, seventeen Earls, four Viscounts, and fifteen Barons, in all 46 Honours.

by
e
i
h
at
e
d
at
rt
ay
ad
of
h,
n,
e-
ng
he
ng
le,
ed;
ght
kat
une
nale
ored
the
hich
that
250
tion
very
ards
the
two
Ba-
mber
one
be-
hew,
chefs
Earls
those
He
rlons,
aron-
1625,
their
timely
seven
r-three
g made
d Nor-
two of
which,
rty-one
s, fifty-
y-seven
is. He
d not be
descend-
titled to
vn.
e Duke
untelles,
s, being
d in the
the title
created
iscounts,

ANNE,



ENGLISH VISCOUNTS.



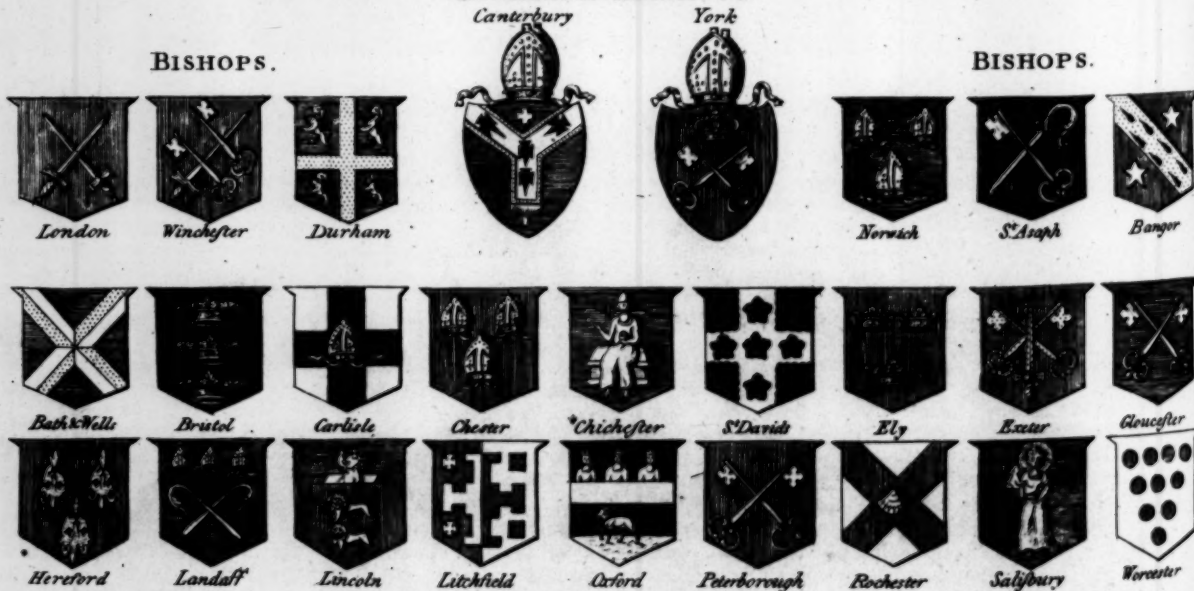
ENGLISH ARCHBISHOPS.

Canterbury

York

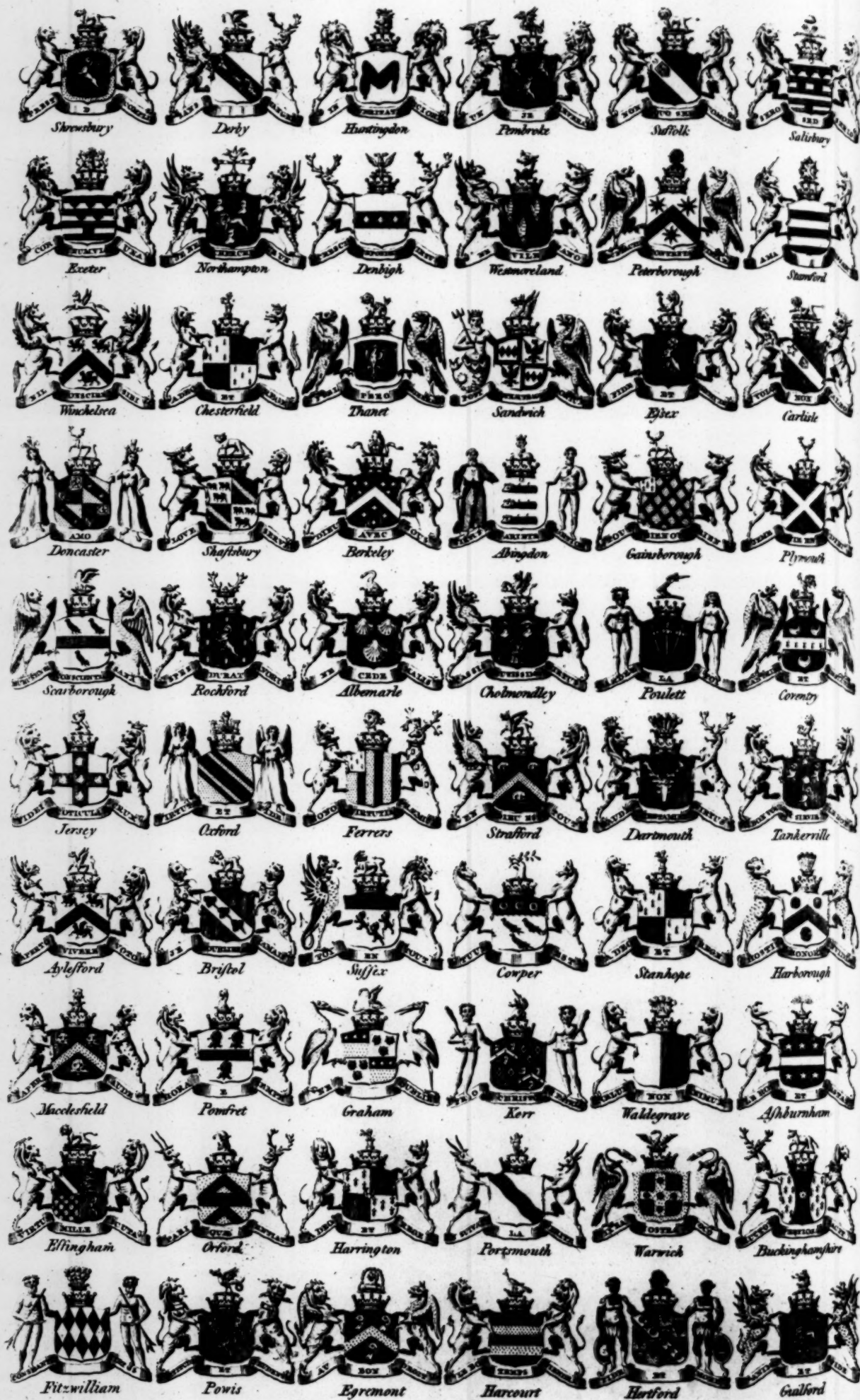
BISHOPS.

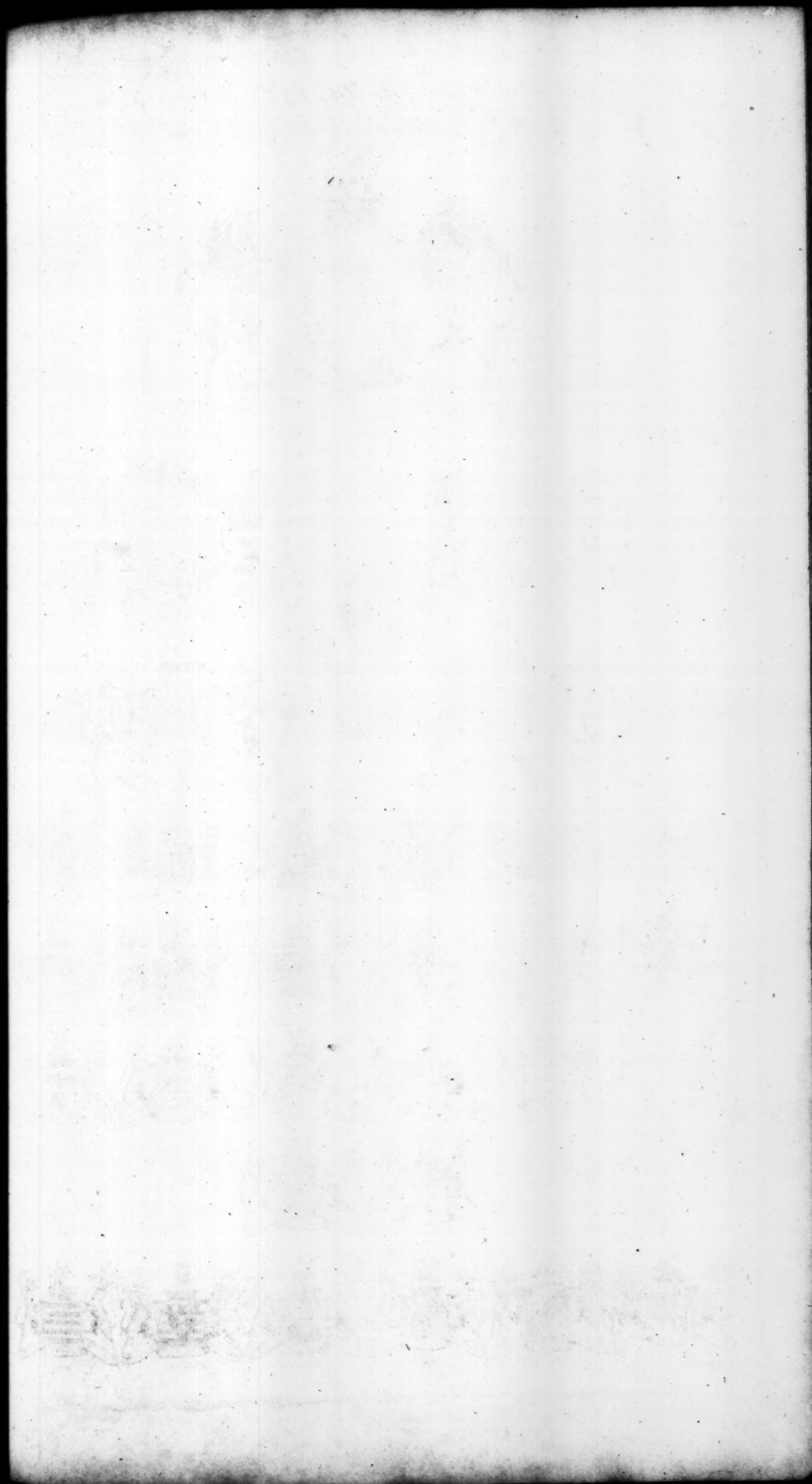
BISHOPS.





Earls of England. - See System of Peerage.





Arms of the King, Princes of the Blood Royal, Dukes & Marquises of England. See the System of Peerage.



The King



Prince of Wales



Duke of York



Duke of Clarence



DUKES



Duke of Gloucester



MARQUISSES



PEERAGE.

ANNE, who reigned 13 years, was by no means sparing of honours. She created five Dukes before the Union, and the Dukes of Dover and Brandon after, whose seats in the House were then denied, but Brandon has been since allowed. Before the Union she also had created three Marquisses, five Earls, and eight Barons. At the Union, which took place in 1706, there were twenty-two Dukes, three Marquisses, sixty-seven Earls, nine Viscounts, fifty-eight Barons, besides six Peeresses in their own right; so that the whole number of lay-peerages was then 165, or thereabouts. After the Union she created one Duke, Kent, before Marquis, besides Dover and Brandon, four Earls, one Viscount, and seventeen Barons; in all, 47. At the Queen's death the Peers were 172.

GEORGE I. whose reign was 13 years, at his accession was much in the same situation as Charles II. and William III. He created four of the Blood-Royal Dukes, and ten more of his nobles to the same dignity, besides the Dukes of Kendal, twenty-two Earls, and Countesses, nine Viscounts, and one Viscountess, and thirteen Barons in all; and at his death, the Peers amounted to 187. In 1725 George I. revived the order of the Knights of the Bath, which had lain dormant from the coronation of Charles II. The antiquity of this order is very considerable, being first introduced into England by the Saxons. The first created at coronations was October 13, 1399, by Henry IV.

GEORGE II. who reigned 33 years, had not the same reasons for indulgence to his nobles; therefore he conferred the title of Duke upon none but his beloved grandson Edward Duke of York, and the additional title of Newcastle-under-line to his late Grace of Newcastle, with remainder to the Earl of Lincoln his nephew, the present Duke. His Majesty created the Marquis of Rockingham, and Marchioness de Grey, fifty-one Earls, two Viscounts, one Countess, one Viscountess, thirty-nine Barons, and one Baroness. At the decease of his late Majesty there were, including Blood-Royal, twenty-three Dukes, one Marquis, one Marchioness, seventy-nine Earls, Eleven Viscounts, sixty Barons, and nine Peeresses in their own right; in all, 184 Peers and Peeresses.

GEORGE III. ascended the throne in 1760, and having at this time seven sons and two brothers, to whom no higher titles can be given than Duke, did not readily confer it on a subject; the Duke of Northumberland being the only one distinguished by that honour; besides admitting the claim of the Duke of Hamilton to the title of Brandon.

THE ENGLISH AND IRISH DIGNITIES.

Conferred and restored by each of our SOVEREIGNS during their respective Reigns.

	Irish.	Eng.		Irish.	Eng.
William I.		20	Edward V.	0	0
— II.		4	Richard III.	0	5
Henry I.		5	Henry VII.	0	20
Stephen		18	Henry VIII.	17	66
Henry II.	7	9	Edward VI.	2	22
Richard I.	0	6	Queen Mary	0	9
John	4	8	Queen Elizabeth	3	29
Henry III.	1	22	James I.	55	98
Edward I.	0	164	Charles I.	57	130
— II.	4	63	Charles II.	41	137
— III.	4	81	James II.	5	11
Richard II.	2	34	William and Mary	14	46
Henry IV.	2	17	Queen Anne	8	47
— V.	0	8	George I.	54	60
— VI.	0	57	George II.	76	99
Edward IV.	3	57	George III.	184	149

THE DEGREES OF PEERAGE IN ENGLAND.

The Degrees of Nobility in Great Britain and Ireland are five, viz. DUKES, MARQUISSES, EARLS, VISCOUNTS, and BARONS; to which may be added a *Sixth*, viz. the Bishops, as they are from that dignity entitled to a seat in the House of Peers.

DUKE—is now the first rank of nobility; but it was the eleventh of Edward III. before this dignity was introduced into England, when his eldest son, commonly called the Black Prince, was created Duke of Cornwall. The only ceremony at his investiture, was girding him with the sword. When John of Gaunt, son of King Edward III. was created Duke of Lancaster, by the same Monarch, he had investiture, not only by the King's girding him with the sword, but by putting on him a cap of fur, under a coronet of gold set with precious stones. In the twenty-first of King Richard II. the Duke of Hereford, and several others, were created by putting a cap of honour on their heads, and by delivering a rod into their hands; then the surcoat, mantle, hood, and patent, were introduced with much ceremony; all which is now omitted, they being now created by patent. The mantle and surcoat which a Duke wears at the coronation of a King or Queen is of crimson velvet, lined with white taffeta, and the mantle is doubled from the neck to below the elbow with ermine, having four rows of spots on each shoulder. His parliamentary robes are of fine scarlet cloth, lined with white taffeta, and the mantle is doubled with four guards of ermine at equal distances, with gold lace above each guard, and is tied up to the left shoulder by a black ribband. His cap is of crimson velvet, lined with ermine, having a gold tassel on the top; and his coronet, which is of gold also, is set round with

flowers in the shape of strawberry leaves. He is styled *His Grace*; and usually styled by the King and Queen, *Our Right Trusty and Right Entirely Beloved Cousin*, and if of the Privy Council, then with the addition of *Counsellor*. His Title *The High and Mighty Prince*. And all his sons are by courtesy styled Lords, and his daughters Ladies.

MARQUIS.—This dignity, which is called by the Saxons *Markin Reve*, and by the Germans *Markgrave*, took its original from *Mark* or *March*, which, in the language of the northern nations, is a limit or bound, and their office was to guard or govern the frontiers of a province. This title, which hath the next place of honour to a Duke, was introduced several years after that title had been established in England; and the first on whom it was conferred was the great favourite of king Richard II. Robert de Vere, Earl of Oxford, who was created Marquis of Dublin, and by him placed in parliament between the Dukes and Earls. The creation to this dignity was with nearly the same ceremony as that of a Duke; but they are now created by patent, under the Great Seal. His coronation robes are of crimson velvet, lined with white taffeta, and has four guards of ermine on the right side, and three on the left, set at equal distances, with gold lace above each guard, and is tied up to the left shoulder by a black ribband. His cap is of crimson velvet, lined with ermine, having a gold tassel at top. His coronet is of gold, and has pearls and strawberry leaves mixed alternately round of equal height. His title is *Most Noble and Puissant Prince*; and he is styled by the King or Queen, *Our Right Trusty and Entirely Beloved Cousin*. His sons, by the courtesy of England, are titled Lords, and his daughters Ladies.

EARL.—This honour, which came from the Saxons, was of great dignity and power, and for many ages continued the highest rank in England, till King Edward III. created Dukes, and Richard II. created Marquisses, both of whom had precedence assigned above Earls. They had anciently, for the support of their state, the third penny out of the sheriff's court, issuing out of the pleas of the shire whereof they had their title; as in ancient times there were no Counts or Earls, but had a county or shire for his Earldom. Afterwards, the number of Earls increasing, they took their title from some eminent town or village, or even from their own seat or park; and some from illustrious families, as Salisbury, Peterborough, Stamford, Paulet, Cholmondeley, Ferrers, Waldegrave, Stanhope, Ashburnham, &c. &c. Nor were titles confined to England alone, as some are taken from the kingdom of France, as Albemarle and Tankerville. Upon the increase of Earls, their revenue ceased, and their powers were much abridged; and it became the custom of the kings of England to assign some stated pension to the person whom he ennobled, for the better support of his dignity, and it was commonly done in the following proportion: Viscounts a fee of twenty marks, Earls of £.20, Marquisses of forty marks, and Dukes of £.40, out of some particular part of the royal revenue. A creation-fee to Barons has not yet been settled; Charles I. when he created Mountjoy Blount, Lord Montjoy of Thurveston in Derbyshire, assigned to him and his heirs male, a creation-fee of twenty marks *per annum*. Anciently an Earl was created with nearly the same ceremony as a Duke or a Marquis, but they are now created by letters patent. His coronation robe is the same as a Duke or a Marquis, except that he has only three rows of spots. His parliamentary robes are the same as a Duke or a Marquis, except that he has only three guards of ermine and gold lace. His cap is the same as theirs. It is uncertain when the coronets of Dukes, Marquisses, and Earls were settled. Sir Robert Cecil, Earl of Salisbury, Viscount Cranbourn, was the first of that degree that wore a coronet. An Earl's coronet has pearls raised upon points, and strawberry-leaves low between them. His title is, *Right Honourable*, and he is styled by the King or Queen, *Our Right Trusty and Right Well Beloved Cousin*.

VISCOUNT.—Was anciently the name of an office under an Earl, *Vice Comes*, who being oftentimes required at court, was his deputy to look after the affairs of the county; but, in the reign of Henry VI. it became a degree of honour, and was made hereditary. The first Viscount in England, created by patent, was John Lord Beaumont, who was by the above King created Viscount Beaumont, and he gave him precedence above all Barons. He is created by letters patent. His coronation robes are the same as an Earl's, except that he has only two rows and a half of plain white fur; and the same distinction on his parliamentary robes. His cap is the same; and his coronet is surrounded with a row of pearls close to the chaplet. His title is, *Right Honourable*, and he is styled by the King or Queen, *Our Right Trusty and Well Beloved Cousin*.

BISHOPS.—The precedence of Bishops was settled by statute 31st Henry VIII. chap. x. to be next to Viscounts, they being Barons of the Realm. They have the title of *Lords*, and *Right Reverend Fathers in God*. Before the Saxons came into England, there were in this kingdom three Archbishopricks, viz. London, York, and Caerleon upon Usk, each of which had many suffragans; but soon after St. Augustine's arrival in England, he from the great kindness he received from the King of Kent, settled the Metropolitan See at Canterbury; where it has continued ever since. York continued Archbishopric, but London and

M m

Caerleon

PEERAGE.

Caerleon lost that dignity. The latter was situated too near the Saxons to be much at ease; so one of its Bishops removed the See to St. David's in Wales. The Archbishop of Canterbury is the first peer in Great Britain next the Royal Family; the Lord High Chancellor is the next; and the Archbishop of York is the third: they taking place of all Dukes, and have the title of *Grace* given them. The Archbishop of Canterbury writes himself, *By Divine Providence*; but the Archbishop of York, and other Bishops, *By Divine Permission*. The Bishops of London, Durham and Winchester, have precedence of all Bishops; the others rank according to the seniority of consecration.

BARON. This dignity, which is either by writ or patent, is extremely ancient, and its original name in England was *Vavaffour*, which by the Saxons was changed into *Thane*, and by the Normans into *Baron*. Many of this rank are named in the History of England, and undoubtedly had assisted, or been summoned to parliament; but such is the deficiency of public records, that the first precept to be found is of no higher date than the 49th year of King Henry III. which, although it was issued out in the King's name, it was neither by his authority nor by his direction; for, not only the King himself, but his son Prince Edward, and most of the nobility who stood loyal to him, were then prisoners in the hands of the rebellious Barons; having been so made in the month of May preceding, at the battle of Lewes, and so continued until the memorable battle of Evesham, which happened in August the year following, when, by the happy escape of Prince Edward, he rescued the King and his adherents out of the hands of Simon Mountfort, Earl of Leicester. It cannot be doubted but that several parliaments were held by King Henry III. and King Edward I. yet no record is to be found giving any account thereof (except the 5th of King Edward I.) until the 22d year of the reign of the last-mentioned King. Some of the Barons were only summoned once. When a Baron is called up to the House of Peers by writ of summons, the writ is in the King's name, and he is directed to come to the parliament appointed to be held at a certain time and place, and there to treat and advise with his Majesty, the prelates, and nobility, about the weighty affairs of the nation. The ceremony of the admission of a Baron into the House of Peers is thus: He is brought into the House between two Barons, who conduct him up to the Lord Chancellor, his patent, or writ of summons, being carried by a King at Arms, who presents it kneeling to the Lord Chancellor, who reads it, and then congratulates him on his becoming a member of the House of Peers, and invests him with his parliamentary robe. The patent is then delivered to the Clerk of the Parliament, and the oaths are administered to the new Peer, who is then conducted to his seat on the Baron's Bench. Some Barons hold their seats by tenure. The first who was raised to this dignity by patent was John de Beauchamp, of Holt Castle, created Baron of Kidderminster, in Worcestershire, to him and his heirs male, by King Richard II. in the 11th year of his reign. He invested him with a mantle and cap. The coronation robes of a Baron are the same as an Earl's, except that he has only two rows of spots on each shoulder. In like manner his parliamentary robes have but two guards of white fur, with rows of gold lace. In other respects they are the same as other Peers. King Charles II. granted a coronet to the Barons. It has six pearls, set at equal distances, on the chaplet. His cap is the same as a Viscount's. His title is, *Right Honourable*; and he is styled by the King or Queen, *Right Trusty and Well Beloved amongst MEN*.

RULES OF PRECEDENCY.

The order of precedence, which is observed in general, is thus: That persons of every degree of honour or dignity take place according to the seniority of their creation, and not of years, unless they are descended from the blood royal; in which case, they have place of all others of the same degree.

The younger sons of the preceding rank take place from the eldest sons of the next mediate, viz. the younger sons of Dukes from the eldest sons of Earls; the younger sons of Earls from the eldest sons of Barons. All the chain of precedence is founded upon this gradation, and thus settled by act of parliament, 31 Henry VIII. cap. 10, anno 1539.

But there have been since some alterations made in this act, by several decrees and establishments in the succeeding reigns, whereby all the sons of Viscounts and Barons are allowed to precede Baronets. And the eldest sons and daughters of Baronets have place given them before the eldest sons and daughters of Knights, of what degree or order soever, though superior to that of a Baronet; these being but temporary dignities, whereas that of Baronets is hereditary: and the younger sons of Baronets are to have place next after the eldest of Knights.

Observe also, that as there are some great officers of state, who take place, although they are not noblemen, above the nobility of higher degrees; so there are some persons, who, for their dignities in the church, degrees in the universities, and inns of court, officers in the state or army, although they are neither knights, nor gentlemen born, yet take place among them. Thus, all colonels and field-officers who are honourable, as also the master of the ordnance, quarter-master-general, doctors of divinity, law, physic, and music; deans, chancellors, prebendaries, heads of colleges in universities, and serjeants at law, are, by courtesy, al-

lowed place before ordinary esquires. And all bachelors of divinity, law, physic, and music; masters of arts, barristers in the inns of courts; lieutenant-colonels, majors, captains, other commissioned military officers; and divers patent officers in the king's household, may equal, if not precede any gentleman, that has none of these qualifications.

In towns corporate the inhabitants of cities are preferred to those of boroughs; and those who have borne magistracy to all others. And herein a younger alderman takes not precedence from his senior being knighted, or as being the elder knight, as was the case of alderman Craven, who, though no knight, had place as senior alderman, before all the rest who were knights, at the coronation of king James. This is to be understood as to public meetings relating to the town; for it is doubted, whether it will hold good in any neutral place. It has been also determined in the earl marshal's court of honour, that all who have been lord mayors of London, shall every where take place of all knights-bachelors, because they have been the king's lieutenants.

It is also quoted by Sir George Mackenzie, in his Observations on Precedency, that, in the case of Sir John Crook, serjeant at law, it was adjudged by the judges in court, that such serjeants as were his seniors, though not knighted, should have preference notwithstanding his knighthood.

RULES OF PRECEDENCY AMONG WOMEN.

The precedence among men being known, that which is due to women, according to their several degrees, will be easily demonstrated: but it is to be observed, that women, before marriage, have precedence by their father, with this difference between them and the male children; that the same precedence is due to all the daughters that belong to the oldest; which is not so among the sons; and the reason of this disparity seems to be, that daughters all succeed equally, whereas the oldest son excludes all the rest.

By marriage a woman participates of her husband's dignities; but none of the wife's dignities can come by marriage to her husband, but are to descend to her next heir.

If a woman have precedence by creation, or birth; she retains the same though she marry a commoner; but if a woman nobly born, marry any peer, she shall take place according to the degree of her husband only, though she be a duke's daughter.

A woman privileged by marriage with one of noble degree, shall retain the privilege due to her by her husband, though he should be degraded by forfeiture, &c. for crimes are personal.

The wife of the eldest son of any degree takes place of the daughters of the same degree, who always have place immediately after the wives of such eldest sons, and both of them take place of the younger sons of the preceding degree. Thus the lady of the eldest son of an earl takes place of an earl's daughter, and both of them precede the wife of the youngest son of a marquis; also the wife of any degree precedes the wife of the eldest son of the preceding degree. Thus, the wife of a marquis precedes the wife or the eldest son of a duke.

GENEALOGICAL DESCENT TO GEORGE III. FROM EGBERT, THE FIRST KING OF ENGLAND.

EGBERT, of the Saxon race, first King of England, crowned A. D. 819; died 838; was succeeded by his son Ethelwolf, crowned 838; died 855, whose eldest son Ethelbald was crowned 857; died 860; who was succeeded by his three brothers, the youngest of whom was Alfred, crowned 872; died 900; whose daughter Elfrida married Baldwin II. Count of Flanders, from whom descended, in a direct line, Matilda of Brunswick, who married William Duke of Normandy, the conqueror of England. After Alfred died, the crown descended to Edward the Elder, his son, who was crowned 900; died 925; and was succeeded by Athelstan, his eldest son, who died without issue in 940, and the crown descended to his brother Edmund, who died in 946; whose sister Thyra married Gormo III. King of Denmark, from whom descended Swaine, King of England, 1012, who died 1015; father of Canute I. who was king of England 1027, Harold, king of England 1036; and Canute II. or Hardycanute, 1039, that died 1041, Edmund, son of Edward the Elder, died 946, whose son Edgar was crowned, 959, and dying 975, was succeeded by Edward II. who was murdered by his step-mother, and was succeeded by his son Etheldred, who died 1016, and was succeeded by his son Edmund II. surnamed Ironsides, who dying in 1017, his son Edward was driven into exile, where he had two children, Edward Atheling who died without issue, and Margaret sole heiress to the crown of England, set aside by the Conquest, married Malcolm III. king of Scotland, whose daughter Maud, in 1101, was married to Henry I. son of William duke of Normandy, the conqueror of England; which Henry succeeded his father in England 1100, and died in 1135; whose daughter Maud was married to Henry V. emperor of Germany, and in 1154, her son Henry II. was crowned king of England, and dying in 1189, left two sons, and a daughter named Matilda, or Maud, married to Henry the Lion, duke of Brunswick, from whom Ernestus Augustus, elector of Hanover, father of king George I. was lineally descended, and who married, 1658, Sophia the Grand-daughter of James I. king of England, and VIth of that name of Scotland, who was descended from Matilda, or Maud, daughter of Henry I. as before shewn.

PART

PEERAGE.

PART I. PEERAGE OF ENGLAND.

SECT. I. DUKES.

Peers of Blood Royal, Duke of Cornwall, &c.

The Most High, Puissant, and Most Illustrious Prince, **GEORGE AUGUSTUS FREDERICK**, Prince of Great Britain, Prince of Wales, Electoral Prince of Brunswick-Lunenburgh. **DUKE OF CORNWALL** and **Rothsay**, Earl of Chester and Carrick, Baron Renfrew, Lord of the Isles, Great Steward of Scotland, Knight of the Garter, &c. &c. *Born*, August 13, 1761. Created Prince of Wales, Aug. 17, 1762, and Earl of Chester by the same letters patent, and in 1765 elected a Knight Companion of the most noble order of the Garter, was installed at Windsor July 25, 1771; and took his seat in the house of Peers, as Duke of Cornwall and Earl of Chester, November 11, 1783.

The first creation of a Duke in England was by a charter, dated March 13, 1337, by King Edward III. in favour of his son Edward, furnished the Black Prince, wherein he was declared Duke of Cornwall, to hold himself and his heirs Kings of England, and to their first born sons; by virtue of which the eldest son of the King of England is duke of Cornwall the moment he is born.

The Earldom of Chester was a creation by letters-patent by Henry III. in 1247, and annexed to the eldest son of the King of England for ever. Prince Edward, his eldest son, was created Earl thereof, and the title has been enjoyed by all his successors.

The title of Prince of Wales, after the reduction of the British Prince Llewelyn, and the incorporation of that principality with England, was first conferred upon Prince Edward, the infant son of Edward I. in June 1284; ever since which time the principality has always been under the government of the English; and notwithstanding the title of Prince of Wales has been several times merged in the crown, yet it was never bestowed but on the heir to the throne.

As presumptive heir to the Crown of Great Britain, he is Hereditary Steward of Scotland, Duke of Rothsay, Earl of Carrick, and Baron of Renfrew; titles settled in 1399 by Robert III. King of Scotland, on the Prince his eldest son, perpetually appropriating those titles to the future Princes of Scotland, as soon as born; and from the accession of James I. they have been continued to the Princes of Great Britain.

Prince Frederick, **DUKE OF YORK AND ALBANY** in Great Britain, and Earl of **ULSTER** in Ireland; Bishop of Osnaburgh in Germany, Knight of the Garter and Knight of the Bath, &c. second son of His Majesty, &c. Generalissimo, or Commander in chief of all his Majesty's Forces in England. His Royal Highness was born August 16, 1763, elected Bishop of Osnaburgh, Feb. 27, 1764, and created to the above titles, Nov. 27, 1784.

Prince William Henry, **DUKE OF CLARENCE** and **St. Andrews** in Great Britain, and Earl of Munster in Ireland, Knight of the Garter, and Knight of the Thistle, third son of his Majesty, an Admiral in the Royal Navy. His Royal Highness was born August 21, 1768, and created to the above titles May 16, 1789.

Prince Edward, **DUKE OF KENT** and **Strathern**, in Great Britain, and Earl of Dublin in Ireland, Knight of the Garter and St. Patrick, fourth son of his Majesty, a Lieutenant General in the Army. His Royal Highness was born Nov. 27, 1767, and was created Duke and Earl, as above, April 23, 1799.

Prince Ernest Augustus, **DUKE OF CUMBERLAND** and **Tavistdale** in Great Britain, and Earl of Armagh in Ireland, a Knight of the Garter, fifth son of his Majesty. His Royal Highness was born June 5th 1771, and created Duke and Earl as above, April 23, 1799.

Prince William Henry, **DUKE OF GLOUCESTER** and **Edinburgh**, in Great Britain, and Earl of **Connaught** in Ireland, by patent, Nov. 19, 1764; next brother to his Majesty; General of his Majesty's Forces; Col. of the 1st Reg. of Foot Guards. Chancellor of the University of Dublin; Ranger and Keeper of Windsor Forest and Cranbourn Chase; Ranger of Hampton Court Park, Warden and Keeper of the New Forest in Hampshire, &c. and Knight of the Garter, 1762. He was born Nov. 25, 1743, and was created Duke and Earl as above, Nov. 17, 1764.

N. B. The Dukes of the Blood Royal are styled Most Illustrious.

Charles Howard, **DUKE OF NORFOLK**, Earl Marishal, and hereditary Earl marshal of England, Earl of Arundel, Surry, and Norfolk, baron of Mowbray, Howard, Segrave, Brewse of Gower, Fitz-Alan, Warren, Clun, Oskeldre, Maltraver, Greytock, Fornival Vendon, Lovetot, Strange of Blackmere, and Howard of Castle-Rising; premier Duke, Earl, and Baron of England, next the blood royal, and chief of the family of Howards. He was born March 15, 1746, and succeeded his father Charles the late Duke, Aug. 1, 1786. [Creation.] Duke of Norfolk, 1483.

Edward Adolphus Seymour, **DUKE OF SOMERSET**, baron Seymour, and Baronet, born Feb. 7, and succeeded his father, the late Duke, Dec. 16, 1793. [Creation.] Duke of Somerset, 1546.

Charles Lennox, **DUKE OF RICHMOND** in England, of Lennox in Scotland, and Aubigny in France, (confirmed at Paris 1777) Earl of March and Darnley, Baron of Settrington and Turbolton; born Feb. 22, 1735, succeeded Charles, the late Duke his father, Aug. 8, 1750. [Creation.] Duke of Richmond, 1675.

Augustus Henry Fitzroy, **DUKE OF GRAFTON**, Earl of Euston and Ailington, Viscount Thetford and Ipswich, baron of Arlington and Sudbury; born Sept. 28, 1736; succeeded his grandfather Charles, the late Duke of Grafton, May 6, 1757. [Creation.] Duke of Grafton, 1675.

Henry Somerset, **DUKE OF BEAUFORT**, Marquis of Worcester, earl of Glamorgan, viscount Groumont, baron Herbert, lord of Ragland, Chepstow and Gower, all in the county of Monmouth; as also baron Beaufort of Caldecott-castle; L. L. D. born Oct. 16, 1744, succeeded his father Charles, the late duke, who died November 1, 1756. [Creation.] Duke of Beaufort, 1682.

Aubrey Beauclerk, **DUKE OF ST. ALBANS**, earl of Burford, baron of Haddington, and baron Vere of Hanworth, in Middlesex; born June 3, 1740, succeeded his cousin, Feb. 16, 1786. [Creation.] Duke of St. Albans, 1684.

George William Frederick, **DUKE OF LEEDS**, marquis of Caermarthen, earl of Danby, viscount Latimer and Dumbaine, baron Osborne of Kiveton, and a baronet; born July 2, 1777, succeeded his father the late Duke, Jan. 31, 1799. [Creation.] Duke of Leeds, 1694.

Francis Russell, **DUKE OF BEDFORD**, marquis of Tavistock, earl of Bedford, baron Russell of Cheney's-Thornhaugh, and baron Howland, of Streatham, in Surry; was born August 11th, 1769, and succeeded his grandfather Jan. 14, 1771. [Creation.] Duke of Bedford, 1694.

William Cavendish, **DUKE OF DEVONSHIRE**, marquis of Hartington, Earl of Devonshire, baron Cavendish of Harwick, born December 14, 1748, and succeeded his father the late duke, October 2, 1764. [Creation.] Duke of Devonshire, 1694.

George Spencer, **DUKE OF MARLBOROUGH**, marquis of Blandford, earl of Sunderland and Marlborough, baron Spencer of Wormleighton, baron

Churchill of Sandridge; born Jan. 3, 1738, succeeded his father Charles, Oct. 20, 1758. [Creation.] Duke of Marlborough, 1702.

John-Henry Manners, **DUKE OF RUTLAND**, marquis of Granby, earl of Rutland, baron Roos of Hamlake, Trustbut and Belvoir, baron Manners, of Haddon, was born Jan. 3, 1778, and succeeded his father, who died Oct. 24, 1787. [Creation.] Duke of Rutland, 1703.

Douglas Hamilton, **DUKE OF BRANDON** and **HAMILTON**, marquis of Hamilton and Baron of Dutton. [Creation.] Duke of Brandon, 1711. See duke of HAMILTON in the Peerage of Scotland.

Brownlow Bertie, **DUKE OF ANCASTER**, duke of Kesteven, marquis and earl of Lindsey, born May 1, 1720, succeeded his nephew Robert, the late duke, July 8, 1779. [Creation.] Duke of Ancafter, 1715.

William Henry Cavendish Bentick, **DUKE OF PORTLAND**, marquis of Tichfield, viscount Woodstock, and baron of Cirencester, born April 14, 1738, succeeded his father William, May 1, 1762. [Creation.] Duke of Portland, 1716.

William Montagu, **DUKE OF MANCHESTER**, viscount Mandeville and baron Montagu of Kimbolton, born March 3, 1768, succeeded his father George, Sept. 2, 1788. [Creation.] Duke of Manchester 1716.

Frederick Sackville, **DUKE OF DORSET**, earl of Dorset and Middlesex, baron Buckhurst, and baron Cranfield, a minor, succeeded his father, the late duke, in 1799. [Creation.] Duke of Dorset, 1720.

Francis Egerton, **DUKE OF BRIDGEWATER**, marquis of Brackley, earl of Bridgewater, viscount Brackley, and baron of Elleimere; was born May 21, 1736, succeeded to the late duke John, his brother, in 1748. [Creation.] Duke of Bridgewater 1720.

John Pelham Clinton, **DUKE OF NEWCASTLE-UNDER-LINE**, in the county of Stafford, earl of Lincoln, was born July 31, 1785, succeeded his father, May 17, 1794, a minor. [Creation.] Duke of Newcastle 1756.

Hugh Percy, **DUKE OF NORTHUMBERLAND**, earl of Northumberland, earl Percy, baron Warkworth, of Warkworth castle, and a baronet in right of his father; and baron Percy, Lucy, Poynings, Fitz-Payne, Bryan, and Latimer, in right of his mother; born Aug. 14, 1742, and succeeded his father June 6, 1786. [Creation.] Duke of Northumberland, 1766.

SECT. II. MARQUISSES.

Francis Powlet, **MARQUIS OF WINCHESTER**, and earl of Wiltshire, to which honours he succeeded on the death of Henry duke of Bolton, &c. who dying Dec. 25, 1794, without male issue, the dukedom became extinct, and the marquissate and earldom descended as above; but the barony of St. John of Basing became in abeyance between the late duke's daughters. [Creation.] Marquis of Winchester 1549.

George Grenville Nugent Temple, **MARQUIS OF BUCKINGHAM**, earl Temple, viscount and baron Cobham, as well as earl Nugent, in Ireland, and Knight of the Garter; born June 17, 1753, succeeded his father, Sept. 12, 1779, in his English honours; and to the Irish on Oct. 13, 1788; was declared Lord Lieutenant of the kingdom of Ireland July 31, 1782, to whom the institution of the order of St. Patrick owes its origin. In 1784 was advanced to the dignity of an English marquis, and a second time declared chief governor of the kingdom of Ireland. [Creation.] Marquis of Buckingham, 1784.

William Petty, **MARQUIS OF LANDSOWN**, viscount Calne and Canston, and baron Wycomb, and also earl of Shelburne, viscount Fitzmaurice, and baron Dunkerton, (Irish honours); and knight of the Garter; born 1737, succeeded his father the late lord, May 14, 1761. [Creation.] Marquis of Landsown 1784.

Grenville Leveson Gower, **MARQUIS OF STAFFORD**, earl Gower, viscount Pretham, and Lord Gower, baron of Stittendam, and baronet; born 1717, succeeded his father Dec. 5, 1754. [Creation.] Marquis of Stafford 1786.

George Townshend, **MARQUIS TOWNSHEND**, viscount Townshend of Raynham, and baron Townshend of Lynn Regis, and baronet; born Feb. 28, 1724, and succeeded his father the late viscount, March 12, 1764. [Creation.] Marquis Townshend 1787.

James Cecil, **MARQUIS OF SALISBURY**, earl of Salisbury, viscount Cranbourn, and baron Cecil, of Effendon, was born Sept. 1, 1748, succeeded his father the late earl, Sept. 1780. [Creation.] Marquis of Salisbury 1789.

Thomas Thynne, **MARQUIS OF BATH**, viscount Weymouth, and baron Thynne, of Warminster, knight of the Garter, and baronet; born Jan. 5, 1765, succeeded his father Nov. 19, 1796. [Creation.] Marquis of Bath 1789.

John James Hamilton, **MARQUIS OF ABERCORN**, viscount Hamilton, and earl of Abercorn. [Creation.] Marquis of Abercorn 1790. See earl of Abercorn in the Scotch Peerage.

Charles Cornwallis, **MARQUIS AND EARL CORNWALLIS**, viscount Broome, baron Cornwallis, and baronet; born Dec. 31, 1738, succeeded his father June 23, 1763. [Creation.] Marquis Cornwallis, 1792.

Francis Seymour Conway, **MARQUIS AND EARL OF HERTFORD**, earl of Yarmouth, viscount Beauchamp, lord Conway, baron of Ragley, and baron Conway of Killallagh in Ireland, born Feb. 12, 1743, succeeded his father Francis, the late marquis, June 14, 1794. [Creation.] Marquis of Hertford 1793.

John Stuart, **MARQUIS AND EARL OF BUTE**, viscount and baron Mount-Stuart in the Scotch peerage, and baron Cardiffe in the English peerage, and a baronet. He succeeded to the Scotch titles of his father John, the late earl, March 10, 1792, and Feb. 20, 1796, was, as an English peer, created viscount Mountjoy and Earl of Windsor, and Marquis of Bute, in North Britain. His lordship was born June 30, 1744. [Creation.] Marquis of Bute 1796.

SECT. III. EARLS.

Charles Talbot, **EARL OF SHREWSBURY**, in England, Wexford and Waterford in Ireland, and baron Talbot, Strange of Blackmere, Femival, Verdun, Lovetot, Giffard of Brimsfield, Comyn of Badenagh, or Badenock, Valence, and Montcheny; born March 8, 1754, succeeded his uncle George, the late earl, July 21, 1787. [Creation.] Earl of Shrewsbury 1442.

Edward Smith Stanly, **EARL OF DERBY**, baron Stanly of Latham, and baronet; born Sept. 1752, succeeded his grandfather the late earl, Feb. 22, 1766. [Creation.] Earl of Derby, 1485.

George Herbert, Earl of **PEMBROKE**, and Montgomery, baron Herbert of Cardiff, Rofs, Kendal, Parr, Fitz-Hugh, Marmion, St. Quintin, and Herbert of Shurland; was born Sept. 10, 1759, and succeeded Henry the late earl his father, Jan. 28, 1794. [Creation.] Earl of Pembroke 1551.

John Howard, **EARL OF SUFFOLK**, earl of Berkshire, viscount Andover, and baron Howard of Charleton; born March 7, 1739, succeeded his cousin Feb. 24, 1783. [Creation.] Earl of Suffolk, 1603.

Henry Cecil, **EARL OF EXETER**, and baron of Burleigh; born March 14, 1754, succeeded his uncle Brownlow, the late earl, Dec. 27, 1793. [Creation.] Earl of Exeter, 1605.

Charles Compton, **EARL OF NORTHAMPTON**, baron Compton, succeeded his father the late earl, April 7, 1796; born March 21, 1760. [Creation.] Earl of Northampton, 1618.

Basil Fielding, **EARL OF DENBIGH**, viscount Fielding, baron Fielding of Newnham Paddox, and St. Litz; also earl of Desmond, viscount Callan, and baron Fielding of Lecaghe, in Ireland, was born Jan. 3, 1720, succeeded his father

PEERAGE.

father William, the late earl, August 2, 1755. [Creation.] Earl of Denbigh, 1622.

John Fane, EARL of WESTMORELAND, and baron Burghersh; born the 1st of January, 1759, and succeeded his father on the 26th of April, 1774. [Creation.] Earl of Westmoreland, 1624.

Charles Henry Mordaunt, EARL of PETERBOROUGH, earl of Monmouth, viscount Mordaunt of Avalon, baron Mordaunt of Turvey, and baron Mordaunt of Ryegate, was born May 11, 1758, succeeded his father Charles, the late earl, Aug. 1, 1779. [Creation.] Earl of Peterborough, 1627.

George Harry Grey, EARL of STAMFORD, baron Grey of Groby, baron Bonville and Harrington; born Oct. 1, 1737, succeeded his father, the late earl, May 20, 1768. [Creation.] Earl of Stamford, 1628.

George Finch, EARL of WINCHELSEA, earl of Nottingham, viscount Maidstone, baron Fitz-herbert, of Eastwell, lord Finch of Daventry, lord of the Royal Manor of Wye, in Kent, a baronet, was born Nov. 4, 1751, and succeeded his uncle, the late earl, on the 2d of Aug. 1769. [Creation.] Earl of Winchelsea, 1628.

Phillip Stanhope, EARL of CHESTERFIELD, baron Stanhope of Shelford; was born Nov. 10, 1755, succeeded to these honours on the death of Philip Dormer, the late earl, March 24, 1773. [Creation.] Earl of Chesterfield, 1628.

Sackville Tufton, EARL of THANET, baron Tufton, hereditary sheriff of Westmoreland and Cumberland, lord of the honour of Skipton in Craven; was born June 30, 1769; succeeded his father, who died April 10, 1786. [Creation.] Earl of Thanet, 1628.

John Montagu, EARL of SANDWICH, viscount Hinchinbroke, baron Montagu of St. Neots, in Huntingdonshire; born Jan. 26, 1744; succeeded John, the late earl, his father, April 30, 1791. [Creation.] Earl of Sandwich, 1660.

George Capel, EARL of ESSEX, viscount Malden, and baron Capel of Hadham; born Nov. 13, 1758, succeeded his father William, late Earl, Mar. 5, 1799. [Creation.] Earl of Essex, 1661.

James Brudenell, EARL of CARDIGAN, baron Brudenell of Stanton Wivil, and baron Brudenell of Dean, and baronet; born April 20, 1725, succeeded his brother George, late duke of Montagu, in the earldom and barony, May 28, 1790, who died without male issue, and the dukedom became extinct. [Creation.] Earl of Cardigan, 1661.

Frederick Howard, EARL of CARLISLE, viscount Howard of Morpeth, baron Dacres of Gilleland; born May 28, 1748, succeeded his father Henry, Sept. 4, 1758. [Creation.] Earl of Carlisle, 1661.

Henry Scot, EARL of DONCASTER, and baron Tynedale, in Northumberland. His Grace is known by the title of duke of Buccleugh, &c. in Scotland. For particulars, see the Scotch Peerage.

Anthony Ashley Cooper, EARL of SHAFTSBURY, baron Ashley of Wimbourn St. Giles, baron Cooper of Powlett; born Sept. 17, 1761, and succeeded his father, the late earl, May 27, 1771. [Creation.] Earl of Shaftsbury, 1672.

Frederick Augustus Berkeley, EARL of BERKELEY, viscount Dursley, baron Berkeley; born May 24, 1745, succeeded his father, the late earl, Jan. 9, 1755.

Willoughby Bertie, EARL of ABINGDON, and baron Norreys of Rycote; born Jan. 16, 1740, succeeded his father Willoughby, the late earl, June 10, 1760. [Creation.] Earl of Abingdon, 1682.

Other Hickman Windfor, EARL of PLYMOUTH, and baron Windfor of Badenham, in Buckinghamshire; born May 30, 1751, succeeded his father, the late earl, April 20, 1771. [Creation.] Earl of Plymouth, 1682.

George Augustus Lumley Saunderson, EARL of SCARBOROUGH, viscount and baron Lumley, of Lumley Castle, and viscount Lumley, of Waterford, in the kingdom of Ireland; succeeded his father May 14, 1782; was born September 22, 1753, unmarried. [Creation.] Earl of Scarborough, 1690.

William Henry Nassau, EARL of ROCHFORD, viscount Tunbridge, baron of Enfield; was born June 28, 1754; succeeded his uncle William, the late earl, Sept. 28, 1781. [Creation.] Earl of Rochford, 1696.

William Charles Keppel, EARL of ALBEMARLE, viscount Bury, baron Ashford, of Ashford, in Kent; born May 13, 1772, succeeded his father the late earl, Oct. 13, 1772. [Creation.] Earl of Albemarle, 1696.

George William Coventry, EARL of COVENTRY, viscount Deerhurst; born April 26, 1721; succeeded his father William, the late earl, March 18, 1751. [Creation.] Earl of Coventry, 1697.

George Buffy Villiers, EARL of JERSEY, viscount Villiers of Dartford, and baron of Hoo, in England; also viscount Grandison, in Ireland; was born June 9, 1735, and succeeded his father as earl of Jersey, August 29, 1769, and also succeeded to the title of viscount Grandison in Ireland, upon the death of the late earl Grandison. [Creation.] Earl of Jersey, 1697.

John Poulett, EARL POULETT, viscount Hinton and baron Poulett, of Hinton, St. George; born April 7, 1746, succeeded his father Vere, the late earl, April 14, 1788. [Creation.] Earl of Poulett, 1706.

George James Cholmondeley, EARL of CHOLMONDELEY, viscount Malpas, and viscount Cholmondeley, of Nampitwich, baron of Newburgh, and also viscount Cholmondeley, of Kells, and baron Newburgh, in Ireland; born April 30, 1749, and succeeded his grandfather, June 10, 1770. [Creation.] Earl of Cholmondeley 1706.

Edward Harley, EARL of OXFORD, earl Mortimer, and baron Harley of Wigmore; was born Sept. 20, 1773, succeeded his uncle October 8, 1790. [Creation.] Earl of Oxford, 1711.

Robert Shirley, EARL FERRERS, viscount Tamworth, and baronet; born Sept. 25, 1756, succeeded his father Robert, the late earl, April 18, 1787. [Creation.] Earl Ferrers, 1711.

Frederic Thomas Wentworth, EARL of STRAFFORD, viscount Wentworth, of Wentworth-Woodhouse, baron of Sabinborough, Raby, Newmarth, and Overley, and baronet; born September 1732, succeeded his cousin William the late earl, March 20, 1791. [Creation.] Earl of Strafford, 1711.

William Legge, EARL of DARTMOUTH, baron of Dartmouth, viscount Lewisham; born 1725, succeeded William the late earl, his grandfather, Dec. 15, 1750. [Creation.] Earl of Dartmouth, 1711.

Charles Bennet, EARL of TANKERVILLE, baron of Offulston; born Nov. 1, 1743, succeeded his father Charles, the late earl, Oct. 27, 1767. [Creation.] Earl of Tankerville, 1714.

Heneage Finch, EARL of AYLESFORD, and baron Guernsey; born July 15, 1751, succeeded his father, the late earl, May 9, 1777. [Creation.] Earl of Aylesford, 1714.

Frederick Hervey, EARL of BRISTOL, lord Hervey of Ickworth, bishop of Derry, in Ireland; born Aug. 1730, succeeded his brother Dec. 23, 1779. [Creation.] Earl of Bristol, 1714.

Henry Yelverton, EARL of SUSSEX, viscount de Longueville, baron Grey of Ruthyn, Hastings, Weyford, and Valence, and baronet; born July 7, 1729, succeeded his brother Augustus, the late earl, in 1758. [Creation.] Earl of Sussex, 1717.

Peter-Lewis-Francis Calvering Cooper, EARL COOPER, viscount Ford-

wich, Baron Cooper, of Wingham, and baronet; and a Prince of the Roman Empire; succeeded his brother Feb. 12, 1799. [Creation.] Earl Cooper, 1717.

Charles Stanhope, EARL STANHOPE, viscount Stanhope, of Mison, and Baron of Elvafton, succeeded his father Phillip, the late Earl, March 7, 1786, born August 3, 1753. [Creation.] Earl Stanhope, 1717.

Robert Sherard, EARL and BARON of HARBOROUGH, and lord Sherard in England, and Baron Leitrim in Ireland. His lordship was born Oct. 15, 1719, and succeeded his brother Bennet, Feb. 24, 1770. [Creation.] Earl of Harborough 1719.

George Parker, EARL of MACCLESFIELD, baron of Macclesfield, viscount Parker, born Feb. 24, 1755, succeeded his father March 1, 1793. [Creation.] Earl of Macclesfield 1721.

George Fermor, EARL of POMFRET, and lord Lempster, born Jan. 2, 1768, succeeded his father Thomas, the late earl, Feb. 9, 1795. [Creation.] Earl of Pomfret 1721.

William Graham, EARL GRAHAM, and baron Graham, of Belfast, in the county of Northumberland, in England, and duke of Montrose, in Scotland. For an account of this family, see duke of Montrose, in the peerage of Scotland.

John Kerr, EARL KERR, and baron Kerr, of Wakefield in Yorkshire; and duke of Roxburgh, in Scotland. For an account of this family see duke of Roxburgh, in the Peerage of Scotland.

John-James Waldegrave, EARL WALDEGRAVE, viscount Chewton, baron Waldegrave of Chewton, and baronet; born July 30, 1786, succeeded his brother George, the late earl, July 29, 1794. [Creation.] Earl Waldegrave 1729.

John Ashburnham, EARL of ASHBURNHAM, viscount St. Asaph, and baron of Ashburnham; born Oct. 30, 1724, succeeded his father John, the earl, March 10, 1737. [Creation.] Earl of Ashburnham 1730.

Richard Howard, EARL of EFFINGHAM, Lord Howard; born Feb. 21, 1748, succeeded his brother, Nov. 15, 1791. [Creation.] Earl of Effingham, 1731.

Charles Stanhope, EARL of HARRINGTON, viscount Peterham, baron of Harrington, born March 20, 1753; succeeded his father William, the late earl, April 1, 1779. [Creation.] Earl of Harrington, 1741.

John Charles Wallop, EARL of PORTSMOUTH, viscount Limington, and baron Wallop, of Farley-Wallop, born Dec. 1767, succeeded his father May 10, 1797. [Creation.] Earl of Portsmouth 1745.

George Greville, EARL of WARWICK, earl of Brooke, and lord Brooke, baron Brooke of Beauchamp-court, in Warwickshire; born Sept. 16, 1746, succeeded his father, the late earl, July 6, 1773. [Creation.] Earl of Warwick 1746.

George Hobart, EARL of BUCKINGHAMSHIRE; lord Hobart, baron Hobart of Blickling, and baronet; born 1724, succeeded his brother John, the late earl, Aug. 3, 1793. [Creation.] Earl of Buckinghamshire 1746.

William Fitz-William, EARL FITZ-WILLIAM, viscount Milton, lord Fitz-William, and baron of Milton in England; also earl Fitz-William, viscount Milton, and baron Fitz-William of Lifford, or Lifford, in Ireland, born May 30, 1748, succeeded his father, the late earl, August 9, 1756. [Creation.] Earl Fitz-William 1746.

George-Edward-Henry-Arthur-Herbert, EARL of POWYS, viscount Ludlow, Lord Herbert, of Cherbury, baron Powys, of Powys-castle, and baron Herbert of Cherbury in Ludlow, born July 7, 1753; succeeded his father, the late earl, Sept. 11, 1778. [Creation.] Earl Powys, 1748.

George Wyndham, EARL of EGREMONT, baron of Cockeremouth, and baronet, born Dec. 7, 1751, and succeeded his father, the late earl, August 21, 1763. [Creation.] Earl of Egremont 1749.

George-Simon Harcourt, EARL HARCOURT, viscount Harcourt, viscount Nuneham, baron Harcourt, born Aug. 1, 1736, succeeded Simon, the late earl, Sept. 16, 1777. [Creation.] Earl of Harcourt 1749.

George Augustus North, EARL of GUILFORD, lord North, and Guilford, born Sept. 11, 1757, succeeded his father, Frederick, the late earl, Aug. 3, 1792. [Creation.] Earl of Guilford, 1752.

Philip Yorke, EARL of HARDWICKE, viscount Royston, lord Hardwicke, baron Hardwicke; born May 29, 1757, succeeded his uncle, the late earl, May 16, 1790. [Creation.] Earl of Hardwicke, 1754.

Henry Vane, EARL of DARLINGTON, viscount and baron Burnard, of Barnard-castle, in the bishopric of Durham; born July 27, 1766, succeeded his father Henry, the late Earl, who died Sept. 8, 1792. [Creation.] Earl of Darlington 1754.

Henry Belasyse, EARL FAUCONBERG, viscount Belasyse, and baron Fauconberg, and baronet; succeeded his father, the late earl, in Feb. 1741. [Creation.] Earl Fauconberg 1756.

Henry-Thomas Fox-Strangways, EARL of ILCHESTER, lord Ilchester and Stavordale, baron Strangways, of Woodford-Strangways, baron Redlynch; born July 27, 1747, and succeeded his father, the late earl, Sept. 29, 1776. [Creation.] Earl of Ilchester, 1756.

John West, EARL DE LA WAR, viscount Cantalupe, baron de la War, and lord West; born Oct. 27, 1791, and succeeded his father July 21, 1795. [Creation.] Earl de la War, 1761.

Jacob Pleydell Bouverie, EARL of RADNOR, viscount Folkestone, baron of Longford in Wilts, baron Pleydell-Bouverie, of Colehill, in Berks, and baronet; born March 4, 1750, succeeded his father William, the late earl, Jan. 28, 1776. [Creation.] Earl of Radnor, 1765.

George-John Spencer, EARL SPENCER, viscount Spencer and Althorpe, and baron Spencer, of Althorpe, in the county of Northampton; born Sept. 1, 1758, succeeded his father John, the late earl, October 31, 1783. [Creation.] Earl Spencer, 1765.

John Pitt, EARL of CHATHAM, viscount Pitt, of Burton-Pynsent, in the county of Somerset; born Sept. 10, 1756, and in 1778 succeeded his father, William, the late earl, who was ennobled for his transcendent abilities, and the eminent services he had rendered the nation. [Creation.] Earl of Chatham 1766.

Henry Bathurst, EARL BATHURST, baron Bathurst, of Battlefield, and baron Apley; born May 22, 1762, and succeeded his father Aug. 6, 1794. [Creation.] Earl Bathurst 1772.

Wills Hill, EARL of HILLSBOROUGH, and viscount Fairford, in England. His lordship is known by the title of Marquis of Downshire in Ireland. See Marquis of DOWNSHIRE, in the Peerage of Ireland. [Creation.] Earl of Hillsborough 1722.

Thomas Bruce Brudenell, EARL of AYLESBURY, lord Bruce, of Tottenham; born 1730, was created June 8, 1776, on the demise of his uncle, the late earl.

Thomas Villiers, EARL of CLARENDON, lord Hyde of Hindon, in the county of Wilts, and baron of the kingdom of Prussia; born Dec. 25, 1753, succeeded his father Thomas, the late earl, Dec. 11, 1786. [Creation.] Earl of Clarendon 1766.

Henry Nevill, EARL of ABERGAVENNY, viscount Nevill, and baron Abergavenny; born 1755, succeeded his father George, the late earl, Sept. 10, 1785. [Creation.] Earl of Abergavenny 1783.

Em.
1717.
about
th 7,

lord
born
Crea.

field,
1795.

n. 2,
[see.]

lord,
in
peer-

ire;
duke

etca,
eded
alde-

and
the

Feb.
ing-

aron
late

ton,
thor

ck,
46,
ar.

aron
the

lord
vil-
nd.
re-

ont
and
fa-

and
21,

vil-
the

u.l.
ug.

rd-
late

rd,
uc-
n.]

ron
i.

ter
ed-

9,

ar,
5.

bi-
ki,

arl,
pe,

i,
n.]

in
fr-

le,
of

and
94.

og-
nd.

of
ck,

in
25,

ron
ic,

age

(Peers and Peers of Ireland.) *The System of Peerage.*

MARQUISSES

EARLS.

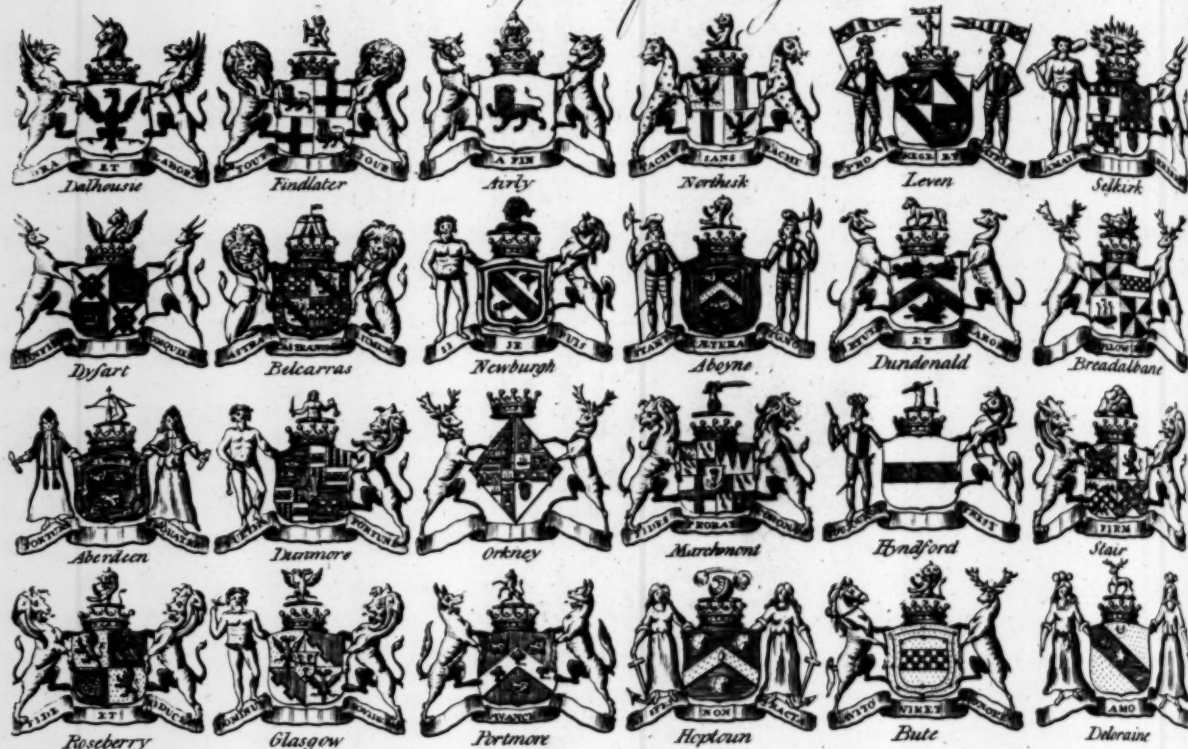


PEERESSES



Earls, (Viscounts) & Barons of Scotland.
See System of Peerage.

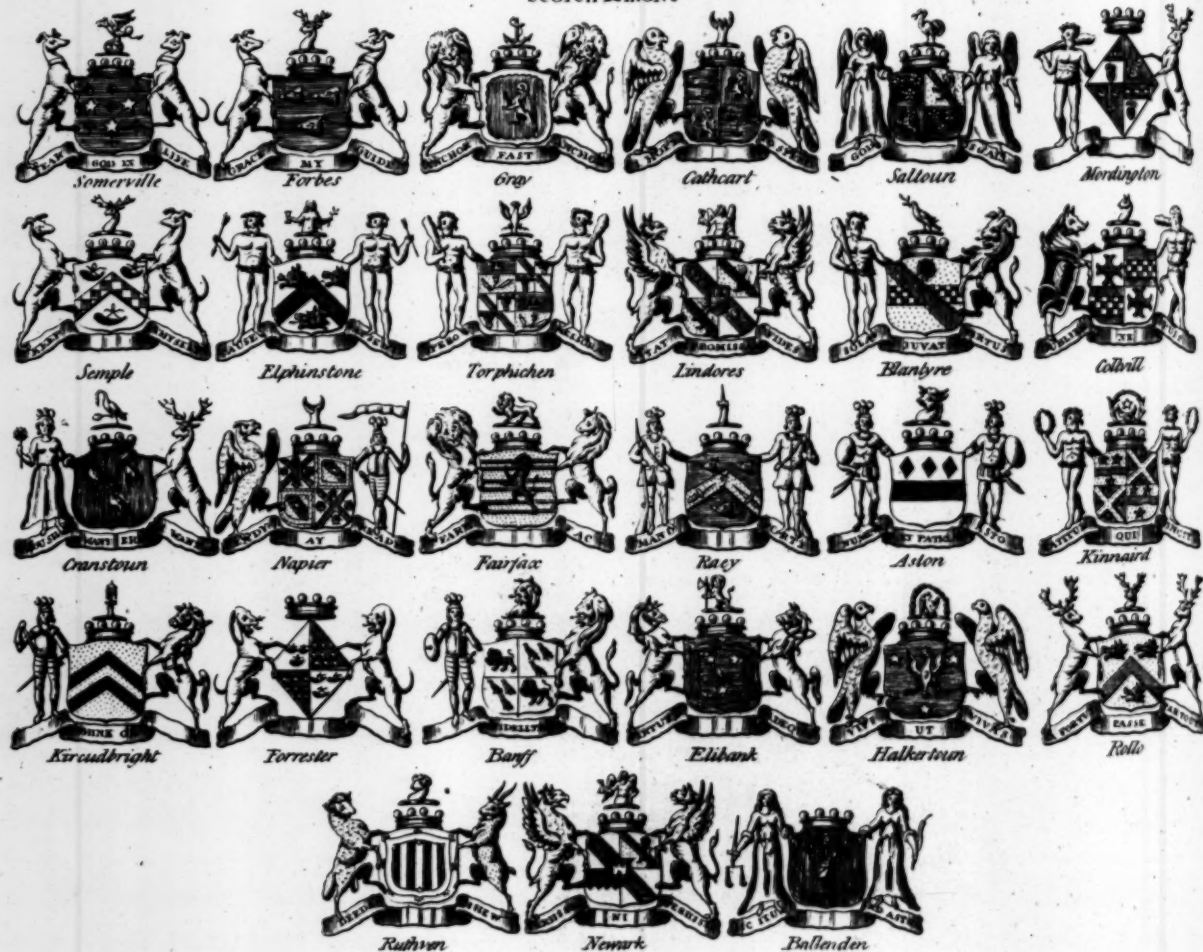
Page



SCOTCH VISCOUNTS



SCOTCH BARONS

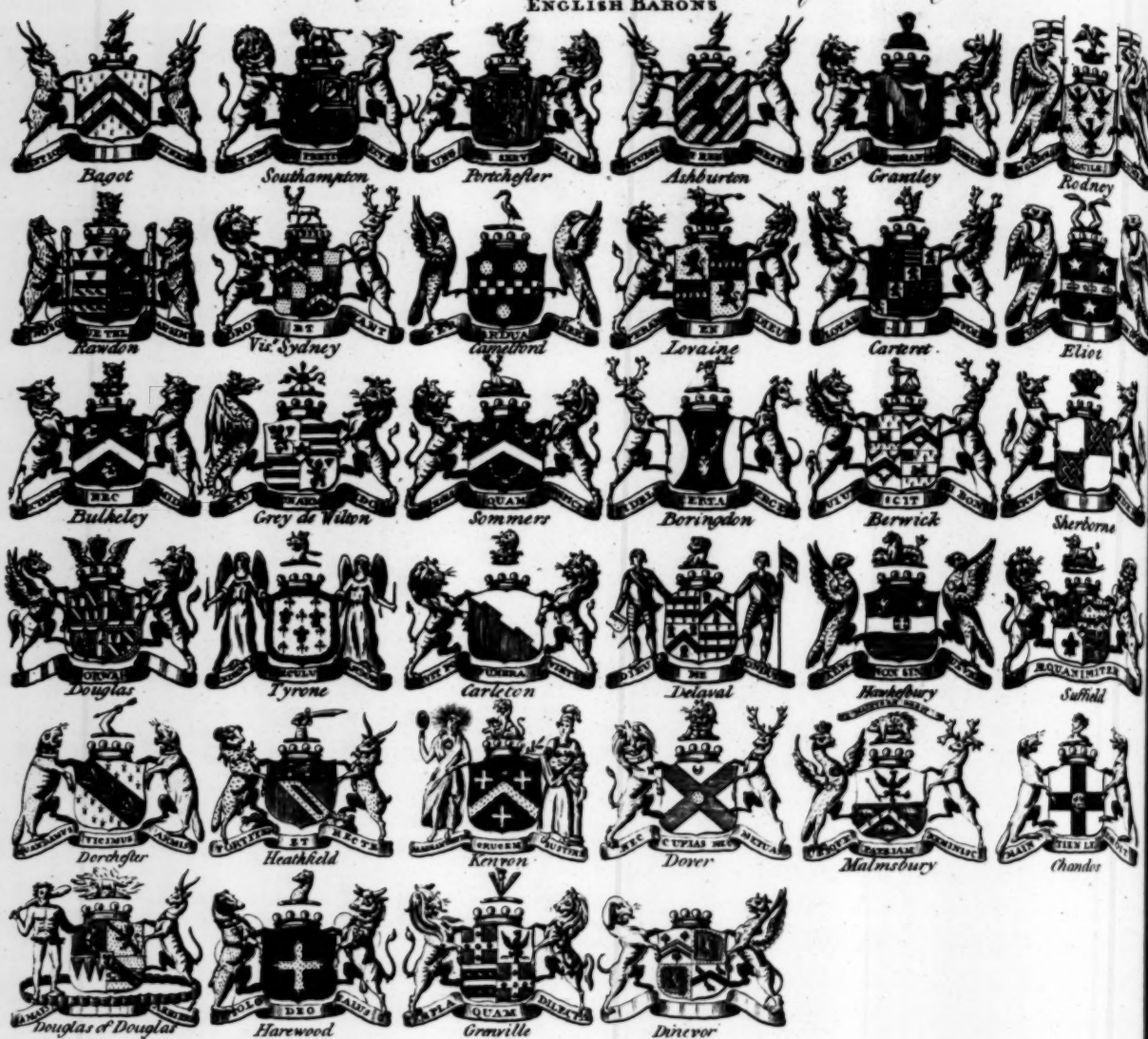




(Barons of England) See System of Peerage.

Plate

ENGLISH BARONS

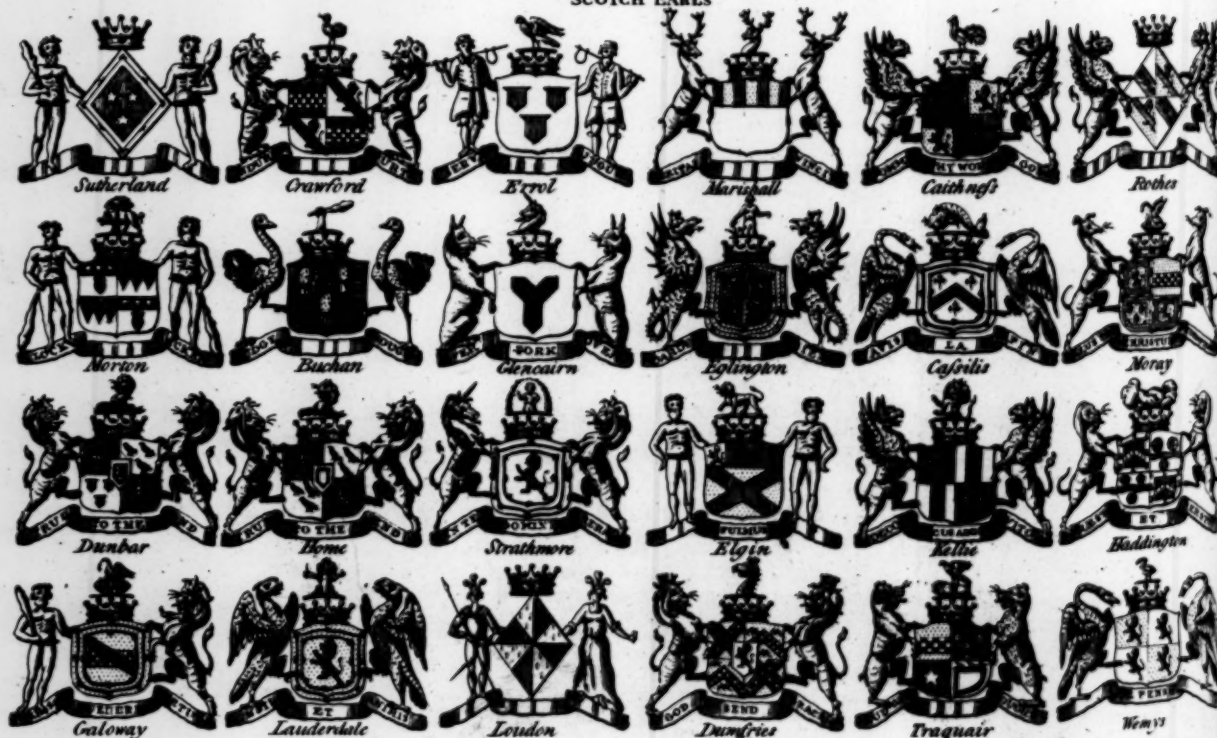


(Peers and Peers of Scotland)

MARQUISSES



SCOTCH EARLS





Barons of England, The System of Peerage

Plate 4



Published according to Act of Parliament by C. Cooke, N^o 7, Pall-mall Row, Mar. 20. 1794.

PEERAGE.

George Townshend, EARL of the county of LEICESTER, baron De Ferrars, of Charley, lord Bouchier, Lovayne, Bassett, and Compton, eldest son of Marquis Townshend, born April 18, 1753, succeeded as baron De Ferrars, on the death of his mother, Sept. 14, 1770, she being the only child of James, fifth earl of Northampton, and Elizabeth, baroness De Ferrars, of Charley in the county of Stafford. [Creation.] Earl of Leicester, 1784.

Henry Bailey-Paget, EARL of UXBRIDGE, lord Paget, of Beaufort, succeeded to this barony on the death of Henry, the late earl of Uxbridge, Nov. 16, 1769, being descended by his mother from William, the fifth lord Paget. [Creation.] Earl of Uxbridge, 1784.

James Lowther, EARL of LONSDALE, viscount Lowther, baron Lowther, baron of Kendall, baron of Burgh; and a baronet. [Creation.] Earl of Lonsdale, 1784.

Alexander Gordon, EARL of NORWICH, and lord Gordon of Huntley, English honours; to which he was created July 2, 1784; His grace is known by the title of duke of Gordon in Scotland. See DUKE of GORDON, in the Peerage of Scotland.

John Chetwynd Talbot, EARL TALBOT, viscount of Ingefrie, in Staffordshire; lord Talbot, baron of Henfoll, born April 23, 1777, succeeded his father, the late earl, May 19, 1793. [Creation.] Earl Talbot, 1784.

Richard Grosvenor, EARL GROSVENOR, viscount Belgrave, in the county palatine of Chester; lord Grosvenor, baron Grosvenor of Eaton, in Cheshire, and baronet; was born June 18, 1731, succeeded his father Aug. 1, 1755, as baronet, and was created a peer, April 9, 1761. [Creation.] Earl Grosvenor, 1784.

Edward-Huffey Montague, EARL BEAULIEU, lord Beaulieu, was advanced to the dignity of an earl July 8, 1784.

John-Jeffries Pratt, EARL CAMDEN, viscount Bayham, and lord Camden; born 1759; succeeded his father, the late earl, April 18, 1794. [Creation.] Earl Camden, 1786.

John Murray, EARL STRANGE, and lord Murray, of Stanley, in the county of Gloucester, was so created Aug. 8, 1786. His grace is known by the title of duke of Athol, in Scotland. See SCOTCH PEERAGE.

Richard Edgcombe, EARL of MOUNT EDGE-CUMBE, viscount Edgecumbe, and Viscount, lord Mount Edgecumbe, born 1764, succeeded his father Richard, Feb. 4, 1795. [Creation.] Earl of Mount Edgecumbe 1789.

Hugh Fortescue, EARL FORTESCUE, viscount Ebrington, and lord Fortescue, of Castle-hill, born March 12, 1753, succeeded his father Matthew, the late lord, July 10, 1785. [Creation.] Earl Fortescue, 1789.

Henry Digby, EARL DIGBY, lord Digby, baron of Sherborne, in the county of Dorset, and also baron Digby in Ireland; born Jan. 6, 1773, succeeded his father, Sept. 25, 1793. [Creation.] Earl Digby, 1790.

Algernon Percy, EARL of BEVERLY, lord Lovaine, and baron of Alnwick; born Jan. 21, 1749, succeeded to the barony on the death of his father, the late duke of Northumberland, June 6, 1786. [Creation.] Earl of Beverly, 1790.

George Damer, EARL of DORCHESTER, viscount Milton, English honours, also baron Milton of Shrotonhill in Ireland; born March 28, 1746, succeeded his father, Feb. 12, 1798. [Creation.] Earl of Dorchester, 1792.

David William Murray, EARL of MANSFIELD, in Middlesex; also viscount Stormont, baron of Scoon and Balvaird, in Scotland, born March 7th, 1777, succeeded his father, the late earl, Sept. 1, 1796; he succeeded to the earldom on the death of his uncle William, the late earl, March 15, 1793; but to his Scotch honours on the death of his father, in 1748. His lady is a countess in her own right, by the entail of the earldom of Mansfield, in Nottinghamshire, on the death also of his uncle, as before mentioned. [Creation.] Earl of Mansfield, 1776.

Henry Herbert, EARL of CARNARVON, and baron Porchester, born Aug. 20, 1741. [Creation.] Earl of Carnarvon, 1793.

Charles Jenkinson, EARL of LIVERPOOL, and baron of Hawksbury, and baronet; he was created baron August 8, 1786, and earl of Liverpool May 28, 1796. [Creation.] 1796.

John Jervis, EARL ST. VINCENT, baron Jervis of Melford in the county of Stafford; was advanced to those dignities for the eminent services he had rendered his country, by the defeat of the Spanish fleet off Cape St. Vincent. [Creation.] 1799.

SECT. IV. VISCOUNTS.

Thomas Stapleton Palmer, VISCOUNT and BARON BEAUMONT, which title was granted as Baron in 1321, and the Viscounty in 1485, but remained in abeyance from the year 1508, till granted to the claimant in March 1798. [Creation.] 1485.

George Devereux, VISCOUNT HEREFORD, and baronet; born April 21, 1744, and succeeded his brother Edward, the late viscount, in July 1783. [Creation.] Viscount Hereford, 1549.

George Richard St. John, LORD VISCOUNT BOLINGBROKE, and St. John, lord St. John, of Lydiard-Tregoze, and lord St. John, of Batterica; born March 5, 1761, succeeded his father, May 5, 1787. [Creation.] Viscount Bolingbroke, 1712.

Evelyn-George Boscawen, VISCOUNT FALMOUTH, baron Boscawen-Rose, succeeded Hugh, the late viscount, his uncle, Feb. 4, 1782. [Creation.] Viscount Falmouth, 1720.

George Byng, VISCOUNT TORRINGTON, lord Byng, and baronet, born in 1739; succeeded George, the late viscount, his father, April 6, 1750. [Creation.] Viscount Torrington, 1721.

William-Robert Fitzgerald, VISCOUNT LEINSTER, of Taplow, in the county of Bucks; his grace is known by the title of duke of Leinster, in the kingdom of Ireland. See duke of Leinster in the Peerage of Ireland. [Creation.] Viscount Leinster, 1746.

Thomas Noel, VISCOUNT WENTWORTH, of Welleborough, and lord Wentworth of Nettlested, and a baronet; was born Nov. 18, 1745, and succeeded his father, the late viscount, Oct. 31, 1774. [Creation.] Viscount Wentworth, 1762.

William Courtenay, VISCOUNT COURTENAY, of Powderham castle, in the county of Devon, and baronet; born July 30, 1768; succeeded his father William, the late viscount, Dec. 14, 1788. [Creation.] Viscount Courtenay, 1752.

William Ward, VISCOUNT DUDLEY, viscount Ward, lord Ward of Birmingham; born Jan. 21, 1750, succeeded his half-brother John, the late viscount, Oct. 8, 1788. [Creation.] Viscount Dudley, 1763.

Charles Maynard, VISCOUNT MAYNARD, and lord Maynard, of Much Easton, and baronet. His lordship was born Aug. 9, 1751, and succeeded his father William in his baronetage, 1773; and upon the death of the late viscount, June 30, 1775, succeeded as viscount and baron Maynard. [Creation.] Viscount Maynard, 1766.

Thomas Hamden Trevor, VISCOUNT HAMPDEN, lord Trevor, of Bromham; succeeded his father Robert, the late viscount, August 21, 1783, was born Sept. 11, 1746. [Creation.] Viscount Hampden 1766.

George Germain, VISCOUNT SACKVILLE, lord Bolebroke, born Aug. 27, 1767, succeeded his father George, the late viscount, Aug. 20, 1783. [Creation.] Viscount Sackville, 1762.

No. 125.

Thomas Townshend, VISCOUNT SYDNEY, of St. Leonard's, Gloucestershire, June 9, 1789, and lord Sydney of Chislehurst, in Kent, March 6, 1783. [Creation.] Viscount Sydney, 1789.

Samuel Hood, VISCOUNT HOOD, of Whitely, in the county of Warwick; also a baron of the kingdom of Ireland, and baronet. His Lordship was created a peer of Ireland, in September, 1783, and in May, 1796, a viscount of Great Britain. [Creation.] 1796.

Charles Meadows Pierrepont, VISCOUNT NEWARK, and baron Pierrepont, was advanced to those dignities July 23, 1796. [Creation.] 1796.

Adam Duncan, VISCOUNT DUNCAN, of Camperdown, and of Lundie, in the county of Perth, in North Britain. His Lordship was advanced to the Peerage October 17, 1797, on account of a most signal and brilliant victory he obtained over the Dutch fleet in the North Sea. Born July 2, 1731. [Creation.] 1797.

SECT. V. BARONS.

Edward Southwell Clifford, LORD DE CLIFFORD, Westmoreland, and Vexcy; born June 2, 1767, succeeded his father Edward, the late lord, Nov. 1, 1777. [Creation.] Baron de Clifford, 1295.

Thomas Stapleton, LORD LE DESPENCER, and a baronet; born Nov. 10, 1766, succeeded his father in the baronetage Jan. 1, 1781, and the late Rachael Aulien Dashwood, baroness le Despencer, on May 1, 1788. [Creation.] Baron le Despencer, 1295.

Robert Cotton St. John Trevisus, Baron CLINTON and SAYE. This title descended to the present peer in 1797, on the death of his father, who succeeded to it on the death of George, late earl of Orford, who died in 1791, without male issue, when this title, being a barony, descended to the issue of baroness Clinton and Saye, his grandmother. [Creation.] Baron Clinton, 1398.

George Thicknesse-Tuchet, LORD AUDLEY, born Feb. 4, 1758; succeeded his uncle John, late earl of Castlehaven, who died April 22, 1777, as baron Audley. [Creation.] Baron Audley, 1401.

Gertrude Brand Holles, BARONESS DACRE, succeeded her brother Charles Trevor, who died without issue, July 3, 1794. Her ladyship was born August 25, 1750.

Priscilla Barbara Elizabeth Burrell, BARONESS WILLOUGHBY DE ERESBY, by original creation in 1314; by writ of summons, Jan. 15, 1580.

Henry Arundel, LORD ARUNDEL of WARDOUR, and Count of the sacred Roman Empire; born March 31, 1740; succeeded his father Henry, the late lord, Sept. 21, 1756. [Creation.] Baron Arundel 1605; Count of the Roman Empire, 1595.

Elizabeth Rawdon, BARONESS HUNGERFORD, Newmarch, Botreaux, Molins and Moel, mother to the present earl of Moira in Ireland; succeeded to the above baronies on the death of her brother, the late earl of Huntingdon, Oct. 2, 1789. [Creation.] Baron of Hungerford, 1402.

Charles Philip Stourton, LORD STOURTON, baron Stourton, born Aug. 22, 1752; succeeded his father William, Oct. 3, 1781. [Creation.] Baron Stourton, 1448.

Elizabeth Somerset, BARONESS BOTETOURT, and duchess Dowager of Beaufort; succeeded her brother the late Norborne Berkeley, baron Botetourt, in 1776, when her Grace became baroness in her own right. [Creation.] Baroness, 1465.

Charlotte Murray, BARONESS STRANGE, lady of the Isle of Man, mother of the present duke of Athol, baroness in her own right, by descent from her great grandmother, a daughter of the earl of Derby, beheaded in 1651.

John Peyto Verney, LORD WILLOUGHBY DE BROKE; born Aug. 4, 1738; succeeded his uncle Richard, the late lord, Aug. 11, 1752. [Creation.] Baron Willoughby de Broke, 1492.

Edward Timewell Brydges, LORD CHANDOS, of Sudley Castle, in Gloucestershire, succeeded to this barony on the death of the late duke of Chandos, who died without male issue, September 29, 1789. [Creation.] Baron Chandos, 1553.

Henry Beauchamp St. John, LORD ST. JOHN, of Bletfoe, and baronet; born August 2, 1758, succeeded his father John, the late lord, in June, 1767. [Creation.] 1559.

Mary Parker Griffin, BARONESS HOWARD, born July 28, 1728, succeeded her brother, who died May 24, 1797. [Creation.] Baron Howard, 1597.

Robert Edward Petre, LORD PETRE of WRITTLE, in Essex, succeeded Robert James, the late lord, his father, July 13, 1742. [Creation.] Baron Petre, 1603.

Gregory William Fiennes Twisleton, LORDSAY and SELE; born April 14, 1769, succeeded his father Thomas, the late lord, July 1, 1788. [Creation.] Baron by writ, 1447.

John Bligh, LORD CLIFTON, baron Clifton of Leighton of Bromfild, in England, created 1608. His lordship is known by the title of earl of Darnley, in Ireland; see the earl of DARNLEY, in the Peerage of Ireland.

Charles Dormer, LORD DORMER, of Wenge, and baronet; born 1722, succeeded his father, Oct. 8, 1785. [Creation.] 1615.

Henry Roper, LORD TEYNHAM; born May 3, 1764; succeeded his father Henry, the late lord, Dec. 10, 1786. [Creation.] 1616.

Richard Byron, LORD BYRON, of Rochdale, in holy orders, born Oct. 23, 1724, succeeded his brother William, May 19, 1798. [Creation.] Baron Byron, 1443.

Amabel Campbell, BARONESS LUCAS, born Jan. 22, 1751, succeeded her mother the late marchioness de Grey, Jan. 10, 1797.

William Craven, LORD CRAVEN, born Sept. 1, 1770; succeeded his father, the late lord, Sept. 26, 1791. [Creation.] Lord Craven, 1665.

Charles Clifford, LORD CLIFFORD, of Chudleigh; born Nov. 2, 1759; succeeded Hugh, his father, late lord Clifford, Jan. 15, 1793. [Creation.] Baron Clifford, 1672.

Edmund Boyle, LORD BOYLE, of Marston, in the county of Somerset, succeeded his brother Hamilton, January 17, 1764; his lordship is known by the title of earl of Cork in Ireland; see the earl of Cork in the Peerage of Ireland.

Robert Auriol Drummond, LORD HAY, of Pedwarden, in England; his lordship is known by the title of earl of Kinnoul, in Scotland; see the earl of Kinnoul, in the Peerage of Scotland.

Henry Willoughby, LORD MIDDLETON, of Middleton, and baronet; born Dec. 19, 1726, succeeded his cousin the late lord, Jan. 19, 1781, by writ of summons. [Creation.] Lord Middleton, 1711.

George Onslow, LORD ONSLOW, lord Clandon, who was created lord Cranley, of Ember Court, in Surrey, May 14, 1776, and a baronet; succeeded as lord Onslow and Clandon, on the death of the late lord, Oct. 9, 1766. [Creation.] Baron Onslow, 1716.

Robert Marham, LORD ROMNEY, and a baronet; born Sept. 28, 1744; succeeded his father, the late lord Romney, Nov. 14, 1793. [Creation.] Baron Romney, 1716.

Charles Sloane Cadogan, LORD CADOGAN, baron of Oakley, in Buckinghamshire; born Oct. 29, 1728, succeeded his father Charles, the late lord, Sept. 24, 1776. [Creation.] Baron of Oakley, 1718.

N n

PEERAGE.

Peter King, LORD KING, baron of Ockham, born in 1776, and succeeded his father Thomas, Nov. 23, 1793. [Creation.] 1795.

John Monson, LORD MONSON, born May 25, 1753, succeeded his father the late lord, July 20, 1774. [Creation.] Baron Monson, 1788.

Thomas Bromley, LORD MONTFORT, baron of Horfeath; born Feb. 11, 1733; succeeded his father Henry, the late lord, Jan. 1, 1755. [Creation.] 1741.

John Howe, LORD CHEDWORTH, and baron of Chedworth; born Aug. 22, 1744; succeeded his uncle, Frederick-Henry, the late lord, Oct. 6, 1781, [Creation.] Lord Chedworth 1741.

William Ponsonby, LORD PONSONBY, of Syfinby. See the Earl of Belborough in the Irish Peerage.

Horatio Walpole, LORD WALPOLE, of Woolterton, in Norfolk; born June 12, 1723; succeeded his father, Horatio, the late lord, February 5, 1757. [Creation.] 1756.

Henry-Legge Stawell, LORD STAWELL, of Somerton in the county of Somerset; born Feb. 22, 1717; succeeded his mother, the late baroness, July 29, 1780. [Creation.] Baron Stawell 1760.

Lewis-Thomas Watfon, LORD SONDES of Lees Court in Kent, born April 18, 1754; succeeded his father Nov. 15, 1785. His lordship, upon the death of Thomas, earl of Rockingham, took the name of Watfon.

Thomas Robinson, LORD GRANTHAM, of Grantham in Lincolnshire, and a baronet; was born Dec. 8, 1781, succeeded his father the late lord, July 20, 1786. [Creation.] Baron Grantham 1761.

Nathaniel Curzon, LORD SCARSDALE, and baronet; born Dec. 23, 1727, was created a peer April 9, 1761, by the title of lord Scarisdale of Scarisdale, Derbyshire.

Frederick Irby, LORD BOSTON, and baronet; was born June 9, 1749, and succeeded his father, the late lord, March 30, 1775. [Creation.] Baron Boston, 1761.

Hester Pitt, BARONESS CHATHAM, was advanced to the dignity of a peeress, Oct. 5, 1767, by George III. by the title of baroness Chatham, of Chatham in Kent, with limitation of her heirs male by her late husband, William Pitt, earl of Chatham.

Thomas Pelham, LORD PELHAM, of Stanmer, in the county of Suffex; was born Feb. 26, 1728, succeeded to this title 1768, upon the death of Thomas, the late duke of Newcastle. [Creation.] Baron Pelham, 1752.

Henry-Richard Fox, LORD HOLLAND, baron of Holland, in Lincolnshire, and of Foxley in Wilts; born Nov. 23, 1771; succeeded his father Stephen, the late lord, November 25, 1774. [Creation.] Baron Holland, 1762.

John-James Percival, LORD LOVELL, lord Holland, baron Lovell, baron Holland, and Earl of Egmont, in the kingdom of Ireland, which see in the Peerage of Ireland.

George Venables Vernon, LORD VERNON, and baron of Kinderton, Cheshire; born May 9, 1735, and succeeded his father, August 2, 1780. [Creation.] 1792.

Francis-Reynolds Morton, LORD DUCIE, of Tortworth, in Gloucestershire; born March 28, 1739; succeeded his brother Thomas, the late lord, Sept. 11, 1785. [Creation.] 1763.

John Campbell, LORD SUNDRIDGE, of Combark in the county of Kent; and in failure of this issue to the lords Frederick and William, his brothers, and their heirs, December 20, 1766. His Grace is known by the title of duke of Argyll in Scotland. See duke of Argyll in the Peerage of Scotland.

Martin-Bladen Hawke, LORD HAWKE; born Sept. 20, 1744, succeeded his father, the late lord, Oct. 16, 1781. [Creation.] Baron Hawke, 1776.

William-Pitt Amherst, LORD AMHERST, of Montreal, born Jan. 1773, succeeded his uncle Jeffrey, August 3, 1797.

Brownlow Cuff, LORD BROWNLOW, baron Brownlow, of Belton in Lincolnshire, and a baronet; born Dec. 3, 1744. [Creation.] Baron Brownlow, 1776.

George Pitt, LORD RIVERS, born 1720, was created baron Rivers of Stratfieldsay, in the county of Southampton, May 20, 1776.

Nathaniel Ryder, LORD HARROWBY, baron of Harrowby, in the county of Lincoln; born June 3, 1735; was created a peer May 20, 1776.

Thomas Foley, LORD FOLEY, of Kidderminster; was born Dec. 22, 1780, and succeeded his father, the late lord, July 2, 1793. [Creation.] Baron Foley, 1776.

Edward Thurlow, LORD THURLOW, of Ashfield, in the county of Suffolk, born 1735, created a peer June 2, 1778.

Alexander Wedderburn, LORD LOUGHBOROUGH, in the county of Leicester; born Feb. 13, 1733, was created baron Loughborough, June 14, 1780.

George-Talbot-Rice-Cardonnel, LORD DINEVOR, in Carmarthenshire; born Oct. 8, 1765; succeeded to the barony on the death of his mother the late baroness, March 14, 1793, created Oct. 17, 1780.

William-Hall Gage, LORD GAGE, of Thirle, in Suffex; so created October 17, 1780; and also viscount Gage, of the kingdom of Ireland.

Thomas De Grey, LORD WALSINGHAM, of Walsingham, in the county of Norfolk; born July 14, 1748, succeeded his father, William, the late lord, May 9, 1781. [Creation.] Baron Walsingham, 1780.

William Bagot, LORD BAGO, of Blithfield, in the county of Stafford, and a baronet; born Sept. 11, 1733, succeeded his father Oct. 22, 1798.

Richard-Barre Dunning, LORD ASHBURTON; was born September 20, 1782, and succeeded his father John, the late lord, August 18, 1783. [Creation.] 1782.

William Norton, Lord GRANTLEY, baron of Markenfield, in the county of York; born Feb. 19, 1742, succeeded his father, Fletcher, Jan. 1, 1789. [Creation.] 1782.

George-Ferdinand Fitzroy, LORD SOUTHAMPTON, born Aug. 1761, succeeded his father, March 21, 1797.

George Rodney, LORD RODNEY; born Dec. 25, 1753, succeeded his father George-Bridges, the late lord, May 24, 1791. [Creation.] 1782.

Francis Rawdon-Hastings, LORD RAWDON, earl of Moira, in Ireland, was created Baron Rawdon, of Rawdon in the county of York, March 4, 1783. See the Peerage of Ireland.

Thomas Pitt, LORD CAMELFORD, baron Bocconoc, in the county of Cornwall, created to that title Jan. 5, 1784. He was born Feb. 25, 1773, and succeeded his father, the late lord, May 24, 1793.

Henry-Frederick-Thynne Carteret, LORD CARTERET, of Hawnes, in the county of Bedford, born Nov. 17, 1735, which title was conferred on his lordship January 30, 1784.

Edward Craggs, LORD ELIOT, of St. Germain's, in Cornwall, born July 8, 1727, created to that title January 30, 1784.

Thomas Bulkeley, LORD BULKELEY, of Beaumaris, in the county of Anglesea (so created May 14, 1784); also viscount Bulkely of the kingdom of Ireland. See viscount Bulkely in the Peerage of Ireland.

Thomas Egerton, LORD GREY of WILTON, in the county of Hereford, and a baronet; was advanced to the peerage May 15, 1784.

Charles Cocks, LORD SOMERS, baron of Evesham, in the county of Worcester, and a baronet; born June 29, 1725; was created a peer May 17, 1784.

John Parker, LORD BORINGDON, baron of Boringdon, in the county of Devon; born May 2, 1779, succeeded his father, the late lord, Jan. 1789. [Creation.] 1784.

Thomas Noel Hill, LORD BERWICK, of Attingham, in Shropshire; born Oct. 7, 1774, succeeded his father, the late lord, in 1778. [Creation.] 1784.

James Dutton, LORD SHERBORNE, baron Sherborne, of Sherborne, in the county of Gloucester, born Oct. 1744, created a peer May 20, 1784.

Henry James Scott Montagu, LORD MONTAGU, of Broughton in Northamptonshire, born Dec. 16, 1776, is the second son of the duke of Buccleugh in Scotland, and succeeded to this barony on the death of his grandfather, the late duke of Montagu, in 1790, agreeable to the patent granted in 1786.

James Douglas, LORD DOUGLAS; created an English baron Aug. 8, 1786. His grace is known by the title of duke of Queensbury in Scotland. See the Scotch Peerage.

George de-la Poer Beresford, LORD TYRONE, of Haverford-Weft, created an English baron, Aug. 8, 1786. His lordship is known by the title of marquis of Waterford, in Ireland. For particulars, &c. see marquis of Waterford in the Peerage of Ireland.

Richard Boyle, LORD CARLETON, baron of Carleton, in Yorkshire; created Aug. 8, 1786, a peer of England. His lordship is known by the title of earl of Shannon, in Ireland. See the Peerage of Ireland, &c.

John Hussey Delaval, LORD DELAVAL; created an English peer Aug. 8, 1786; and baron Delaval, in Ireland.

Charles Jenkinson, LORD HAWKESBURY, baron of Hawkbury, in the county of Gloucester, created a peer, August 8, 1786.

Harbord Harbord, LORD SUFFIELD, of Suffield, in the county of Norfolk; born Jan. 26, 1734, created Aug. 21, 1786; also a baronet.

Guy Carleton, LORD DORCHESTER, baron of Dorchester, in the county of Oxford; created Aug. 21, 1786.

Francis Augustus, LORD HEATHFIELD, baron Gibraltar, succeeded his father the late lord, June 6, 1790. [Creation.] Baron Gibraltar, 1788.

Lloyd Kenyon, LORD KENYON, baron of Gredington, in the county of Flint; and a baronet. [Creation.] 1788.

James Harris, LORD MALMSBURY, baron of Malmbury in Wiltshire, born April 20, 1746. [Creation.] 1788.

Archibald Douglas, LORD DOUGLAS, created a peer June 19, 1790.

Edward Lascelles, LORD HAREWOOD, created a peer, June 19, 1790.

Arthur Chichester, LORD FISHERWICK, created an English peer, June 19, 1790. His lordship is known by the title of marquis of Donegal, in the kingdom of Ireland. For particulars see the Irish Peerage.

James Duff, LORD FIFE, created an English peer, June 19, 1790. His lordship is known by the title of earl of Fife, in the kingdom of Ireland. For particulars see the Irish Peerage.

James Bucknall Grimston, LORD VERULAM, created an English peer, June 19, 1790. His lordship is known by the title of viscount Grimstone, in the kingdom of Ireland. For particulars see the Irish Peerage.

William Wyndham Grenville, LORD GRENVILLE, brother to the marquis of Buckingham, born Oct. 25, 1759, was created a peer of Great Britain, by the title of baron Grenville, Nov. 21, 1790.

Archibald Douglas, LORD DOUGLAS, of Douglas Castle, in North Britain; was created July 9, 1770.

George Douglas, LORD DOUGLAS, of Lochleven, was created an English peer, July 16, 1791. His lordship is known by the title of earl of Morton, in the kingdom of Scotland. For particulars see the Scotch Peerage.

Henrietta Laura Pulteney, BARONESS OF BATH, to which title she was created July 21, 1792.

William Eden, LORD AUCKLAND, was created an English peer, May 18, 1793, having been created baron Auckland in Ireland.

John Fitzpatrick, LORD UPPER OSSORY, of Amptill, was created an English peer Aug. 12, 1794. His lordship is known by the title of earl of Upper Ossory, in the kingdom of Ireland. See the Irish Peerage, for his creations, &c.

Edward Clive, LORD CLIVE, of Walcot, in Salop, was created an English peer Aug. 14, 1794. His lordship is a peer of Ireland by the same title.

Henry Phipps, LORD MULGRAVE, was created an English peer Aug. 14, 1794. His lordship is a peer of Ireland by the same title.

William-Henry Lyttleton, LORD LYTTLETON, was created an English peer, Aug. 14, 1794. His lordship is a peer of Ireland by the title of lord Westcote.

Welbore Ellis, LORD MENDIP, was created a peer of England, Aug. 14, 1794, with several remainders.

Henry Bridgman, LORD BRADFORD, and a baronet, was created a peer of England, Aug. 14, 1794.

James Peachy, LORD SELSEY, and a baronet, was created a peer of England August 14, 1794.

Thomas Dundas, LORD DUNDAS, and a baronet, was created a peer of England, Aug. 14, 1794.

Asheton Curzon, LORD CURZON, was created a peer of England, Aug. 14, 1794.

Charles-Anderson Pelham, LORD YARBOROUGH, was created a peer of England, Aug. 14, 1794.

Sufannah Hood, BARONESS HOOD, was created a peeress March 27, 1795.

Francis Stuart, LORD STUART, was created an English peer May 28, 1796. His lordship is earl of Moray in the Scotch Peerage, which see.

John Stewart, LORD STEWART, was created an English peer May 28, 1796. His lordship is earl of Galloway in the Scotch Peerage, which see.

James Stopford, LORD SALTERFORD, was created an English peer May 28, 1796. His lordship is earl of Courtown, in the Irish Peerage, which see.

George Macartney, LORD MACARTNEY, was created an English peer May 28, 1796. His lordship is earl Macartney in the Irish Peerage, which see.

John Christopher-Dawney Burton, LORD DAWNEY was created an English peer May 28, 1796. His lordship is viscount Downe in the Irish Peerage, which see.

George Broderick, LORD BRODERICK, was created an English peer May 28, 1796. His lordship is viscount Middleton in the Irish Peerage, which see.

Alexander-Arthur Hood, LORD BRIDPORT, was created May 28, 1796.

John Rous, LORD ROUS, was created May 28, 1796. His lordship is likewise a baronet.

Henry-Gough Calthorpe, LORD CALTHORP, and a baronet, succeeded his father, who was created June 24th, 1787, March 16, 1798.

Peter Burrell, LORD GWYDDIR, and baronet, was created May 28, 1796.

Francis Basset, LORD DE DUSTANVILLE, and baronet, was created May 28, 1796.

Edward Lascelles, LORD HAREWOOD, was created May 28, 1796.

John Rolle, LORD ROLLE, was created May 28, 1796.

PEERAGE.

John Campbell, LORD CAWDOR, was created May 28, 1796.
 Richard Colby-Walley, LORD WELLESLEY, was created Oct. 10, 1797.
 Robert Smith, LORD CARRINGTON, was created Oct. 10, 1797.
 James Grenville, LORD GLASTENBURY, was created Oct. 10, 1797.
 Charles Townshend, LORD BAYNING, was created Oct. 10, 1797.
 Thomas-Orde Powlett Bolton, LORD BOLTON, was created Oct. 10, 1797.
 Gilbert Elliot, LORD MINTO, was created Oct. 10, 1797.
 John Wodehouse, LORD WODEHOUSE, and baronet, was created Oct. 10, 1797.
 John Ruthout, LORD NORTHWICK, and baronet, was created Oct. 10, 1797.
 Thomas Powis, LORD LILFORD, was created Oct. 10, 1797.
 Thomas Lister, LORD RIBBLESDALE, was created Oct. 10, 1797.
 James Drummond, LORD PERTH, was created Oct. 10, 1797.
 Francis Humberstone Mackenzie, LORD SEAFORTH, was created Oct. 10, 1797.
 Horatio Nelson, LORD NELSON, of the Nile, was created Oct. 6, 1798.
 George Leveson Gower, LORD GOWER, was created Feb. 25, 1799.

PART II. PEERAGE OF SCOTLAND.

SECT. I. DUKES.

Peers of Blood Royal, have nominal Titles, but no Votes for the Sixteen Peers.

Prince George-Augustus-Frederick Prince of Great Britain, Prince of Wales, DUKE of ROTHESAY, earl of Carrick and baron of Renfrew, lord of the isles, and great steward of Scotland. See duke of Cornwall in the Peerage of England.

Prince Frederick, DUKE of ALBANY in Scotland, and York in Great Britain. See duke of York in the Peerage of England.

Prince William-Henry, DUKE of St. ANDREWS in Scotland, and Clarence in England. See duke of Clarence in the Peerage of England.

Prince William-Henry DUKE of EDINBURGH in Scotland, and Gloucester in England. See duke of Gloucester in the Peerage of England.

Archibald Hamilton, DUKE of HAMILTON, in Scotland, Chattelherault in France, and Brandon in England; marquis of Hamilton, Clydale, and Douglas; earl of Angus, Arran, and Lanerk, Lord Macanishire, Polmont, Abernethy, Aberbrothick, Dutton, and Hamilton in England; hereditary keeper of the king's palace of Holyrood-house at Edinburgh; succeeded his nephew the late duke, in 1799. [Creation.] Duke of Hamilton, 1643.

Henry Scott, DUKE of BUCCLEUGH, earl of Buccleugh, earl of Dalkeith, baron Scott of Buccleugh and Eldale, in Scotland, and a peer of England, by the title of lord Tinsdale, in Northumberland, and earl of Doncaster, in Yorkshire; was born Sept. 2, 1746, and succeeded his grandfather Francis, the late duke, April 22, 1751. [Creation.] Duke of Buccleugh, 1673.

Charles Lennox, DUKE of LENNOX, in Scotland. His grace is known by the title of duke of Richmond, in England, and Aubigny in France. See duke of Richmond, in the peerage of England.

Alexander Gordon, DUKE of GORDON, marquis of Huntley, earl of Huntley, earl of Enzie, and baron Gordon of Strathbogy, viscount of Inverness, lord Badenoch, Lochaber, Strathaven, Achindon, Balmore, Grately, and Kilkardine, Scotch honours; lord Gordon of Huntley, and earl of Norwich, English honours; succeeded his father, Cosmo-George, the late duke, in Aug. 1752. [Creation.] Duke of Gordon, 1684.

James Douglas, DUKE of QUEENSBURY, marquis of Queensbury and Dumfries, earl of Queensbury, March, Ruglen, Drumlanrig, Sanquar, and Solway, viscount Drumlanrig, Nith, Torthorald, Tibbers, and Rois; Middleby, Tibbers and Dornick; baron Douglas in the English Peerage, succeeded his father as earl of March, and as earl of Ruglen in right of his mother; and in 1778, on the death of the late duke, became duke of Queensbury, &c. [Creation.] Duke of Queensbury, 1684.

John Campbell, DUKE of ARGYL, marquis of Argyll, Lorn, and Kintyre, earl of Argyll, Campbell, and Cowal; viscount Locho, and Glenilla; lord of Laveray, Mull, Morven, and Tyrie; succeeded his father, the late duke of Argyll, Nov. 17, 1770. [Creation.] Duke of Argyll, 1701.

John Murray, DUKE, MARQUIS, and EARL of ATHOL, marquis and earl of Tullibardin; viscount Glenalmond, lord Murray, and lord of the Isle of Man; Earl Strange, and baron Murray in England; was born June 30, 1755, and succeeded his father, the late duke, Nov. 4, 1774. [Creation.] Duke of Athol, 1675.

James Graham, DUKE of MONTROSE, marquis of Montrose, earl of Montrose, marquis Graham, and lord Graham, Dundaff, Kincarn, Mindoc and Kinabur, in Scotland; and earl and lord Graham of Belford, in the county of Northumberland, in England; born Sept. 8, 1755; succeeded his father Sept. 25, 1790. [Creation.] Duke of Montrose, 1707.

John Kerr, DUKE of ROXBURGH, marquis of Beaumont and Cesford; earl of Roxburgh and Kelso; viscount Broxmouth, lord Kerr, of Roxburgh, Cesford, and Caverton, in Scotland; and also an English peer, by the title and title of earl Kerr, of Wakefield, in the county of York, was born in April, 1740, and succeeded his father Robert, the late duke, Aug. 20, 1755. [Creation.] Duke of Roxburgh, 1707.

SECT. II. MARQUISES.

George Hay, MARQUIS of TWEEDALE, earl Tweedale, viscount Peebles, and lord Yester, succeeded his cousin, Nov. 16, 1787. [Creation.] Marquis of Tweedale, 1694.

William John Kerr, MARQUIS of LOTHIAN, earl of Lothian, earl of Ancrum, lord Kerr of Newbottle and Jedburgh; born 1737, and succeeded his father, the late marquis, April 20, 1775. [Creation.] Marquis of Lothian, 1701.

John Johnston, MARQUIS of ANNANDALE, earl of Annandale, earl of Hartfield, viscount Annan, and Lord Johnston, of Lockwood, Lochmaban and Moffat, in Annandale; a baronet, and hereditary keeper of Lochmaban; succeeded his cousin the late marquis, in 1792. [Creation.] Marquis of Annandale, 1701.

SECT. III. EARLS.

Elizabeth Sutherland, COUNTESS of SUTHERLAND, and baroness Strathnaver, in the county of Sutherland; born June, 1765, succeeded her father June 16, 1766. [Creation.] Earl of Sutherland, 1057.

George Lindsay Crawford, EARL of CRAWFORD, earl of Lindsay; viscount and lord Garnock; lord Crawford and Spinzy, succeeded his father George, the late earl, June 25, 1781. [Creation.] Earl of Crawford, in the county of Lanerk, 1399.

William Hay, EARL of ERROL, lord Hay of Slaines, hereditary high constable of Scotland; born May 13, 1767, and succeeded his brother June 24, 1795. [Creation.] Earl of Errol, 1458.

Jane Elizabeth Leslie, COUNTESS of ROTHES, baroness of Lesley, and Bumbreigh, succeeded her brother John, June 18, 1773. [Creation.] Earl of ROTHES, in the county of Elgin, 1437.

John Sinclair, EARL of CAITHNESS, and lord Barendale, succeeded the late earl in 1789. [Creation.] Earl of Caithness, 1456.

George Keith, EARL MARISHAL, lord Keith, lord Marishal of Scotland, and hereditary sheriff in the county of Kincardin; which titles, on the death of the late earl marishal in 1778, became extinct in this branch; but was claimed Sept. 8, 1782, by George Keith, Esq. of Northfield, a descendant of Sir Robert Keith, which claim was examined before a respectable jury of noblemen and gentlemen, of which the earl of Buchan was chancellor. Such a connected chain of evidence from 1413, was produced, as is without a parallel even in the annals of Scotch nobility, much more in those of this country. [Creation.] Earl Marishal, 1755.

George Douglas, EARL of MORTON, and lord Aberdour, in Fifeshire, and baron Douglas in England, succeeded his father, Sept. 27, 1774. [Creation.] Earl of Morton, in the county of Edinburgh, 1456.

David Stewart Erskine, EARL of BUCHAN, and baron Cardross of Menteith, in the county of Perth; succeeded his father Dec. 1, 1767. [Creation.] Earl of Buchan, in 1469.

John Gunningham, EARL of GLENCAIRN, and lord Kilmaures, succeeded the late earl, Oct. 1, 1796. [Creation.] Earl of Glencairn, in the county of Dumfries, 1488.

Archibald Montgomery, EARL of EGLINTOUN, and lord Montgomerie, in the district of Coningham, in the county of Air, succeeded the late earl, Oct. 18, 1796. [Creation.] Earl of Eglington, in 1503.

Archibald Kennedy, EARL of CASSILLIS, and lord Kennedy, succeeded his father, the late earl, Dec. 29, 1794. [Creation.] Earl of Cassillis, 1509.

Francis Stewart, EARL of MORAY, and lord Down, of Down in Menteith, in the county of Perth, succeeded his father July 7, 1767. [Creation.] Earl of Moray, 1561.

William Home, EARL of HOME, and baron of Douglas, succeeded his father Dec. 14, 1786. [Creation.] Earl of Home, 1604.

John Home, EARL of DUNBAR, descended from Alexander, 1st earl of Dunbar and Home, so created by James VI. March 4, 1604. This title was claimed by John Home, Esq. of the county of Berwick, and allowed him by the sheriff and a respectable jury, Oct. 11, 1776, being descended from Sir Alexander Home, to whom the title was adjudged, 1689.

John Bowes Lyon, EARL of STRATHMORE, and earl Kinghorn, lord Lyon and Glamis, succeeded his father the late earl, in April, 1776. [Creation.] Earl of Strathmore, soon after the restoration of Charles II.

John James Hamilton, EARL of ABERCORN, and lord Abercorn, lord Paisley, also viscount Strabane in Ireland, and lord Mountcastle, Kilpatrick, and baronet of the same kingdom; likewise marquis of Abercorn, and viscount Hamilton, in England; succeeded his uncle James, the late earl, Oct. 9, 1789. [Creation.] Earl of Abercorn, 1606.

Charles Erskine, EARL of KELLIE, viscount Fenton, and lord Dirleton, premier viscount of Scotland; born in 1736, succeeded his cousin May 8, 1797. [Creation.] Earl of Kellie, 1619.

Charles Hamilton, EARL of HADDINGTON, and lord Binning, succeeded his father Thomas, May 10, 1794. [Creation.] Earl of Haddington, 1619.

John Stewart, EARL of GALLOWAY, and lord Garlies, knight of the Thistle; succeeded his father the late earl, Sept. 23, 1773. [Creation.] Earl of Galloway, 1623.

James Maitland, EARL of LAUDERDALE, viscount Maitland, lord Thirlstane, Musselburgh, and Bolton; hereditary royal standard-bearer of Scotland, and a baronet; succeeded Charles his father, Aug. 17, 1789. [Creation.] Earl of Lauderdale, 1623.

Flora Muir Campbell, COUNTESS and BARONESS of LOUDON, and baroness Macblane, succeeded her father the late earl, who died April 28, 1786. [Creation.] Earl of Loudon, 1633.

Robert Auriol Drummond, EARL of KINNOUL, viscount Duplin, and baron of Kinfauns in Scotland, and baron Hay of Pedwarden, in England; succeeded Thomas May, the late earl, Dec. 27, 1787. [Creation.] Earl Kinnoul, 1633.

Patrick Crichton, EARL of DUMFRIES, viscount Air, and lord Crichton, of Sanquhar, Cummock, &c. succeeded in the right of his mother, upon the death of his uncle, the late earl of Dumfries, July 27, 1768. [Creation.] Earl of Dumfries, 1633.

Thomas Bruce, EARL of ELGIN, earl of Kincardin, lord Bruce of Kinlofs and Torry, succeeded on the death of his brother the late earl, July 8, 1777. [Creation.] Earl of Elgin, 1611.

Francis Charteris Wemyss-Charteris, EARL of WEMYSS. [Creation.] Earl of Wemyss, 1633.

George Ramsay, EARL of DALHOUSIE, and lord Ramsay, succeeded his father George, the late earl, Nov. 15, 1787. [Creation.] Earl of Dalhousie, 1633.

Charles Stewart, EARL of TRAQUAIR, lord Traquair, and lord Linton, succeeded his father, April, 1779. [Creation.] Earl of Traquair, 1633.

David Ogilvie, EARL of AIRLY, 1637, lord Ogilvie and Lentrathin, 1637. [Creation.] Earl of Airly, 1637.

James Ogilvie, EARL of FINLATER and SEAFIELD, viscount Redhaven, and lord Delford, succeeded his father in 1770. [Creation.] Earl of Finlater and Seafield, 1637.

David Lesly, EARL of LEVEN, earl of Melvil, lord Melvil and Balgony; succeeded his father Alexander, September 2, 1754. [Creation.] Earl of Leven, 1641.

William Tollemache, EARL of DYSART, lord Huntingtoun, baronet; born 1747, succeeded his brother, the late earl, Feb. 22, 1799. [Creation.] Earl of Dysart, 1646.

Dunbar Douglas, EARL of SELKIRK, lord Dair, succeeded his grand-uncle John, the late earl, in 1745. [Creation.] Earl of Selkirk, 1646.

William Carnegie, EARL of NORTHESK, lord Rosehill, succeeded his father George, the late earl, June 21, 1792. [Creation.] Earl of Northesk, 1647.

Alexander Lindsay, EARL of BALCARRAS, and lord Lindsay, of Cumbernald, succeeded his father, the late earl, in March, 1767. [Creation.] Earl of Balcarras, 1651.

Anthony James Radcliffe, EARL of NEWBURGH, viscount Newburgh, and lord Kennard, who succeeded his father James Bartholomew, the late earl, Jan. 2, 1786. [Creation.] Earl of Newburgh, 1647.

George Gordon, EARL of ABOYNE, and lord Gordon of Glenlivet and Strathaven, succeeded Charles, his father Dec. 28, 1794. [Creation.] Earl of Aboyne, 1661.

Archibald Cochran, EARL of DUNDONALD, and lord Cochran, succeeded his cousin, the late earl, April 5, 1778. [Creation.] Earl of Dundonald, 1669.

Anthony Keith Falconer, EARL of KINTORE, lord Keith, and is claimed by the above. [Creation.] 1677.

John

PEERAGE.

John Campbell, EARL of BREADALBANE, viscount Glenorchy, lord Campbell, and baronet; born in 1762, succeeded his distant cousin John, in July, 1782. [Creation.] Earl of Breadalbane, 1677.

George Gordon, EARL of ABERDEEN, and lord Haddo, in the county of Aberdeen, succeeded his father William, 1715. [Creation.] Earl of Aberdeen, 1682.

John Murray, EARL of DUNMORE, viscount Fincaisle, and lord Murray, of Blair, Moulin, and Tilimet, succeeded his father William, Dec. 1, 1756. [Creation.] Earl of Dunmore, 1686.

Mary Hamilton, COUNTESS of the ISLANDS of ORKNEY, viscountess Kirkwall, and baroness Deghmont; born Sept. 4, 1755, succeeded her mother Anne, May 10, 1790. [Creation.] Countess of the Islands of Orkney, 1696.

Thomas Carmichael, EARL of HYNDFORD, lord Carmichael, and baronet; succeeded upon the death of the late earl, in 1787. [Creation.] Earl of Hyndford, 1701.

John Dalrymple, EARL STAIR, viscount Stair, and lord Stair of Dalrymple, of Newliston and Stranrawer, succeeded upon the death of the late earl of Stair, Oct. 1789. [Creation.] Earl of Stair, 1703.

Niel Primrose, EARL of ROSEBERRY, viscount Roseberry, lord Dalmeiney, succeeded his father James, the late earl Nov. 20, 1735. [Creation.] Earl of Roseberry, 1701.

George Boyle, EARL of GLASGOW, viscount Kelburn, and lord Boyle, of Stewarton; born March 26, 1766, succeeded his father, the late earl, March 22, 1775. [Creation.] Earl of Glasgow, 1703.

John Stuart, EARL of BUTE, viscount and lord Mount-Stuart, baron Mount-Stuart, likewise marquis of Bute, and baron Cardiffe, in the English peerage; succeeded his father, the late earl, Jan. 28, 1783. [Creation.] Earl of Bute, 1703.

James Hope, EARL of HOPE TOUN, viscount Aithrie, and lord Hope, succeeded his father, Feb. 12, 1781. [Creation.] Earl of Hopetoun, 1703.

William Charles Colyear, EARL of PORTMORE, viscount Malfington, in the county of Roxburgh, and lord Portmore, succeeded his father Charles, the late earl, in 1785. [Creation.] Earl of Portmore, 1703.

Henry Scot, EARL of DELORAINE, viscount Hermitage, and baron Scot of Goldylands, all in the county of Roxburgh; born in Jan. 1736, succeeded his father Henry, in Jan. 1740. [Creation.] Earl of Deloraine, 1706.

SECT. IV. VISCOUNTS.

Charles John Cary, VISCOUNT FALKLAND, and lord Cary, succeeded his brother Henry Thomas, May 21, 1796. [Creation.] Viscount Falkland, 1620.

David Murray, VISCOUNT STORMONT, lord of Scoope and Balvaird, knight of the Thistle, and earl of Mansfield in the English Peerage, which see. [Creation.] Viscount Stormont, 1612.

John Arbuthnot, VISCOUNT ARBUTHNOT, lord Arbuthnot, in the county of Kincardin, succeeded his father John, the late viscount, in May 21, 1791. [Creation.] Viscount Arbuthnot, 1641.

George William Frederick Osborne, VISCOUNT LATIMER and DUNBLAIN; also Duke of Leeds, &c. in the English Peerage, which see.

SECT. V. BARONS.

Hugh Somerville, LORD SOMERVILLE, succeeded his uncle James, April 17, 1796. [Creation.] Baron Somerville, 1424.

James Forbes, LORD FORBES, succeeded his father in 1763. [Creation.] Baron Forbes, 1440.

William Cathcart, LORD CATHCART, succeeded his father Aug. 13, 1776. [Creation.] Baron Cathcart, 1445.

George Frazer, LORD SALTOUN, lord Abernethy, succeeded his brother Alexander, Sept. 12, 1793. [Creation.] Baron Saltoun, 1445.

William John Gray, LORD GRAY, succeeded his father John, in Aug. 1782. [Creation.] Lord Gray, 1445.

Charles Sinclair, LORD SINCLAIR, who proved his descent from Matthew Sinclair, 4th son of Henry, 7th lord Sinclair; and on his claiming the honours of his family, in 1782, they were allowed him, the attainer having been reversed.

Hugh Semple, LORD SEMPLE, in the county of Renfrew; succeeded the late lord, in Feb. 1782. [Creation.] Lord Semple, 1489.

John Elphinstone, LORD ELPHINSTON, succeeded his father John Aug. 19, 1794. [Creation.] Baron Elphinstone, 1509.

James Sandilands, LORD TORPICHEN, in West Lothian, succeeded his father in 1765. [Creation.] 1563.

John Leslie, LORD LINDORES, in the county of Fife, succeeded on the death of the late lord, June 27, 1775. [Creation.] Baron Lindores, 1600.

Robert Walter Stewart, LORD BLANTYRE, in the county of Lanerk; born Dec. 26, 1775, succeeded his father Oct. 30, 1783. [Creation.] Baron Blantyre, 1606.

John Colville, LORD COLVILLE, of Culrofs, succeeded his brother Alexander, May 21, 1770. [Creation.] Baron Colville, 1609.

Francis Napier, LORD NAPIER, of Merchiston, succeeded his father William, Jan. 2, 1775. [Creation.] Baron Napier, 1627.

James Cranston, LORD CRANSTON, in the county of Edinburgh, succeeded his brother William, July 29, 1778. [Creation.] 1680.

Eric Mackay, LORD REAY, in the county of Caithness, and baronet, succeeded his brother George, in 1797. [Creation.] Baron Reay, 1628.

Walter Aiton, LORD ASTON, of Forfar, in the county of Forfar, succeeded to this title on the death of the late lord, in March, 1768. [Creation.] Baron Aiton, 1620.

John Maclellan, LORD KIRCUDBRIGHT, succeeded his father, Dec. 2, 1772. [Creation.] Baron Kircudbright, 1633.

C. cilia Cockbourn, BARONESS FORRESTER, of Costorpin in Mid-Lothian, succeeded her mother 1784. [Creation.] Baron Forrester, 1633.

William Ogilvie, LORD BANFF, succeeded his father Dec. 2, 1771. [Creation.] Baron Banff, 1642.

Alexander Murray, LORD ELIBANK, and baronet, succeeded his uncle the late lord, Nov. 12, 1785. [Creation.] Baron Elibank, 1643.

David Falconer, LORD HALKERTOUN, succeeded his brother William, the late lord, December 12, 1776. [Creation.] Baron Halkertoun, 1647.

John Rollo, LORD ROLLO, born 1773, succeeded his father John, 1784. [Creation.] Baron Rollo, 1649.

James Ruthven, LORD RUTHVEN, of Freeland, in the county of Perth, succeeded his father, Dec. 27, 1789; born Oct. 16, 1777. [Creation.] Baron Ruthven, 1651.

John Leslie, LORD NEWARK, succeeded his father, Alexander, March 10, 1791, but his vote was rejected in Feb. 1793. [Creation.] Baron Newark, 1660.

William Kerr Bellenden, LORD BELLENDEN, in the county of Selkirk, succeeded his cousin Kerr, the late lord, in 1797. [Creation.] Baron of Belenden, 1661.

George Kinnaird, LORD KINNAIRD, of Infture in the county of Perth, succeeded his father, August, 1, 1767. [Creation.] Lord Kinnaird, 1682.

PART III.

PEERAGE OF IRELAND.

Peers of Blood Royal.

Prince Frederick, EARL of ULSTER, in the kingdom of Ireland. See duke of York, in the Peerage of England.

Prince William Henry, EARL of MUNSTER, in the kingdom of Ireland. See duke of Clarence, in the Peerage of England.

Prince Edward, EARL of DUBLIN, in the kingdom of Ireland. See duke of Kent in the Peerage of England.

Prince Ernest Augustus, EARL of ARMAGH, in the kingdom of Ireland. See duke of Cumberland in the Peerage of England.

Prince William Henry, EARL of CONNAUGHT, in the kingdom of Ireland. See duke of Gloucester, in the Peerage of England.

SECT. I. DUKE.

William Robert Fitzgerald, DUKE of LEINSTER, marquis Kildare, earl and baron of Offaley; and viscount Leinster, of Taplow, in the kingdom of Great Britain; was born March 2, 1749, and succeeded his father, the late duke, Nov. 19, 1773. [Creation.] Duke of Leinster, 1766.

SECT. II. MARQUIS.

George de la Poer Beresford, MARQUIS of WATERFORD, earl and viscount of Tyrone, lord Beresford of Beresford, and baronet; born Jan. 8, 1735, succeeded his father Marcus, the late earl, April 4, 1763. [Creation.] Marquis of Waterford, 1789.

Arthur Hill, MARQUIS of DOWNSHIRE, earl and viscount Hillborough, viscount and lord Kilwarling, Irish titles; and earl of Hillborough, viscount Fairford, and baron Harwich in England; born Feb. 23, 1753, succeeded his father, Oct. 17, 1793. [Creation.] Marquis Downshire, 1789.

George Augustus Chichester, MARQUIS and EARL of DONNEGAL, viscount Chichester, earl and lord Belfast, also baron Fiferwick in England, succeeded his father the late marquis in 1799; born Aug. 13, 1769. [Creation.] Marquis of Donegal, 1791.

Charles Moore, MARQUIS and EARL of DROGHEDA, viscount Moore, and baron Melifont; born June 29, 1730, succeeded his father Edward, Oct. 28, 1758. [Creation.] Marquis of Drogheda, 1792.

SECT. III. EARLS.

Walter Butler, EARL of ORMOND and OSSORY, and viscount Thurles, [Creation.] Earl of Ormond and Ossory, 1526.

John Richard Boyle, EARL of CORK, earl of Orrery, viscount Donagrove, lord Boyle of Youghall, lord Borghill, and baron Boyle in England; was born Nov. 21, 1742, and succeeded his father the late earl, Oct. 1790. [Creation.] Earl of Cork, 1620.

George Frederick Nugent, EARL of WESTMEATH, lord Delvin; born Nov. 18, 1760; succeeded his father, the late earl, Sept. 7, 1792. [Creation.] Earl of Westmeath, 1621.

Edward Brabazon, EARL of MEATH, lord Brabazon and Ardee; succeeded his cousin, May 26, 1797. [Creation.] Earl of Meath, 1620.

Henry Barry, EARL of BARRYMORE, viscount Buttevant, lord Barry of Oleanth and Ibanne, was born Aug. 16, 1770, and succeeded his brother, March 5, 1793. [Creation.] Earl of Barrymore, 1627.

John Thomas De Burgh, EARL of CLAWICKARDE, and baron Durkellin, succeeded his brother Henry Dec. 8, 1797.

Arthur James Plunket, EARL of FINGAL, baron Kellen, succeeded his father, the late earl, Aug. 21, 1793, born Sept. 9, 1759. [Creation.] Earl of Fingal, 1628.

Richard Lambert, EARL of CAVAN, viscount Kilcoursy, and lord Lambert, born Sept. 10, 1763, succeeded his father, the late earl, in 1778. [Creation.] Earl of Cavan, 1647.

Murrough O'Brien, EARL of INCHQUIN, lord Burren, and Knight of St. Patrick, succeeded his uncle June 8, 1777. [Creation.] Earl of Inchiquin, 1454.

Charles-Henry Coote, EARL of MOUNTRATH, viscount Castle-Coote, lord Castle-Cuff, and baronet; succeeded his father Algernon in August, 1744. [Creation.] Earl of Mountrath, 1660.

George Forbes, EARL of GRANARD, viscount Granard, lord Chenehugh, and baronet; born June 14, 1760, succeeded his father, the late earl, April 10, 1780. [Creation.] Earl of Granard, 1684.

Frederick-Christian-Rhyndhart de Ginkell, EARL of ATHLONE, viscount of Aghrim, and lord of Ballymore, succeeded his father, the late earl, in 1712. [Creation.] Earl of Athlone, 1691.

William Fitz-William Wentworth, EARL FITZ-WILLIAM, viscount Milton, and baron Fitz-William, of Lifford in Ireland; also earl Fitz-William, viscount Milton, and lord Milton, in Northamptonshire in England. See the Peerage of England. He was born May 30, 1748, and succeeded his father William, the late earl, Aug. 9, 1756. [Creation.] Earl Fitz-William, 1716.

Francis Thomas Fitz-Maurice, EARL of KERRY, viscount Clan-Maurice, lord Kerry and Linaw; born Sept. 9, 1740, and succeeded his father William, April 4, 1747. [Creation.] Earl of Kerry, 1722.

John Bligh, EARL DARNLEY, viscount Darnley, lord Clifton of Rathmore, also lord Clifton of Leighton Bromfield, in England; succeeded his father John, the late earl, July 31, 1781; born June 30, 1767. [Creation.] Earl of Darnley, 1724.

John-James Percival, EARL of EGMONT, viscount Percival, of Kinturk, lord Percival of Burton, and baronet, lord Lovel and Holland of Esmore, in Great Britain, born Jan. 29, 1738, succeeded his father, the late earl, Dec. 20, 1771. [Creation.] Earl of Egmont, 1733.

William Ponsonby, EARL of BESBOROUGH, viscount Duncannon, lord Westborough, in Ireland; lord Ponsonby, baron Ponsonby of Syfonby, in England, born Jan. 24, 1758, succeeded his father William, the late earl, March 11, 1793. [Creation.] Earl of Besborough, 1739.

Henry-Thomas Butler, EARL of CARRICK, viscount Ikernie, and lord Butler, of Lismullen; was born May 19, 1746, and succeeded his father, the late earl, in May 1774. [Creation.] Earl of Carrick, 1748.

John Fitz-Patrick, EARL of UPPER OSSORY, in Queen's county, lord Gowran, in the county of Kilkenny; and baron of Amphill in England, born in May 1745, succeeded his father John, the late earl, Sept. 23, 1758. [Creation.] Earl of Upper Ossory, 1751.

William Petty, EARL of SHELBURNE, viscount Fitz-Maurice, lord Dunkerton. His lordship is known by the title of marquis of Lansdown in England. See marquis of Lansdown in the Peerage of England.

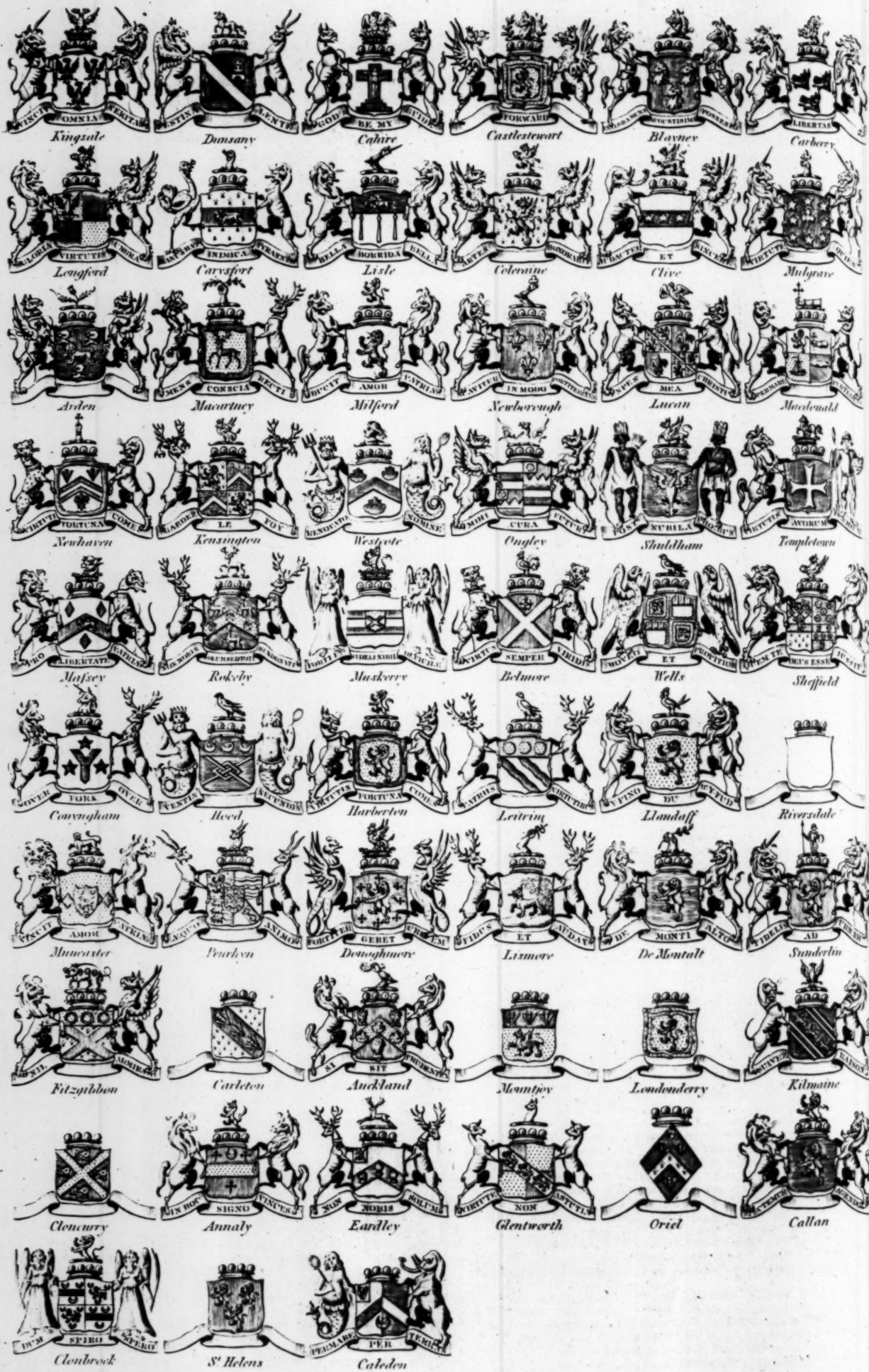
Richard Boyle, EARL of SHANNON, viscount Bandon, in the county of Cork, lord Boyle, of Castle-Martyr, in Ireland; and baron Carleton, of Great Britain, born Jan. 30, 1727, succeeded his father, Dec. 28, 1764. [Creation.] Earl of Shannon 1756.

Clothworthy Skeffington, EARL MASSARENE, viscount and lord Lough-Neagh, and baronet; born Jan. 28, 1743; succeeded his father Clothworthy, the late earl, in 1764. [Creation.] Earl of Massarene 1756.

Robert Herbert Butler, EARL of LANESBOROUGH, viscount Lanef-
borough,

a
e
f
d
b,
]
o.
o,
c.
o,
L,
i,
a.
o,
t.
o,
n-
d;
o.
on
t.]
ac-
rry
er,
ur-
his
of
am-
ca-
ght
chi-
ote,
uul,
one-
earl,
ount
y 42.
ount
Wil-
and.
e led
Wil-
man-
ather
tath-
is fa-
ise.]
Kun-
En-
e earl,
lord
Eng-
March
d lord
er, the
r, lord
born
[Cre-
t, lord
own in
nty of
Great
ation.]
Lough-
worthy,
Lanc-
rough,

Barons of Ireland. See the System of Peerage

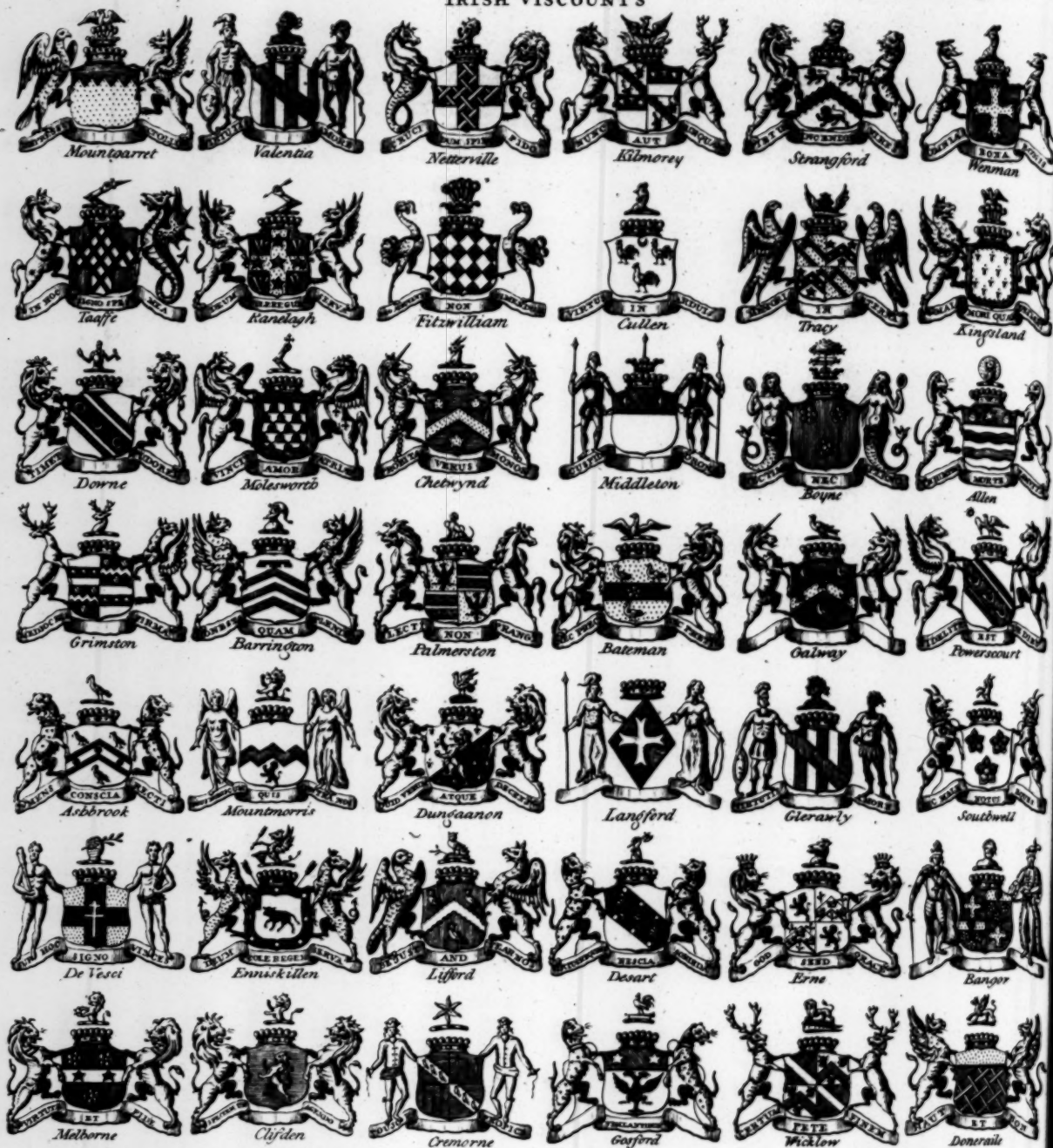




Viscounts, & Bishops of Ireland, See System of Peerage!

Plate 8

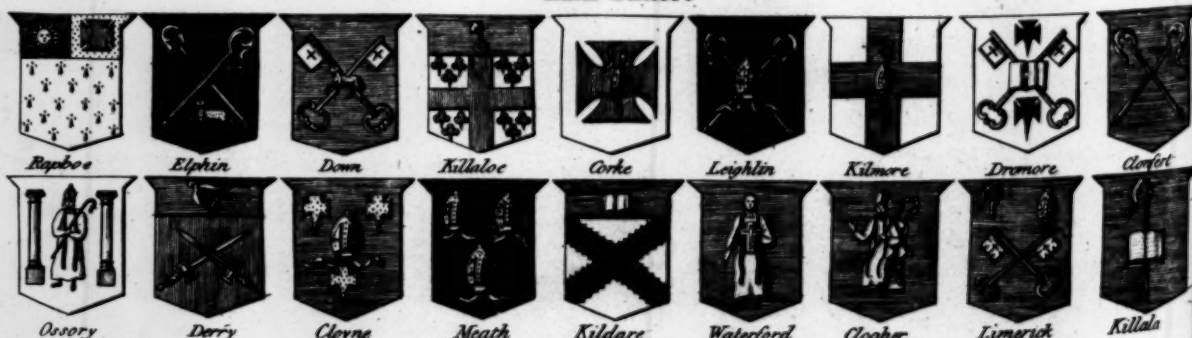
IRISH VISCOUNTS



IRISH ARCHBISHOPS



IRISH BISHOPS



PEERAGE.

borough, lord Newton-Butler, born July 1761, succeeded his father Humphrey in January 1779. [Creation.] Earl of Lanborough 1756.

George Rotchford, EARL of BELVEDERE, viscount Belfield, lord Belfield, born Oct. 12, 1738, succeeded his father, the late earl, Nov. 5, 1774. [Creation.] Earl of Belvedere 1756.

James Duff, EARL of FIFE, viscount Macdoff, lord Braco, of Kilbryde, in the county of Cavan, and baron Fife in England, succeeded his father William, the late earl, in December 1763. [Creation.] Earl of Fife 1759.

Richard Colley-Welley, EARL of MORNINGTON, viscount Wellesley, of Dengencastle, lord Mornington of Mornington in the county of Meath; was born June 20, 1760, and succeeded his father May 22, 1784. [Creation.] Earl of Mornington 1760.

Peter Ludlow, EARL of LUDLOW, viscount Preston, and Lord Ludlow, of Ardilla, in the county of Meath, born April 21, 1730, succeeded his father in 1750. [Creation.] Earl of Ludlow 1760.

George Carpenter, EARL of TYRCONNEL, viscount Callingsford, and lord Carpenter, of Killaghy, in the county of Kilkenny; born June 3, 1750, succeeded his father George, the late earl, March 8, 1762. [Creation.] Earl of Tyrconnel, 1761.

Francis Rawdon Hastings, EARL of MOIRA, lord Rawdon and baronet, also baron Rawdon in England, and on the death of his uncle the late earl of Huntingdon, took the name of Hastings, born Dec. 7, 1754, and succeeded his father John, the late earl, June 20, 1793. [Creation.] Earl of Moira, 1761.

Arthur-Saunders Gore, EARL of ARRAN, viscount Sudley, of Cattle-Gore, in the county of Mayo, lord Saunders, of Deeps, in the county of Wexford, was born July 23, 1734, succeeded his father, the late earl, April 21, 1773. [Creation.] Earl of Arran 1762.

James Stopford, EARL of COURTOWN, viscount Stopford, and lord Courtown, in the county of Wexford; born May 28, 1731, succeeded his father James Jan. 22, 1770. [Creation.] Earl of Courtown 1762.

Joseph Leeson, EARL of MILLTOWN, in the county of Dublin, viscount Rusborough, of Ruffellstown, and lord Rusborough of Rusborough, in the county of Wicklow, born Dec. 13, 1729, succeeded his father Oct. 2, 1751. [Creation.] Earl of Milltown 1763.

James Caulfield, EARL CHARLEMOUNT, viscount Charlemount, and lord Caulfield, in the county of Armagh, born August 22, 1728, succeeded his father James, the late viscount, April 21, 1735. [Creation.] Earl of Charlemount 1763.

John Saville, EARL of MEXBOROUGH, of Lifford in the county of Donegal, viscount Pollington, of Ternes, and lord Pollington, of Longford; born April 8, 1761, succeeded his father John, Feb. 12, 1778. [Creation.] Earl of Mexborough, 1766.

Edward Garth Turnour, EARL of WINTERTON, viscount Turnour, lord Winterton of Gort, in the county of Galway, succeeded his father August 10, 1788. [Creation.] Earl of Winterton, 1766.

Thomas Taylor, EARL BECTIVE, viscount Headfort, lord Headfort, in the county of Meath; born Nov. 18, 1757, succeeded his father Feb. 14, 1795, was created an earl, 1766.

George Maion-Villiers, EARL GRANDISON, of Dromana, in the county of Waterford, and viscount Grandison, born July 23, 1751, succeeded his mother Elizabeth in 1782. [Creation.] Earl Grandison, 1766.

Thomas St. Lawrence, EARL of HOWTH, viscount St. Lawrence, and lord Howth, in the county of Dublin; born May 10, 1730, succeeded his father William, April 4, 1748. [Creation.] Earl of Howth, 1767.

Charles Coote, EARL of BELLAMONT, lord Coote, of Colony, upon the death of the late earl of Bellamont, 1764, succeeded to the barony of Colony. [Creation.] Earl of Bellamont, 1767.

George King, EARL of KINGSTON, of Roscommon, viscount and lord Kingston, of Kingsborough, succeeded his father April 17, 1799. [Creation.] Earl of Kingston, 1768.

William Molyneux, EARL of SEFTON, and viscount Molyneux, of Marborough, and baronet; born Sept. 18, 1772, succeeded his father, Charles William, Dec. 30, 1794. [Creation.] Earl of Sefton, 1771.

Robert Jocelyn, EARL of RODEN, viscount Jocelyn, and lord Newport, of Newport, in the county of Tipperary; born 1731, succeeded his father, as viscount, in 1758. [Creation.] Earl Roden, 1771.

John Dennis Browne, EARL of ALTAMONT, viscount Westport, and lord Mount Eagle, in the county of Mayo, succeeded his father, the late earl, in 1780. [Creation.] Earl of Altamont, 1771.

Ralph Gore, EARL of ROSS, in the county of Fermanagh, viscount Bellefield, of Bellefield, in the same county, and lord Gore, of Manor-Gore, in the county of Donegal, born Nov. 12, 1725, advanced to the dignity of earl of Ross, 1772.

Wilnot Vaughan, EARL of LISBURNE, in the county of Antrim, viscount Lisburne, and lord Vaughan, of Fethers, succeeded his father, Jan. 19, 1765, as viscount Lisburne. [Creation.] Earl of Lisburne, 1776.

John Meade, EARL of CLANWILLIAM, in the county of Cork, viscount Clanwilliam, lord Gillford, and baronet, born April 21, 1744. [Creation.] Earl of Clanwilliam, 1776.

George Granville Nugent Temple, EARL NUGENT. His lordship is known by the title of marquis of Buckingham in England. See marquis of Buckingham, in the English Peerage.

John Crosbie, EARL of GLANDORE, and viscount Crosbie, lord Brandon, in the county of Kerry; born May, 1753, succeeded his father Maurice, the late lord, April 11, 1781. [Creation.] Earl of Glandore, 1776.

Edward Stratford, EARL of ALDBOROUGH, of the Palatinate of Upper Ormond, viscount Amiens and Aldborough, and lord of Balinglaffa, in the county of Wicklow, succeeded his father, May 29, 1777. [Creation.] Earl of Aldborough, 1777.

William Henry Fortescue, EARL of CLERMONT, viscount Clermont, and lord Clermont, in the county of Louth; born Aug. 5, 1722, created earl of Clermont, 1777.

Stephen Moore, EARL and VISCOUNT MOUNTCASHILL, in the county of Tipperary, and lord Kilworth, of Moore-Park, in the county of Cork; born March 1, 1770, succeeded his father Stephen, the late viscount, May, 1790. [Creation.] Earl Mountcashill, 1781.

Ann Katharine Macdonald, COUNTESS of ANTRIM, viscountess Dunlure, Baroness Antrim, born Aug. 11, 1788, succeeded her father, the late marquis of Antrim in these honours, July 28, 1791. [Creation.] Earl of Antrim, 1785.

Thomas Pakenham, EARL and BARON LONGFORD, of the county of Longford, succeeded to the barony on the death of his father, in 1792, and to the earldom on the death of his mother, in 1794.

John Dawson, EARL of PORT-ARLINGTON, in Queen's County, viscount Carlown, in the county of Carlown, and lord Dawson of Dawsoncourt, in Queen's County, succeeded his father in Nov. 1798. He was born Aug. 23, 1741. [Creation.] Earl of Port Arlington, 1785.

Barry Maxwell, EARL FARNHAM, viscount Farnham, and lord Farn-

ham, succeeded to the barony on the death of his brother, Oct. 10, 1779. [Creation.] Earl of Farnham, 1785.

Henry-Lawes Lutterell, EARL CARHAMPTON, viscount Carhampton, and Lord Irnham, of Luttrellstown, in the county of Dublin; succeeded his father, the late earl, Jan. 11, 1787. [Creation.] Earl of Carhampton, 1785.

John Bourke, EARL of MAYO, viscount Mayo, of Moncreoner, and baron Naas of Naas, born Jan. 18, 1766, and succeeded his father, the late Archbishop of Tuam, Aug. 20, 1794. [Creation.] Earl of Mayo, 1785.

Francis Charles Annesley, EARL ANNESLEY, viscount Glerawley, and lord Annesley, born Nov. 1740, and succeeded his father, Sept. 12, 1770. [Creation.] Earl Annesley, 1789.

William Willoughby Cole, EARL of ENNISKILLEN, viscount Enniskillen, lord Mount-Florence, of Florence-Court, in the county of Fermanagh; born March 12, 1736; succeeded his father John, the late lord, Jan. 6, 1768. [Creation.] Earl of Enniskillen, 1789.

John Creighton, EARL ERNE, viscount and lord Erne, of Crum-Castle, in the county of Fermanagh, succeeded his father, May 25, 1772. [Creation.] Earl of Erne, 1789.

Joshua-John Proby, EARL CARYSFORT, and lord Carysfort, in the county of Wicklow; knight of St. Patrick, was born Aug. 12, 1751, and succeeded his father, the late lord, Oct. 18, 1772. [Creation.] Earl of Carysfort, 1789.

Edmund Butler, EARL of KILKENNY, and viscount Mountgarret, born 1771, succeeded his father Edmund, the late viscount, July 17, 1793. [Creation.] Earl of Kilkenny, 1791.

Arthur Annesley, EARL MOUNTNORRIS, viscount Valentia, baron Mountnorris, and Altham, and a baronet, born Aug. 7, 1744, succeeded his father Richard, 1761. [Creation.] Earl Mountnorris, 1793.

Otway Cuff, EARL, VISCOUNT, and BARON DESART, succeeded his brother John, the late viscount, Nov. 25, 1767. [Creation.] Earl Desart, 1793.

Alice Howard, COUNTESS of WICKLOW, to which title she was created Dec. 20, 1791.

John Scott, EARL and VISCOUNT CLONMEL, and baron Earlsfort, born June 2, 1739. [Creation.] Earl Clonmel, 1793.

George Macartney, EARL, VISCOUNT, and BARON MACARTNEY. [Creation.] Earl Macartney, 1794.

Charles Tottenham Loftus, EARL of ELY, viscount and baron Loftus, was created earl of Ely, 1794.

John Fitzgibbon, EARL of CLARE, viscount and baron Fitzgibbon, of lower Conelly, in the county of Limerick. He was created a baron in 1789, viscount in 1793, and earl of Clare in June 16, 1795; Lord Chancellor of the kingdom of Ireland.

Robert Clements, EARL, VISCOUNT, and BARON LEITRIM, was created a baron, Sept. 20, 1783, viscount, Dec. 20, 1793, and earl, Oct. 6, 1795.

Richard Bingham, EARL and BARON LUCAN, and a baronet, succeeded his father, Charles, March 24, 1799. [Creation.] 1776.

Robert Stewart, EARL of LONDONDEERRY, VISCOUNT CASTLE-REAGH, created baron, Nov. 8, 1789, viscount Oct. 6, 1795, and earl, Aug. 10, 1796.

Almar-Lowry Corry, EARL and VISCOUNT BELMORE, was created a peer by that title Jan. 6, 1781, advanced to the dignity of a viscount Dec. 1789, and to that of an earl in Nov. 1797.

Henry Burton Conyngham, EARL, VISCOUNT, and BARON CONYNGHAM, succeeded his father 1787, was advanced to the degree of viscount Dec. 1789, and to that of earl, Nov. 1797.

Francis Matthew, EARL, VISCOUNT, and BARON LANDAFF, was advanced to the dignity of a viscount, Dec. 20, 1793, and to that of an earl in Nov. 1797.

SECT. IV. VISCOUNTS.

Jenico Preston, VISCOUNT GORMANSTON, succeeded his father Anthony, Dec. 15, 1786, was born in 1777, and is claimant to the title granted 1478, and has lain dormant since 1691.

George-Buffey Villiers, VISCOUNT GRANDISON. His lordship is known by the title of the earl of Jersey in England. See earl of Jersey in the English Peerage.

Charles Lee-Dillon, VISCOUNT DILLON, in the county of Mayo; was born Nov. 6, 1745, succeeded to the estates and honours of his ancestors, which he claimed, Jan. 22, 1788. [Creation.] Viscount Dillon, 1621-2.

John Netterville, VISCOUNT NETTERVILLE, of Louth, in the county of Meath, born in 1744, succeeded his father John, March 19, 1750. [Creation.] Viscount Netterville, 1622.

Robert Needham, VISCOUNT KILMOREY; succeeded his father John, the late viscount, May 27, 1791. [Creation.] Viscount Kilmorey, 1625.

George-Augustus Lumley-Saunders, LORD LUMLEY, of Waterford. His lordship is known by the title of earl of Scarborough in England. See earl of Scarborough, in the English Peerage.

Lionel Smythe, VISCOUNT STRANGFORD, in the county of Downe; born May 19, 1753, succeeded his father Philip, the late viscount, April 29, 1787. [Creation.] Viscount Strangford, 1628.

Philip Wenman, VISCOUNT WENMAN, of Tuam, lord Wenman, of Kilmaynham, and baronet; born April 18, 1742, and succeeded his father, the late viscount, Aug. 16, 1760. [Creation.] Viscount Wenman, 1628.

Rodolphus Taaffe, VISCOUNT TAAFE, of Corran, lord Ballymote, both in the county of Sligo, succeeded his father the late viscount, December 29, 1769. [Creation.] Viscount Taaffe, 1628.

Charles Jones, VISCOUNT RENELAGH, lord Jones, of Navan, succeeded to the title in 1721, but the title was not claimed till 1759. [Creation.] Viscount Renelagh, 1628.

Richard Fitz-William, VISCOUNT FITZ-WILLIAM, of Merion, lord Fitz-William of Thorn-Castle; born in August 1745, and succeeded his father May 25, 1776. [Creation.] Viscount Fitz-William, 1629.

Charles Cockayne, VISCOUNT CULLEN, lord Cullen, in the County of Donegal; born Sept. 2, 1710, succeeded his father Charles the late viscount. [Creation.] Viscount Cullen, 1622.

Henry Leigh, VISCOUNT TRACY, lord Tracy, of Rathcoole, in the county of Dublin, succeeded his brother, Thomas Charles, February 2, 1792. [Creation.] Viscount Tracy, 1622.

Thomas-James Bulkeley, VISCOUNT BULKELY, of Cashel, in the county of Tipperary, and baron Beaumaris in England, born Dec. 10, 1752. [Creation.] Viscount Bulkeley, 1641.

George Barnwell, VISCOUNT KINGSLAND, lord Turvey, both in the county of Dublin; was born August 12, 1752, succeeded his father March 11, 1774. [Creation.] viscount Kingsland, 1646.

George James Cholmondeley, VISCOUNT CHOLMONDELEY, of Kells, lord Cholmondeley, of Newburgh, in Ireland. His lordship is known by the

PEERAGE.

the title of earl Cholmondeley in England. See earl Cholmondeley in the English Peerage.

John-Christopher Dawney Burton, **VISCOUNT DOWNE**, and baronet; born Nov. 15, 1764, succeeded his father, Dec. 21, 1780. [Creation.] Viscount Downe, 1680.

Richard Howe, **VISCOUNT HOWE**, baron of Cienawley. His lordship is known by the title of earl Howe in England. See the English Peerage.

John-James Hamilton, **VISCOUNT STRABANE**, lord Mountcastle. His lordship is known by the title of marquis of Abercorn in England. See the English Peerage.

Robert Molesworth, **VISCOUNT MOLESWORTH**, of Swords, in the county of Dublin, lord Philipstown in King's county, born 1729, succeeded his cousin Richard, June 23, 1793. [Creation.] Viscount Molesworth, 1716.

Richard Chetwynd, **VISCOUNT CHETWYND**, of Bearhaven, in the county of Cork, lord Rathdowne, born Sept. 29, 1757, and succeeded his father William, Nov. 12, 1791. [Creation.] Viscount Chetwynd, 1717.

George Broderick, **VISCOUNT MIDDLETON**, and lord Broderick, of Middleton, in the county of Cork, born 1756, succeeded his brother, the late viscount, Nov. 17, 1791. [Creation.] Viscount Middleton, 1717.

Gustavus Hamilton, **VISCOUNT BOYNE**, lord Hamilton, of Stackallan, both in the county of Meath; born Dec. 20, 1749, succeeded his father, July 30, 1789. [Creation.] Viscount Boyne, 1717.

Joshua Allen, **VISCOUNT ALLEN**, and lord Allen, of Stillorgan, in the county of Dublin; born April 26, 1728, succeeded his brother John, Nov. 10, 1753. [Creation.] Viscount Allen, 1717.

James Bucknall Grimston, **VISCOUNT GRIMSTON**, lord Dunboyne, and baron Verulam of Gerhambury, in England, and a baronet; born May 9, 1747, succeeded his father the late viscount, Dec. 15, 1773. [Creation.] Viscount Grimston, 1719.

William Wickham Barrington, **VISCOUNT BARRINGTON**, of Ardglais, lord Barrington of Newcastle, succeeded his uncle Feb. 1, 1793. [Creation.] Viscount Barrington, 1720.

Henry Gage, **VISCOUNT GAGE**, of Castle island, lord Castle-bar, baron Gage, of High Meadows, in Great-Britain, and a baronet; born March 4, 1761, and succeeded his uncle William Hall, Oct. 12, 1791. [Creation.] Viscount Gage 1721.

Henry Temple, **VISCOUNT PALMERSTON**, of Palmerston, in the county of Dublin, lord Temple of Mount Temple, in the county of Sligo; born Dec. 4, 1739, succeeded his grandfather, Henry, the late viscount, who died June 10, 1757. [Creation.] Viscount Palmerston 1722.

John Bateman, **VISCOUNT BATEMAN**, lord Culmore, succeeded his father William, who died in Nov. 1744. [Creation.] Viscount Bateman, 1732.

Robert Monston Arundel, **VISCOUNT GALWAY**, in the county of Galway, and lord Killard, in the county of Clare, born Aug. 18, 1752, and succeeded his brother William Henry, March 2, 1774. [Creation.] Viscount Galway, 1772.

Richard Wingfield, **VISCOUNT POWERSCOURT**, of Powerscourt, in the county of Wicklow, lord Wingfield; born Oct. 29, 1762, and succeeded his father Aug. 8, 1788. [Creation.] Viscount Powerscourt, 1743.

William Flower, **VISCOUNT ASHBROOK**, lord Castle Durrus; born Oct. 19, 1767, succeeded his father, Henry, Aug. 1780. [Creation.] Viscount Ashbrook, 1751.

Francis Harvey Morris, **VISCOUNT MOUNTMORRES**, lord Mountmorres, of Castlemorres, in the county of Kilkenny, succeeded his half-brother Aug. 17, 1797. [Creation.] Viscount Mountmorres, 1763.

Arthur-Hill Trevor, **VISCOUNT DUNGANNON**, in the county of Tyrone, lord Hill, of Olderfleet, in the county of Antrim; was born Oct. 2, 1763, and succeeded his grandfather, the late viscount, Jan. 30, 1771. [Creation.] Viscount Dungannon, 1765.

Hercules Rowley, **VISCOUNT LONGFORD**, baron of Summerhill; born March, 1737, succeeded his mother, the late viscountess, Dec. 18, 1791. [Creation.] Viscount Longford, 1766.

Thomas Southwell, **VISCOUNT SOUTHWELL**, lord Southwell, succeeded his father February 15, 1796. [Creation.] Viscount Southwell, 1717.

Thomas Vesey, **VISCOUNT DE VESCI**, lord Knapton, and baronet; succeeded his father the late lord, June 25, 1761. [Creation.] Viscount de Vesey, June 22, 1776.

James Hewitt, **VISCOUNT LIFFORD**, lord Lifford, in the county of Donegal; succeeded his father James, the late viscount, in April, 1789. [Creation.] Viscount Lifford, 1781.

Pennilton Lamb, **VISCOUNT MELBOURNE**, lord Melbourne, of Kilmore, and baronet. [Creation.] Viscount Melbourne, 1780.

Henry Welbore Agar, **VISCOUNT CLIFDEN**, lord Clifden, succeeded his father Dec. 28, 1788. [Creation.] Viscount Clifden, 1781.

Thomas Dawson, **VISCOUNT CREMORNE**, lord Dartry; born April 1725. [Creation.] Viscount Cremorne, 1785.

Arthur Achefon, **VISCOUNT GOSFORD**, lord Gosford, who succeeded his father Archibald, September 5, 1790. [Creation.] Viscount Gosford, 1785.

Robert Howard, **VISCOUNT WICKLOW**, lord Clonmore, of Clonmore, Castle, in the county of Carlow, succeeded his father, June 26, 1789. [Creation.] Viscount Wicklow, 1785.

Hayes St. Leger, **VISCOUNT DONERAILE**, lord Doneraile, succeeded his father, 1787; born March 9, 1755. [Creation.] Viscount Doneraile, 1785.

Edmund Sexton Pery, **VISCOUNT PERY**, of Newtown Pery, near Limerick; born, 1719. [Creation.] 1785.

Henry Burton Conyngham, **VISCOUNT CONYNGHAM**, lord Conyngham, of Mount Charles, in the county of Donegal, born December 26, 1766, and succeeded his father in 1787. [Creation.] Viscount Conyngham, 1789.

Thomas Knox, **VISCOUNT NORTHLAND**, and baron Willes, of Dungannon, was advanced to the dignity of viscount July 5, 1791.

Henry Pomeroy, **VISCOUNT and BARON HARBERTON**, of Carberry, in Kildare, succeeded his father April 9, 1798.

Andrew Thomas Stewart, **VISCOUNT and BARON CASTLEWART**, advanced to the dignity of viscount, 1793.

Robert Clements, **VISCOUNT and BARON LEITRIM**, of Manor Hamilton, in the county of Leitrim, was advanced to the dignity of viscount, 1793.

Francis Mathew, **VISCOUNT and BARON LANDAFF**, was advanced to the dignity of viscount, 1793.

Cornelius Maude, **VISCOUNT HEWARDEN**, baron Mountaff, in the county of Flint, and a baronet; born 1729, was advanced to the dignity of viscount, 1793.

Charles Gardner, **VISCOUNT and BARON MOUNTJOY**, succeeded his father Luke, who was killed at Ross in suppressing the rebellion, June 5, 1798. [Creation.] Baron, 1789, Viscount 1795.

Lawrence Harman Harman, **VISCOUNT and BARON OXMANTOWN**,

in the county of Dublin, was advanced to the dignity of baron Sept. 5, 1792, and to that of viscount, Oct. 6, 1795. The barony is in remainder to Sir Laurence Parsons, Bart.

Charles O'Neil, **VISCOUNT and BARON O'NEIL**, of Slane's Castle, in the county of Antrim, succeeded his father John, who was slain in battle at Antrim, June 7, 1798, in opposing the Irish rebels.

Francis Bernard, **VISCOUNT and BARON of BANDON**, of Castle Bernard, in the county of Cork, was created baron in Dec. 1793, and viscount, Oct. 6, 1795.

Richard Hely Hutchinson, **VISCOUNT and BARON DONOUGHMORE**, of Knocklofty, in the county of Tipperary; created Nov. 7, 1797. He succeeded to the barony in right of his mother in 1788.

Hugh Carleton, **VISCOUNT and BARON CARLETON**, of Anmer, in the county of Tipperary, was created baron June 16, 1789, viscount, Nov. 12, 1797. His lordship is Chief Justice of his Majesty's Court of Common Pleas in Ireland.

Margaretta Foster, **VISCOUNTESS FERRARD**, and **BARONESS ARIEL** of Cullon, in the county of Louth, created a baroness in June, 1790, and viscountess in Nov. 1797.

James Alexander, **VISCOUNT CALEDON**, baron Caledon, in the county of Tyrone; created a baron June 6, 1790, viscount, Nov. 1797.

Valentine Browne, **VISCOUNT KENMARE**, baron of Castle Role, in the county of Kerry, baronet; created Feb. 12, 1398.

SECT. VI. BARONS.

John de Courcy, **LORD KINSALE**, lord Courcy, of Courcy, and lord Kinrole in the said county; succeeded his father, the late lord, March 13, 1776. [Creation.] Baron of Kinsale, 1397.

Nicholas Barnwell, **BARON TRIMLESTOWN**, in the county of Meath, succeeded his cousin Thomas Dec. 29, 1796.

Randal Plunket, **LORD DUNSANY**, in the county of Meath; born Dec. 16, 1750, succeeded his father, 1781. [Creation.] 1438.

Richard Butler, **LORD CAHIER**, in the county of Tipperary; born Nov. 13, 1775, succeeded his distant cousin, June 10, 1788. [Creation.] 1543.

Edward Digby, **LORD DIGBY**, baron of Geafhill, in King's county; being earl Digby in England. See English peerage. [Creation.] Baron Digby, 1620.

Andrew Thomas Blayney, **LORD BLAYNEY**, of Monaghan; born 1772, succeeded his brother April 2, 1784. [Creation.] 1621.

Robert Sherard, **LORD LEITRIM**. His lordship is known by the title of earl of Harborough, in England. See earl of Harborough in the English peerage.

Francis Seymour Conway, **LORD CONWAY**, baron of Ragley, and baron of Killaltah in Ireland. His lordship is known by the title of earl of Hertford, in England. See earl of Hertford in the English peerage.

George Evans, **LORD CARBERY**, in the county of Cork; succeeded his father George, the late lord, May 26, 1783. [Creation.] 1715.

Matthew Aylmer, **LORD AYLMEER**, of Balrath, in the county of Meath; born 1775, succeeded his father in 1785. [Creation.] 1718.

Joseph Damer, **LORD MILTON**, of Shrone-Hill, in the county of Tipperary, in Ireland. His lordship is earl of Dorchester, in England. See the English peerage. [Creation.] 1753.

John Lyfght, **LORD LISLE**, of Mount North, in the county of Cork, succeeded his father, Jan. 9, 1758. [Creation.] Lord Lisle, 1758.

William Hanger, **LORD COLERAIN**, of Colerain, in the county of Londonderry; succeeded his brother John, the late lord, Jan. 27, 1795. [Creation.] Baron Colerain, 1762.

Edward Clive, **LORD CLIVE**, of Plaffey, in the county of Clare; also baron Clive, in England; born March 7, 1754, and succeeded his father, the late lord, Nov. 23, 1774. [Creation.] Baron Plaffey, 1762.

Henry Phipps, **LORD MULGRAVE**, of New Ross, in the county of Wexford; born 1755, succeeded his brother Constantine John, the late lord, Oct. 10, 1792. [Creation.] Baron of New Ross, 1767.

Charles George Perceval, **BARON of ARDEN**, of Lohort Castle, in the county of Cork; born Oct. 1, 1756, succeeded his mother, the late baroness, 1784. [Creation.] Baron Arden, 1770.

Richard Philipps, **LORD MILFORD**, and a baronet; was created a peer in 1776.

Thomas Wynn, **LORD NEWBOROUGH**. [Creation.] 1776.

Charles Bingham, **LORD LUCAN**, of Castlebar, in the county of Mayo, and a baronet. [Creation.] Baron Lucan, 1776.

Alexander Wentworth Macdonald, **LORD MACDONALD**, baron of Slate, in the county of Antrim, and a baronet; succeeded his father, 1795. [Creation.] Baron Macdonald, 1776.

William Mayne, **LORD NEWHAVEN**, of Carrickmayne, in the county of Dublin. [Creation.] Baron Newhaven, 1776.

William Edwardes, **LORD KENSINGTON**. [Creation.] 1776.

William Henry Lyttleton, **LORD WESTCOTE**, of Balamore, in the county of Longford, and a baronet. [Creation.] Baron Westcote, 1776.

Robert Ongle, **LORD ONGLE**, of Old Warden; born Oct. 3, 1770, succeeded his father in 1785. [Creation.] 1776.

Molyneux Shuldham, **LORD SHULDHAM**. [Creation.] 1776.

John Henry Upton, **LORD TEMPLETOWN**, in the county of Antrim, in the kingdom of Ireland; born Nov. 8, 1771, succeeded his father in 1785.

Hugh Massey, **LORD MASSEY**, of Duntryleague, in the county of Limerick; born Oct. 24, 1761; succeeded his father, the late lord, April 17, 1790. [Creation.] 1776.

Matthew Robinson, **LORD ROKEBY**, of Armagh, succeeded the late lord Oct. 10, 1794. [Creation.] Baron Rokeby, 1777.

Robert Tilson Deane, **LORD MUSKERRY**, of Dromore, in the county of Cork, and a baronet; born 1745, created a peer by the title of baron Muskerrey, 1781.

John Baker Holroyd, **LORD SHEFFIELD**, lord Dunamore, lord Sheffield, baron of Roscommon, with remainder of the last title in failure of issue male, severally to his daughters and their issue male. [Creation.] Lord Sheffield, 1783.

Samuel Hood, **LORD HOOD**, baron of Catherington, and baronet. [Creation.] 1783.

William Tonson, **LORD RIVERSDALE**, succeeded his father William the late lord, who was created a peer Dec. 4, 1787.

John Hufsey Delaval, **LORD DELAVAL**, was created a peer of Ireland Oct. 7, 1783.

John Pennington, **LORD MUNCASTER**, was, Sept. 20, 1783, created baron Muncafter, in the county of Cumberland, with remainder to his brother Lowther Pennington.

Richard Pennant, **LORD PENRHYN**, of Penrhyn, in the county of Lowth, created the 9th of November, 1783.

Cornelius O'Callaghan, **LORD LISMORE**, baron Lismore of Shanbally, in the county of Tipperary, succeeded his father July 12, 1797; created June 27, 1785.

P E L

P E N

Richard Malone, LORD SUNDERLIN, of Lake Sunderlin, in the county of Wexmouth; was created a peer July 4, 1785.
William Eden, LORD AUCKLAND, to which title he was created Aug.

18, 1789.
John Brown, LORD KILMAINE, of the Neale, in the county of Mayo, and baronet; was created a peer in Oct. 1789.

Nicholas Lawless, LORD CLONCURRY, in the county of Kildare, succeeded his father in 1799.

Samuel Eardley, LORD EARDLEY, of Spalding, and a baronet; was created a peer, Oct. 1789.

Edmund Henry Pery, BARON GLENTWORTH; born 1757, succeeded his father, William Cecil, bishop of Limerick, &c. July 4, 1794, and is nephew to viscount Pery. [Creation.] 1790.

George Agar, BARON CALLAN, of Callan, in the county of Kildare; born April 18, 1754, and was created to the above barony, June, 1790.

Luke Dillon, BARON CLONBROCK, of Clonbrock, in the county of Galway, succeeded his father, 1795.

Allen Fitzherbert, BARON ST. HELENS, born Feb. 1753, and was created a peer, 1791.

Mary Verney, BARONESS FERMANAGH, was created to the peerage June 14, 1793.

Sarah Cavendish, BARONESS WATERPARK, of Waterpark, in the county of Cork, to which dignity she was created June 14, 1793.

Thomas Greaves, LORD GRAVES, Baron of Graveland, in the county of Londonderry, to which honour he was created Nov. 14, 1794.

Alexander Hood, BARON BRIDPORT, of Cricket St. Thomas, brother of Lord Hood, to which honour he was created Nov. 14, 1794.

Charles Agar, BARON SOMERTON, in the county of Kildare, was created June 16, 1793. His lordship is also Archbishop of Cashel.

Barry Yelverton, LORD YELVERTON, baron of Avonacre, in the county of Cork, was created June 16, 1795. His lordship is Chief Baron of his Majesty's Court of Exchequer in Ireland.

Anne Wolfe, BARONESS KILTEEL, lady Kilwarden, in the county of Kildare; created, Oct. 1795. Her ladyship is wife to baron Kilwarden, so created July 3, 1798, late his Majesty's Attorney-General in Ireland.

Richard Longfield, BARON LONGUEVILLE, of Longueville, in the county of Cork; created Oct. 1795.

Ralph Payne, BARON LAVINGTON, of Lavington, and Knight of the Bath; was created Oct. 1, 1795.

Thomas Boothby Parkyns, BARON RANCLIFF; was created Oct. 3, 1795.

Julius Vanneck, BARON HUNTINGFIELD, of Heveningham, Hull, and a baronet; was created June 8, 1796.

Robert Smith, BARON CARRINGTON, of Sulcot Lodge; created in July, 1796; and baron Carrington, of Upton, in the county of Nottingham, in the English Peerage, Oct. 10, 1797.

Robert Cunningham, BARON ROSMORE, of Monaghan, in the county of Monaghan; created Oct. 19, 1796.

George Keith Elphinstone, BARON KEITH, of Stonehaven, Marischal; created March 7, 1797. His lordship is a Knight of the Bath, and Vice-Admiral of the Blue.

William Hotham, BARON HOTHAM, of South Dalton; created March 7, 1797.

Richard White, BARON BANTRY, of Bantry, in the county of Cork; created March 31, 1797.

James Duff, BARON TYRAWLEY, of Ballinwabe, in the county of Mayo; created Nov. 7, 1797.

Charles Stanley Monck, BARON MONCK, of Ballytramon, in the county of Wexford; created Nov. 7, 1797.

Grace Toler, BARONESS NORWOOD, in the county of Tipperary; created Nov. 7, 1797. Her ladyship is married to John Toler, Esq. the Solicitor-General.

William Paver Keating French, LORD KILCONNEL, of Garbally, in the county of Galway, created Nov. 7, 1797.

Charles-William Bury, BARON TULLIMORE, of Charleville Forest, in the King's county, created Nov. 7, 1797.

Charles Allanson Winn, LORD HEADLEY, of Aghadoer, in the county of Kerry, created April 6, 1798.

John Shore, BARON TEIGNMOUTH, of Teignmouth; created Nov. 7, 1797.

Leonard Troughefn Holmes, BARON HOLMES, of Kilmallock, in the county of Limerick; created Nov. 7, 1797.

Anne Crofton, BARONESS CROFTON, of Moate, in the county of Roscommon; created Dec. 1, 1797.

Rose French, BARONESS FRENCH, of Castle French, in the county of Galway; created Feb. 14, 1798.

Arthur Wolfe, BARON KILWARDEN, of Newland, in the county of Dublin; created July 3, 1798.

This was the statement of the Peerage, in the year 1799.

PEGASUS, among the poets, a horse imagined to have wings, being that whereon Bellerophon was fabled to be mounted when he engaged the Chimera.

PEGASUS, in astronomy, the name of a constellation of the northern hemisphere, figured in form of a flying horse. See the SYSTEM, Sect. VIII.

PELICANUS, in ornithology, a genus belonging to the order of Anseres. The bill is straight, without teeth, and crooked at the point; the face is naked, and the feet are palmated. There are eight species, principally distinguished by the shape of their tails. The most remarkable is, the onocrotalus, or pelican of Asia, Africa, and America; though Linnaeus thinks that the pelican of America may possibly be a distinct variety. This creature in Africa is much larger in the body than a swan, and somewhat of the same shape and colour.

This is the bird of which so many fabulous accounts have been propagated; such as its feeding its young with its own blood, and its carrying a provision of water for them in its great reservoir in the desert. Its amazing pouch may be considered as analogous to the crop in other birds; with this difference, that as theirs lie at the bottom of the gullet, so this is placed at the top. Thus, as pigeons and other birds macerate their food for their young in their crops, and then supply them; so the pelican supplies its

young by a more ready contrivance, and macerates their food in its bill, or stores it for its own particular sustenance.

They are torpid and inactive to the last degree, so that nothing can exceed their indolence but their gluttony; it is only from the stimulations of hunger that they are excited to labour; for otherwise they would continue always in fixed repose. When they have raised themselves about 30 or 40 feet above the surface of the sea, they turn their heads with one eye downwards, and continue to fly in that posture. As soon as they perceive a fish sufficiently near the surface they dart down upon it with the swiftness of an arrow, seize it with unerring certainty, and store it up in their pouch. They then rise again, though not without great labour, and continue hovering and fishing, with their head on one side as before. This work they continue with great effort and industry, till their bag is full, and then fly to land to devour and digest at leisure the fruits of their industry. This, however, it would appear, they are not long performing; for towards night they have another hungry call, and they again reluctantly go to labour. At night, when their fishing is over, and the toil of the day crowned with success, these lazy birds retire a little way from the shore; and, though with the webbed feet and clumsy figure of a goose, they will be contented to perch on where but upon trees, among the light and airy tenants of the forest. There they take their repose for the night, and often spend a great part of the day, except such times as they are fishing, sitting in dismal solemnity, and, as it would seem, half asleep. Their attitude is with the head resting upon the great bag, and that resting upon their breast. There they remain without motion, or once changing their situation, until they find it necessary to fill their magazine for a fresh meal. Thus their life is spent between sleeping and eating; and they are as foul as they are voracious, as they are every moment voiding excrements in heaps as large as one's fist. The same indolent habits seem to attend them even in preparing for incubation, and defending their young when excluded. The female makes no preparation for her nest, nor seems to choose any place in preference to lay in, but drops her eggs on the bare ground to the number of five or six, and here continues to hatch them. Attached to the place, without any desire of defending her eggs or her young, she tamely sits and suffers them to be taken from under her. See Plate V. Genus 94.

PELLICLE, *pellicula*, a thin film or fragment of a membrane or skin. The epidermis, or cuticula, is a little pellicle, covering the derma, cutis, or skin. The valves of the veins and arteries are insensible pellicles which open and shut to promote the circulation. When any chymical solution is evaporated in the general heat, till a thin skin or film arises a-top, it is called an evaporation to a pellicle: in this case there is but just liquor enough left to keep salts in fusion.

PELVIS, in anatomy, the lower part of the cavity of the abdomen; thus called from its resemblance to a basin, or ewer, called in Latin pelvis. Most writers on that important part of the Human System, have omitted to illustrate their descriptions by representations; and the plates which have been introduced have been executed in so different a manner, as to be of very little use in explaining the subject. For a description of the bones of the pelvis, see the SYSTEM, Part I. Sect. III. Art. 3. For representation, see Plate I. Fig. 1 and 2. For the contents of the Male Pelvis, see Part III. Sect. XV. Art. 1. For representation, see Plate X. Fig. 3. upper division. For the contents of the Female Pelvis, see Part III. Sect. XV. Art. 2. For representation, see Plate X. upper division. For a further description and representation of the Female Pelvis, see the SYSTEM of MIDWIFERY, and Plate I. with the explanation.

PENANCE, *penitentia*, is properly the exercise of penitence; and may be defined a punishment, either voluntary, or imposed by legal authority, for the faults a person has committed. The Romanists defined penitence, a sacrament, wherein a person, who has the requisite dispositions, receives absolution at the hand of the priest, of all sins committed since baptism. To a legitimate penance they require three things, contrition, absolution, and satisfaction. See POPERY.

PENANCE is particularly used in the Romish church, for the penalty which a confessor imposes for the satisfaction of the sins whereof a person is absolved. The ancient discipline, Du Pin observes, was very severe on the head of penance: for great crimes people were excluded the communion of the church, expelled the assemblies of the faithful, obliged to fast, and to mortify themselves publicly, even at the church door, cut their hair, go always on foot, &c. He adds, that those who had done public penance were never admitted into the clergy; and that public penance was never granted more than once. Those who fell a second time, were never to be reconciled to the church, and were to look for pardon only at the hands of God.

PENANCE, in our canon law, is an ecclesiastical punishment, chiefly adjudged to the sin of fornication. The punishment is thus described by the canons: the delinquent is to stand in the church-porch on some Sunday, bare-head, and bare-foot, in a white sheet, with a white wand in his hand; here bewailing himself, and begging every one to pray for him; then to enter the church

church falling down, and kissing the ground; and at last, to be placed on an eminence in the middle of the church, against the minister, to declare the foulness of his crime, odious to God, and scandalous to the congregation. If the crime be not notorious, the canons allow the punishment to be commuted at the parties request, for a pecuniary mulct, for the benefit of the poor, &c.

PENATES, in the ancient mythology, a term applied to all the domestic gods, whom the ancients adored in their houses, whence they are ordinarily confounded with the **LARES**. See **LARES**.

PENCIL of Rays, in optics, is a double cone, or pyramid of rays, joined together at the base.

PENDANT, in heraldry, a term applied to the parts hanging down from the label, to the number of three, four, five, or six at most. These must be specified in blazoning, when there are more than three. They resemble the drops at the bottom of the triglyphs in the Doric frieze.

PENDULOUS, *hanging down*; a name which botanists give to those heads of flowers which hang downwards; the stalk not being able to sustain them upright.

PENDULUM, in mechanics, denotes any heavy body, so suspended as that it may vibrate or swing, backwards or forwards, about some fixed point, by the force of gravity. The vibrations of a pendulum are called its *oscillations*.

The Doctrine of Pendulums, from principles of motion and gravitation, mathematicians have demonstrated the following properties concerning the vibration, &c. of pendulums.

1. That if a pendulum vibrates in a small arc of a circle, the time of one vibration is to the time of a body's falling perpendicularly through half the length of the pendulum, as the circumference of a circle to its diameter, viz. as 3.1416 to 1 nearly.
2. In a small arc the time of descending through the chord, is to the time of descending through the arch; as the diameter to $\frac{1}{2}$ the circumference.
3. All vibrations of the same pendulum, in arches not very large, are performed nearly in the same time.
4. The lengths of pendulums describing similar arcs, are as the squares of the times of vibration.
5. The times of vibration of pendulums in small circular arcs, are as the square roots of the lengths of the pendulums.
6. The velocity of a pendulum at its lowest point, is as the chord of the arc through which it descends.
7. Pendulums of the same length, vibrate in the same time, whether they be heavy or light.
8. The lengths of pendulums vibrating in the same time, in different places of the world, will be as the forces of gravity.
9. The times wherein pendulums of the same length will vibrate by different forces of gravity, are reciprocally as the square roots of the forces.
10. The lengths of pendulums in different places, are as the forces of gravity, and the squares of the times of vibration.
11. The times wherein pendulums of any length perform their oscillations, are as the square roots of their length directly, and the square roots of the gravitating forces reciprocally.
12. The forces of gravity in different places are as the lengths of pendulums directly, and the squares of the times of vibration reciprocally.
13. As the square of the number of vibrations made in any given time, is to the square of that time (taken in seconds) so is 39.2 inches, to the length of the vibrating pendulum.
14. As the length of a pendulum is to 39.2 inches, so is the square of the time (taken in seconds) to the square of the number of vibrations made in that time.

Remark. The two last proportions are applications of the preceding properties, and are adapted to the situation of London, or any other place of the same latitude where the length of a pendulum vibrating seconds is 39.2 inches long. But the proportions will serve for any latitude, by first finding the length of a pendulum vibrating seconds in the proposed latitude, and substituting it in lieu of 39.2 inches. Now the lengths of pendulums vibrating seconds in different latitudes, are as the forces of gravity, and these are as the distances from the earth's centre; so that if the earth was a perfect sphere, there would be no difference in the lengths of pendulums vibrating seconds in any part of the earth. But the equatorial diameter is to the earth's axis from pole to pole, in the ratio of about 230 to 229, according to Sir Isaac Newton, and as the figure of the earth is that of a spheroid, therefore, from the properties of the ellipsis, as laid down in our treatise of Conic Sections, contained in the system of Geometry, the proportional distance from the centre answering to any assigned places may be readily found, and from thence the lengths of pendulums vibrating seconds there. Or the different lengths may be found extremely near from the following considerations, viz. The lengths of such pendulums increase from the equator to the poles, nearly in the proportion of the versed sines of double the latitudes, or as the squares of the right sines of the latitudes, and the excess of the force of gravity at the pole, to the force of gravity at the equator, is as 1 to 229.

From these properties of the pendulum, we may discern its use as an universal chronometer, or regulator of time, as it is used in clocks, and such like machines. By this instrument also we can measure the distance of a ship, by measuring the interval of time between the fire and the sound of the gun; also the distance of a cloud, by numbering the seconds or half-seconds between the lightning and thunder. Thus, suppose between the lightning and

thunder, we number 10 seconds; then, because sound passes through 1142 feet in one second, we have the distance of the cloud equal to 11420 feet. Again, the height of any room, or other object, may be measured by a pendulum vibrating from the top thereof. Thus, suppose a pendulum from the height of a room vibrates once in three seconds; then say, as 1 is to the square of 3, viz. 9, so is 39.2 to 352.8 feet, the height required.

When pendulums were first applied to clocks, they were made very short: and, the arches of the circle being large, the time of vibration through different arches could not in that case be equal; to effect which the pendulum was contrived to vibrate in the arch of a cycloid, the property of which curve is, that a body vibrating in it will describe all its arches, great or small, in equal times.

In what has been observed before, the power of gravity has been supposed constantly the same. But if the said power varies, the lengths of pendulums must vary according, that they may vibrate in equal times. The greatest inconvenience attending this most useful instrument is, that it is constantly liable to an alteration of its length, from the effects of heat and cold, which very sensibly expand and contract all metaline bodies. To remedy this inconvenience, the common method is by applying the bob of the pendulum with a screw: so that it may be at any time made longer or shorter, according as the bob is screwed downwards or upwards, and thereby the time of its vibrations kept always the same. Again, if a glass or metalline tube, uniform throughout, filled with quicksilver, and 58.8 inches long, were applied to a clock, it would vibrate seconds for $39.2 = \frac{2}{3}$ of 58.8: and such a pendulum admits of a two-fold expansion and contraction, viz. one of the metal, and the other of the mercury; and these will be at the same time contrary, and therefore will correct each other. For by what we have shewn, the metal will extend in length with heat, and so the pendulum will vibrate slower on that account. The mercury will also expand with heat; and since by this expansion it must extend the length of the column upward, and consequently raise the centre of oscillation; so that by this means its distance from the point of suspension will be shortened, and therefore the pendulum on this account will vibrate quicker: wherefore, if the circumstances of the tube and mercury are skillfully adjusted, the time of the clock might by this means, for a long course of time, continue the same, without any sensible gain or loss. This is the invention of the late ingenious Mr. Graham, in the year 1721, who made a clock of this sort, and compared it with one of the best common sort for three years together, and found the errors of the former but about one-eighth part of the latter; of which the reader may see a farther account in Phil. Transf. No. 393. It is what is now called *Mr Graham's quicksilver pendulum*.

Mr. John Harrison of Barrow, in Lincolnshire, famous for his invention of a clock to find the difference of longitude at sea, without having the least knowledge of what Mr. Graham had done before him, made several experiments upon wires of different metals, in order to find their different degrees of expansion and contraction. He thought, that by a proper combination of wires of two different metals, differing considerably in their expansion and contraction, he might be enabled to keep the centre of oscillation of a pendulum always at the same distance from the point of suspension. In consequence of these experiments, he made a pendulum consisting of one steel wire, at the end of which is the bob or weight; and on each side of this wire, four wires, alternately brass and steel, so disposed and contrived as to raise the pendulum by the same quantity that it is lengthened by heat, and to let down the pendulum in the same proportion as it is raised by cold.

Mr. Harrison, in his first machine for measuring time at sea, likewise applied this combination of wires of brass and steel, to prevent any alterations by heat and cold. And in the two machines or clocks he has since made for the same purpose, a like method of guarding against the irregularities arising from this cause is used.

Mr. Graham also made a pendulum consisting of three bars, one of steel between two of brass; and the steel bar acted upon a lever, so as to raise the pendulum, when lengthened by heat, and to let it down, when shortened by cold; but he found this clock liable to sudden starts and jerks in its motion.

But besides the irregularities arising from heat and cold, pendulum clocks are liable to others from friction and foulness; to obviate which, Mr. Harrison has several excellent contrivances, whereby his clocks are almost entirely free from friction, and never need to be cleaned.

PENETRATION, *penetratio*, the act whereby one thing enters another, or takes up the place already possessed by another. The schoolmen define penetration the co-existence of two or more bodies, so that one is present, or has its extension in the same place as the other. Philosophers hold the penetration of bodies absurd, i. e. that two bodies should be, at the same time, in the same place; and accordingly, impenetrability is laid down as one of the essential properties of MATTER. What we properly call *penetration*, only amounts to the matter of one body's being admitted into the vacuity of another. Such is the penetration of water through the substance of GOLD.

PENGUIN, in ornithology, the English name of the Genus called

P E N

called by naturalists *Diomedea* and *Phaeton*. For description of the Genus, see *DIOMEDEA*, for representation see Plate V.

Genus 93.
PENINSULA, in geography, a portion or extent of Land, joining to the continent by a narrow neck or isthmus, the rest being encompassed with water. See the *SYSTEM*, under the article *Natural Divisions of the Earth*.

PENIS, in anatomy, a part of the body, called, by way of eminence, the *member*, or *virile member*, as being one of the principal organs of generation in the male kind. For description see the *SYSTEM*, Part III. Sect. I.

PENITENCE, is sometimes used for a state of repentance, and sometimes for the act of repenting. It is also used for a discipline, or punishment attending repentance; more usually called *penance*. It also gives title to several religious orders, consisting either of converted debauchees, and reformed prostitutes, or of persons who devote themselves to the office of reclaiming them. Of this latter kind is the

Order of PENITENCE of St. Magdalen, established about the year 1272 by one Bernard, a citizen of Marseilles, who devoted himself to the work of converting the courtezans of that city.— Bernard was seconded by several others, who, forming a kind of society, were at length erected into a religious order, by Pope Nicholas III. under the rule of St. Augustine. F. Gelnay says, that they also made a religious order of the penitents, or women they converted, giving them the same rules and observances which they themselves kept.

Congregation of PENITENCE of St. Magdalen at Paris, owed its rise to the preaching of F. Tisseran, a Franciscan, who converted a vast number of courtezans, about the year 1492. Louis duke of Orleans gave them his house for a monastery; or rather, as appears by their constitutions, Charles VIII. gave them the hotel called *Bochaigne*, whence they were removed to St. George's Chapel, in 1572. By virtue of a brief of Pope Alexander, Simon bishop of Paris, in 1497, drew them up a body of statutes, and gave them the rule of St. Augustine. It was necessary, before a woman could be admitted, that she had first committed the sin of the flesh. None were admitted who were above 35 years of age. Till the beginning of the last century, none but penitents were admitted; but since its reformation by Mary Alvequin, in 1616, none have been admitted but maids, who, however, afterwards retained the ancient name penitents.

PENITENTS, an appellation given to certain fraternities of penitents distinguished by the different shape and colour of their habits. These are secular societies, who have their rules, statutes, and churches, and make public processions under their particular crosses or banners. Of these there are more than a hundred, the most considerable of which are as follow: the white penitents, of which there are several different forts at Rome, the most ancient of which was constituted in 1264; the brethren of this fraternity every year give portions to a certain number of young girls, in order to their being married: their habit is a kind of white sackcloth, and on the shoulder is a circle, in the middle of which is a red and white cross. Black penitents, the most considerable of which are the brethren of mercy, instituted in 1488, by some Florentines, in order to assist criminals during their imprisonment, and at the time of their death: on the day of execution, they walk in procession before them, singing the seven penitential psalms and the litanies; and after they are dead, they take them down from the gibbet and bury them; their habit is black sackcloth. There are others whose business it is to bury such persons as are found dead in the streets: these wear a death's head on one side of their habit.—There are also blue, grey, red, green, and violet penitents; all which are remarkable for little else besides the different colours of their habits. Mabillon tells us, that at Turin there are a set of penitents kept in pay to walk through the streets in procession, and cut their shoulders with whips, &c.

PENNATULA, or *SEA-PEN*, in Vermeology, a Genus of Zoophyte, which, though it swims about freely in the sea, approaches near to the *Gorgonia*. This genus hath a bone along the middle of the infide, which is its chief support; and this bone receives the supply of its osseous matter by the same polype mouths that furnish it with nourishment. Linnæus reckons seven species.

Dr. Shaw, in the History of Algiers, says, that these animals are so luminous in the water, that in the night the fishermen discover fishes swimming about in various depths of the sea by the light they give: From this extraordinary quality Linnæus calls this species of the sea-pen, *pennatula phosphorea*, and remarks, after giving the synonyms of other authors, *Habitat in oceano: fundum illuminans*.

There are other kinds of sea-pens, or species of this animal, which have not a resemblance to a pen. There is a kidney shaped sea-pen, the feather of the peacock fish, the *pennatula filosa* of Linnæus, his *pennatula sagitta*, his *pennatula mirabilis*, and the finger-shaped sea-pen. Of all the pennatulæ yet known the feather-shaped one, or as it is called the silver sea-pen, is the largest as well as the most specious in its appearance. It is of a

P E N

beautiful silvery white, elegantly striated on each of the feather-like processes with lines or streaks of the deepest black. It is very rare, and is a native of the Indian seas. There is a very fine specimen of this species in the British Museum.

PENNY, or *PENY*, in Commerce, an ancient English coin, which had formerly a considerable course. The ancient English penny, *penig*, or *pening*, was the first silver coin struck in England; nay, and the only one current among our Saxon ancestors; as is agreed by Camden, Spelman, Dr. Hicks, &c. Some writers affirm, that the Saxons had likewise a half-penny and farthing, both of them probably of silver. Clark on Coins, p. 248.

The penny, which in Ethelred's time was the 20th part of the Troy ounce, was equal in weight to our three-pence; five of them made one shilling, or schilling Saxon; and thirty a mark or mancuse, equal to our 7s. 6d. It was the largest silver coin in England, and retained this value till the reign of Edward III. Till the time of king Edward I. the penny was struck with a cross so deeply indented in it that it might be easily broke, and parted, on occasion, into two parts; thence called *half-pennies*; or into four, thence called *four-things* or *farthings*. But that prince coined it without indenture; in lieu of which he first struck round *half-pence* and farthings. Stow, in his annals, p. 200, observes, that *half-pennies* were first coined round, A. D. 1279, in the reign of Edward I. But historians have since discovered, that *half-pennies* of this kind were coined by Henry I. and that though the usual way in the reign of the two first Williams was to cut the penny into two for making of *half-pennies*, &c. yet it has been supposed that some few *half-pennies* might even then be coined round. Some few pieces of this kind are preserved in the cabinets of the curious. See Mr. Pegge's remarks on this subject in Gent. Mag. vol. xxviii. p. 64, &c.

PENSIONARY, or *PENSIONER*, a person who has an appointment or yearly sum, payable during life, by way of acknowledgment, charged on the estate of a prince, company, or particular person.

Grand Pensionary, an appellation given to the first minister of the States of Holland. The grand pensionary, prior to the conquest of Holland by the French, was chairman in the assemblies of the states of that province; he proposed the matters to be consulted on; collected the votes; formed and pronounced the resolutions of the states; opened letters; conferred with foreign ministers, &c. His business was also to inspect the finances, to maintain the authority of the states, and to see that the laws were observed; and he was perpetual deputy of the states general of the United Provinces. His commission was, however, given him only for five years; after which it was deliberated whether or not it should be renewed; but there was no instance of its being revoked; therefore death only put an end to the functions of this important minister.

PENSIONARY, was also the first minister of the regency of each city in Holland. His office was to give his advice in affairs relating to the government, either of the state in general, or of the city in particular; and in assemblies of the states of the province, he was speaker in behalf of his city. The function, however, of these pensionaries was not every where alike; in some cities they only gave their advice, and were never found in assemblies of the magistrates, except when expressly called thither: in others they attended constantly; and in others they made the propositions on the part of the burgomasters, drew up their conclusions, &c. They were called *pensionaries*, because they received an appointment or pension.

PENSIONER, in general, denotes a person who receives a pension, yearly salary, or allowance. Hence *The Band of Gentlemen Pensioners*, the noblest sort of guard to the king's person, consists of 40 gentlemen, who receive a yearly pension of 100l. This honourable band was first instituted by King Henry VIII. and their office is to attend the king's person, with their battle-axes, to and from his chapel-royal, and to receive him in the presence-chamber, or coming out of his privy lodgings; they are also to attend at all great solemnities, as coronations, St. George's feast, public audiences of ambassadors, at the sovereign's going to parliament, &c.

They are each obliged to keep three double horses, and a servant, and so are properly a troop of horse. They wait half at a time quarterly; but on Christmas-day, Easter-day, Whit Sunday, &c. and on extraordinary occasions, they are all obliged to give their attendance. They have likewise the honour to carry up the sovereign's dinner on the coronation-day and St. George's feast; at which times the king or queen usually confer the honour of knighthood on two such gentlemen of the band as their captain presents.

Their arms are gilt battle-axes; and their weapons on horseback, in time of war, are cuirassiers-arms, with sword and pistols. Their standard, in time of war, is, argent, a cross gules. Their captain is always a nobleman, who has under him a lieutenant, a standard-bearer, a clerk of the Check, secretary, paymaster, and harbinger.

PENTAGON, from *πενταγωνος*, *quinguanulus*, compounded of *πεντε*, five, and *γωνια*, angle, in geometry, a figure of five sides and five angles. See the *SYSTEM*, Part I. Sect. I.

P E N

PENTANDRIA, formed of *πεντε*, five, and *ανδρ*, male, in botany, the fifth class of plants, which have hermaphrodite flowers, with five stamina or male parts in each. Of this class of plants, which comprehends six orders, distinguished by the number of stiles, are the primrose, willow-herb, bindweed, &c. See the System, Sect. IV. For representation of the different orders, see Plate IV. and the Explanation.

PENTATEUCH, in the sacred learning, the five books of Moses at the head of the Old Testament: viz, Genesis, Exodus, Leviticus, Numbers, and Deuteronomy. The word is formed from *πεντατευχος*, which signifies the same; compounded of *πεντε*, five, and *τευχος*, volume. Some modern critics have disputed Moses's right to the Pentateuch.

Pere Simon, in his Hist. Crit. du V. Test. produces a great number of passages to prove that Moses was not wholly the author of the *Pentateuch*, as we now have it. Indeed, those apparent interpolations at the end are sufficient to determine that point; it being absurd to suppose Moses the author of the account of his own death and burial, and of the comparison between him and the succeeding prophets in Israel. These interpolated passages are usually attributed to Esdras; who, on his return from the Babylonish captivity, is supposed to have published the Old Testament, or at least a part of it, corrected and enlarged. It is observed also in the text of the *pentateuch*, that there are some places that are defective; for example, in Exodus (xii. 8.), we see Moses speaking to Pharaoh, where the author omits the beginning of his discourse. The Samaritan inserts in the same place what is wanting in the Hebrew. In other places, the same Samaritan copy adds what is deficient in the Hebrew text; and what it contains more than the Hebrew seems so well connected with the rest of the discourse, that it would be difficult to separate them. Lastly, they believe that they observe certain strokes in the *pentateuch* which can hardly agree with Moses, who was born and bred in Egypt; as what he says of the earthly paradise, of the rivers that watered it, and ran through it; of the cities of Babylon, Erech, Refen, and Calneh; of the gold of Pison, of the Bdelium, of the stone of Soem, or onyx-stone, which was to be found in that country. These particulars, observed with such curiosity, seem to prove that the author of the *pentateuch* lived beyond the Euphrates. Add what he says concerning the ark of Noah, of its construction, of the place where it rested, of the wood wherewith it was built, of the bitumen of Babylon, &c. But in answer to all these objections, we may observe, in general, from an eminent writer of our own country, that these books are by the most ancient writers ascribed to Moses; and it is confirmed by the authority of heathen writers themselves, that they are of his writing: besides this, we have the unanimous testimony of the whole Jewish nation, ever since Moses's time, from the first writing of them. Divers texts of the *pentateuch* imply that it was written by Moses, and the book of Joshua, and other parts of scripture, import as much; and though some passages have been thought to imply the contrary, yet this is but a late opinion, and has been sufficiently confuted by several learned men. The Samaritans receive no other scriptures but the *pentateuch*, rejecting all the other books which are still in the Jewish canon.

There are two famous *Pentateuchs*, or editions of the *Pentateuch*, which have a long time disputed the preference, both as to antiquity and as to character: viz. that of the *Jewish* or *Hebrew Pentateuch*, written in the Chaldean or Assyrian character; and that of the Samaritans, written in the Samaritan or Phoenician character. Each is maintained to be the ancient Hebrew; though the generality of the critics give it in behalf of the latter.

Archbishop Usher takes the Samaritan *Pentateuch* to have been compiled by Dositheus, a Samaritan, mentioned by Origen to have adulterated the *Pentateuch*. Dupin supposes it the work of some modern Samaritan, whom he imagines to have compiled it chiefly out of the different copies of the Palestinian and Babylonian Jews, and the Septuagint, because it sometimes agrees with one, and sometimes with another. The Jews read the whole *Pentateuch* every year; and for this purpose they divide it into paragraphs or sections, which they distinguish into great and small. The great are those which they read in a week, of which there are fifty-four; and the small regard particular matters.—Each greater section, which is denominated by the word with which it begins, is divided into seven parts, because they are read by so many different persons; the priest begins, a Levite proceeds; and, in the choice of the other readers, respect is paid to the rank of the people. After the text of Moses, they read a paragraph of the *PARAPHRASE* of Onkelos. The books of the prophets are also divided in the same manner. See the article **BIBLE**.

PENTECOST, Πεντηκοστή, Whitfuntide; a solemn feast of the Christian church, held in the commemoration of the descent of the Holy Ghost on the Apostles; as described in the Acts.

It has its name from the Greek, *πεντηκοστή*, q. d. *quingagesimus*, fiftieth, because held on the fiftieth day after Easter. In the ancient church, Pentecost finished the Paschal time, or Easter

P E R

season; wherein, as Tertullian, St. Jerom, &c. observe, Hallelujah was sung every where, the office celebrated standing, no fasting allowed, &c. The Jews likewise had a feast they called Pentecost, or Quingagesimus, solemnized in memory of the laws being given to Moses fifty days after their departure out of Egypt. This was the second of the three grand festivals in the ecclesiastical year, at which all the males were to appear before the Lord at the national altar. It is called by several names in the Old Testament; as the Feast of Weeks, because it was celebrated seven weeks, or a week of weeks, after the Passover, or rather, after the first day of the feast of unleavened bread; the feast of Harvest, according to Mede and Bochart, because, as the harvest began at the Passover, it ended at Pentecost; or, according to others, because at this feast they offered the first fruits of the wheat harvest, which was then completed: besides which they presented at the temple seven lambs of that year, one calf, and two rams, for a burnt offering; two lambs for a peace offering; and a goat for a sin-offering. (Levit. xxiii. 15, 16. Exod. xxxiv. 22. and Deut. xvi. 9, 10.) The feast of the Pentecost was instituted among the Israelites, first to oblige them to repair to the temple of the Lord, there to acknowledge his absolute dominion over the whole country, and to offer him the first fruits of their harvest; and, secondly, that they might call to mind, and give thanks to God, for the law which he had given them from mount Sinai, on the 50th day after their coming out of Egypt.

The modern Jews celebrate the pentecost for two days. They deck the synagogue and their own houses with garlands of flowers. They hear a sermon or oration in praise of the law, which they suppose to have been delivered on this day. The Jews of Germany make a very thick cake, consisting of seven layers of paste, which they call *Sinai*. The seven layers represent the seven heavens, which they think God was obliged to re-ascend from the top of this mountain. See *Leo of Modena et Buxtorf's synag. jud.*

It was on the feast of pentecost that the Holy Ghost miraculously descended on the apostles of our Lord, who were assembled together after his ascension in a house at Jerusalem. (Acts ii.)

PENUMBRA, in astronomy, a faint or partial shade, observed between the perfect shadow and the full light in an eclipse. The penumbra arises from the magnitude of the sun's body; were he only a luminous point, the shadow would be all perfect; but by reason of the diameter of the sun, it happens that a place which is not illuminated by the whole body of the sun, does yet receive rays from a part thereof.

PEPPER, PIPER, in natural history, an aromatic berry of a hot dry quality, chiefly used in seasoning. We have three kinds of pepper at present used in the shops, the black, the white, and the long pepper. Black pepper is the fruit of the piper, and is brought from the Dutch settlements in the East Indies. See **PIPER**.

The common white pepper is factitious, being prepared from the black in the following manner: they steep this in sea-water, exposed to the heat of the sun for several days, till the rind or outer bark loosens; they then take it out, and, when it is half dry, rub it till the rind falls off; then they dry the white fruit, and the remains of the rind blow away like chaff. A great deal of the heat of pepper is taken off by this process, so that the white kind is more fit for many purposes than the black. However, there is a sort of native white pepper produced on a species of the same plant; which is much better than the factitious, and indeed little inferior to the black.

The long pepper is a dried fruit, of an inch or an inch and a half in length, and about the thickness of a large goose quill: it is of a brownish grey colour, cylindrical in figure, and said to be produced on a plant of the same genus.

Pepper is principally used by us in food, to assist digestion: but the people in the East Indies esteem it as a stomachic, and drink a strong effusion of it in water by way of giving them an appetite: they have also a way of making a fiery spirit of fermented fresh pepper with water, which they use for the same purposes. They have also a way of preserving the common and long pepper in vinegar, and eating them afterwards at meals.

PERAMBULATOR, in surveying, an instrument for the measuring of distances; called also *pedometer*, *way-wiser*, and *surveying wheel*. Its advantages are its handiness and expedition: its contrivance is such, that it may be fitted to the wheel of a coach; in which state it performs its office, and measures the road without trouble.

PERCA, the **PERCH**; in ichthyology, a Genus of fishes belonging to the order of Thoracici. The head is furnished with scaly and serrated opercula; there are seven rays in the membrane of the gills; and the fins on the back are prickly. There are 38 species, principally distinguished by peculiarities in the back fin. The most remarkable is, the fluviatilis, or common perch.

The perch was much esteemed as food by the Romans, nor is it less admired at present as a firm and delicate fish; and the Dutch are particularly fond of it when made into a dish called *water-fouchy*. It is a gregarious fish, and loves deep holes and gentle

gentle streams; is exceedingly voracious, and an eager biter; if the angler meets with a shoal of them, he is sure of taking every one. It is a common notion that the pike will not attack this fish, on account of the spiny fins which the perch erects on its approach. This may be true of large fish; but it is well known that small perches are the most tempting bait which can be laid for a pike. The perch is very tenacious of life, and has been known to survive a journey of 60 miles in dry straw. It seldom grows to a large size, though Mr. Pennant mentions one that weighed nine pounds, but this he tells us, is very uncommon. For the most approved methods of angling for this fish, see the Article ANGLING.

PERCEPTION, is a word which is so well understood, that it is difficult for the lexicographer to give any explanation of it. It has been called the first and most simple act of the mind by which it is conscious of its own ideas. This definition, however, is improper, as it confounds perception with consciousness; although the objects of the former faculty are things without us, those of the latter are the energies of our own minds. Perception is that power of faculty by which, through the medium of the senses, we have the cognizance of objects distinct and apart from ourselves, and learn that we are but a small part in the system of nature. By what process the senses give us this information, we have endeavoured to shew in the System of LOGIC, Part I. and we should not again introduce the subject, but to notice a singular opinion of a very able writer, whose work has been given to the public since our article alluded to had issued from the press.

Dr. Sayers, who is an ornament to that school in which we are strongly inclined to enlist ourselves, has endeavoured to prove that no man can perceive two objects, or be conscious of two ideas at the same instant. If this be true, not only our theory of time is grossly absurd, but even memory itself seems to be an imaginary faculty. If a man be not conscious of his present existence, at the very instant when he thinks of a past event, or reviews a series of past transactions, it is difficult, to us indeed impossible, to conceive what idea he can have of time, or what he can mean when he says that he remembers a thing.

PERCOLATION. See FILTRATION. Many have attempted the condensing of wines by percolation, or separating from them that superfluous moisture or water, which dilutes them below the true standard of vinous liquors, in order to make them richer and fitter for keeping, but it does not appear that such attempts have as yet succeeded.

PERCUSSION, in mechanics, an impression the body makes in falling or striking upon another; or the shock or collision of the two moving bodies; which meeting, alter each other's motion. See MOTION.

PERDIX, in Ornithology, a species of the Genus Tetrao. For description of the Genus and several species, see TETRAO.

PERENNIAL, in Botany, is applied to those plants whose roots will endure many years. Perennials are of two kinds; the one retain their leaves all the winter, called *evergreens*. The other cast their leaves in winter, called *deciduous* or *perdefols*. See the SYSTEM, Sect. II.

PERFECTION, the state or quality of a thing PERFECT. Perfection is divided, according to Clauvinus, into physical, moral, and metaphysical. *Physical* or natural perfection, is that whereby a thing has all its powers and faculties, and those too in full vigour; and all its parts, both principal and secondary, and those in their due proportion, constitution, &c. in which sense man is said to be perfect when he has a sound mind in a sound body. This perfection is by the schools frequently termed *επεργητικη*, because a thing is enabled thereby to perform all its operations. *Moral* perfection is an eminent degree of virtue or moral goodness, to which men arrive by repeated acts of piety, beneficence, &c. This is usually subdivided into absolute or inherent, which is actually in him to whom we attribute it: into imputative, which exists in some others, and not in him it is attributed to. *Metaphysical*, transcendental, or essential perfection, is the possession of all the essential attributes, or of all the parts necessary to the integrity of a substance: or it is that whereby a thing has or is provided of every thing belonging to its nature. It is called absolute, where all imperfection is excluded, such is the perfection of God; *secundum quid*, and in its kind.

PERFUME, denotes either the volatile effluvia from any body affecting the organ of smelling, or the substance emitting those effluvia; in which last sense the word is most commonly used. The generality of perfumes are made up of musk, ambergris, civet, rose and cedar woods, orange-flowers, jessamines, jonquils, tuberoses, and other odoriferous flowers. Those drugs commonly called aromatics, such as storax, frankincense, benzoin, cloves, mace, &c. enter the composition of a perfume; some are also composed of aromatic herbs or leaves, as lavender, marjoram, sage, thyme, hyssop, &c.

The use of perfumes was frequent among the Hebrews, and among the orientals, in general, before it was known to the Greeks and Romans. In the time of Moses perfumes must have been known in Egypt, since he speaks of the art of the perfumer, and gives the composition of two kinds of perfumes (Exod. xxx. 25.)

of which one was to be offered to the Lord upon the golden altar, which was in the holy place; and the other was appointed for the anointing of the high priest and his sons (*ibid.* 34, &c.) as also of the tabernacle, and all the vessels that were used in divine service.

The Hebrews had also perfumes which they made use of in embalming their dead. The composition is not known, but it is certain that they generally made use of myrrh, aloes, and other strong and astringent drugs, proper to prevent putrefaction (John xix. 49.) See the Article EMBALMING.

Besides the perfumes for these purposes, the scripture mentions other occasions whereon the Hebrews used perfumes. The spouse in the Canticles (i. 3.) commends the scent of the perfumes of her lover; and her lover in return says, that the scent of the perfumes of his spouse, surpasses the most excellent odours (*ib.* iv. 10--14.) He names particularly the spikenard, the calamus, the cinnamon, the myrrh, and the aloes, as making a part of these perfumes. The voluptuous woman described by Solomon (Prov. vii. 17.) says, that she had perfumed her bed with myrrh, aloes, and cinnamon. The epicures in the book of Wisdom (ii. 7.) encourage one another to the luxuriant use of odours and costly perfumes.

Isaiah (lvii. 9.) reproaches Judea, whom he describes as a spouse faithless to God, with being painted and perfumed to please strangers, "Thou wentest to the king with ointment, and didst increase thy perfumes." Ezekiel (xxiii. 41.) seems to accuse the Jews with having profaned the odours and perfumes, the use of which was reserved to sacred things, by applying them to their own use.

They came afterwards to be very common among the Greeks and Romans, especially those composed of musk, ambergris, and civet. The *nardus* and *molabathrum* were held in much estimation, and were imported from Syria. The *unguentum nardinum* was variously prepared, and contained many ingredients. *Malobathrum* was an Indian plant. Perfumes were also used at sacrifices to regale the gods; at feasts, to increase the pleasures of sensation; at funerals, to overpower cadaverous smells, and please the manes of the dead; and in the theatres to prevent the offensive effluvia, proceeding from a crowd, from being perceived.

Since people are become sensible of the harm they do to the head, perfumes are generally disused among us; however, they are still common in Spain and Italy.

PERICARDIUM, περικαρδιον, formed from περι, about, and καρδια, heart, in anatomy, a membranous capsule, or pouch, which includes the heart. The pericardium consists of three laminæ; the inner arising from the coats of the vessels of the heart; the outer from the mediastinum; and the middle, which is the chief, is composed of very fine tendinous filaments, closely interwoven and crossing each other in different directions. Its figure resembles that of the heart, being conoidal; and it embraces the heart laxly, allowing room for its pulsation. See the SYSTEM, Part V. Sect. II.

PERICARPIUM, formed from περι, about, and καρπος, fruit, in botany, a pellicle, membrane, or other substance, encompassing the fruit or seed of a plant. It is the germen of the pistil enlarged; or, as Linnaeus defines it, it is an entrail of the plant big with seed, which it discharges when ripe. There are no less than nine species of pericarpia. 1. A capsule. 2. A conceptaculum. 3. A pod. 4. A legume. 5. A nut. 6. A drupe. 7. An apple or pomum. 8. A berry. 9. A strobilus. See the SYSTEM, Sect. II. and Plate III.

PERICRANIUM, Περικρανιον, formed from περι, about and κρανιον, head or skull, in anatomy, a thick, solid coat, or membrane, covering the outside of the cranium or skull. See the SYSTEM, Part VI. Sect. I.

PERIGÆUM, PERIGEE, formed of περι and γη, earth, in astronomy, that point of the sun's or moon's orbit, wherein they are at their least distance from the earth. In which sense perigee stands opposed to APOGEE. See the SYSTEM, Section VIII. Article XII.

PERIGORD Stone, an ore of manganese, of a dark grey colour, like the basalt or trapp. It may be scraped with a knife, but is extremely difficult to be broken. It is found of no regular figure, is very compact, heavy, and as black as charcoal. Its appearance is glittering and striated, like the ore of antimony; its particles being disposed in the form of needles, crossing one another without any agglutination, inasmuch that some are loose as iron-filings when struck by a loadstone; resembling the scoria from a blacksmith's furnace. By calcination it becomes harder and of a reddish brown colour, but is not attracted by the magnet. It has a considerable specific gravity, does not melt *per se*, but with borax runs into a glass of the colour of an amethyst. It is scarcely affected by the nitrous acid without the addition of sugar. It seems also to contain some argil and iron. It is met with in Gascony and Dauphiny in France, and in some parts of England. It is employed by the French potters and enamellers in the glassy varnish of their earthen wares. See the SYSTEM of CHYMISTRY, Part III. Chap. I. Sect. VI.

PERIHELIIUM, formed from περι, and ηλιος, sun, in astronomy, that point of the orbit of a planet, or comet, where-

P E R

in it is at its least distance from the sun. *Peribolium* stands opposed to *APHELUM*. See the System, Sect. VII. Art. II.

PERINÆUM, or **PERINEUM**, *περιναϊον*, or *περινεον*, formed of *περι*, and *ναϊν*, to inhabit, in anatomy, the space between the pudendum and the fundament, properly the ligamentous seam which connects those two parts, called by the Latins, *interfæminum*. See the System, part III. Sect. XV. Art. 2. The part is subject to laceration in a difficult birth: and in this part an operation is performed, called the puncture of the *perineum*. But the principal disorders to which this part is subject, are abscesses and fistulas.

PERIOD, in astronomy, the time taken up by a star or planet in making a revolution round the sun; or the duration of its course till its return to the same part of its orbit. See **PLANET**.

The different periods and mean distances of the several planets are as follow:

	Days.	h.	'	"	mean Dist.
Saturn	10579	6	36	26	953800
Jupiter	4332	12	20	35	520110
Mars	686	23	27	30	152309
Earth	365	6	9	30	100000
Venus	224	16	49	24	72333
Mercury	87	23	15	53	36710

There is a wonderful harmony between the distance of the planets from the sun, and their periods round him; the great law whereof is, that the squares of the periodical times of the primary planet, are to each other as the cubes of their distances from the sun: and likewise, the squares of the periodical times of the secondaries of any planet are to each other as the cubes of their distances from that primary. This harmony among the planets is one of the greatest confirmations of the Copernican hypothesis. See the System, Sect. VII. and VIII.

PERIOD, in medicine, is applied to certain diseases which have intervals, and returns, to denote an entire course or circle of such disease; or its progress from any state through all the rest till it return to the same again. Galen describes *period* as a time composed of an intention and remission; whence it is usually divided into two parts, the paroxysm or exacerbation, and remission. In intermitting fevers, the *periods* are usually stated and regular; in other diseases, as the epilepsy, gout, &c. they are vague or irregular.

PERIODICAL Diseases, are such as decline and rise again with similar symptoms alternately. In the Philosophical Transactions, Dr. Musgrave gives us an instance of *periodic* palsy; and Dr. Cole an instance of a *periodical* convulsion.

PERIECI, *Περιεικοί*, formed from *περι*, about, and *οικω*, I inhabit, in geography, such inhabitants of the globe as have the same latitudes, but opposite longitudes; or live under the same parallel, and the same meridian, but in different semicircles of that meridian, or opposite points of the parallel. These have the same common seasons throughout the year, and the same phenomena of the heavenly bodies; but their hours, or times of the day, are opposite to each other. When v. gr. with the one it is mid-day, with the other it is mid-night. See the Treatise on the GLOBES, Prob. XVI.

PERIOSTEUM, or **PERIOSTIUM**, in anatomy, a nervous vascular membrane, endued with a very quick sense, immediately surrounding, in every part, both the internal and external surfaces of all the bones in the body, excepting only so much of the teeth as stand above the gums, and the peculiar places on the bones, in which the muscles are inserted. It is hence divided into the external and internal periosteum; and where it externally surrounds the bones of the skull, it is generally called the *pericranium*. See the System. Part I. Sect. I.

PERIPATETICS, *Περικατητικοί*; a sect of philosophers, the followers of Aristotle, or the maintainers of the *Peripatetic* philosophy: called also **ARISTOTELIANS**. Cicero tells us that Plato left two excellent disciples, Xenocrates and Aristotle, who founded two sects, which only differed in name; the former taking the appellation of **ACADEMICS**, who were those who continued to hold their conferences in the Academy, as Plato had done before: the others, who followed Aristotle, were called *Peripatetics*, from *περιπατω*, I walk; because they disputed walking in the Lyceum.

The greatest and best part of Aristotle's philosophy, he borrowed from his master Plato: Serranus affirms confidently, and says he is able to demonstrate it, that there is nothing exquisite in any part of Aristotle's philosophy, dialectics, ethics, politics, physics, or metaphysics, but is found in Plato. And of this opinion are many of the ancient authors, Clements, Alexandrinus, &c. Gale endeavours to shew, that Aristotle borrowed a good deal of his philosophy, both physical, about the first matter, and metaphysical about the first Being, his affections, truth, unity, goodness, &c. from the sacred books; and adds, from Clearchus, one of his (Aristotle's) scholars, that he made use of a certain Jew, who assisted him therein. Aristotle's philosophy preserved itself in *puris naturalibus* for a long time; in the earlier ages of Christianity, the Platonic philosophy was more generally preferred; but this did not prevent the doctrine of Aristotle from forcing its way into the Christian church. Towards the

P E R

close of the fifth century, it rose into considerable credit; the Platonics interpreting, in their schools, some of the writings of Aristotle, particularly his dialectics, and recommending them to young persons. This seems to have been the first step to that universal dominion, which Aristotle afterwards obtained in the republic of letters; which was also very much promoted by the controversies which Origen had occasioned; he was zealously attached to the Platonic system; and, therefore, after his condemnation, many, to avoid the imputation of his errors, and to prevent their being counted among the number of his followers, openly adopted the philosophy of Aristotle. Nor was any philosopher so proper for furnishing those weapons of subtle distinctions and captious sophisms, which were used in the Nestorian, Arian, and Eutychian controversies. About the close of the sixth century, the Aristotelian philosophy, as well as science in general, was almost universally decried; and it was chiefly owing to Boethius, who explained and recommended it, that it obtained a higher degree of credit among the Latins than it had hitherto enjoyed. Towards the end of the seventh century, the Greeks abandoning Plato to the monks, gave themselves up entirely to the direction of Aristotle, and in the succeeding century, the Peripatetic philosophy was taught every where in their public schools, and propagated in all places with considerable success. John Damascenus very much contributed to its credit and influence, by composing a concise, plain, and comprehensive view of the doctrines of the Stagirite, for the instruction of the more ignorant, and in a manner adapted to common capacities. Under the patronage of Photius, and the protection of Bardas, the study of philosophy, having for some time declined, revived again about the end of the ninth century. About the year 1050, a revolution in philosophy commenced in France, when several eminent logicians, who followed Aristotle as their guide, took nevertheless the liberty of illustrating and modelling anew his philosophy, and extending it far beyond its ancient limits. In the twelfth century, three methods of teaching philosophy were practised by different doctors; the first was the ancient and plain method, which confined its researches to the philosophical notions of Porphyry, and the dialectic system, commonly attributed to St. Augustine, and in which was laid down this general rule, that philosophical inquiries were to be limited to a small number of subjects, lest, by their becoming too extensive, religion might suffer by a prophane mixture of human subtilty with its divine wisdom. The second method was called the Aristotelian, because it consisted in explications of the works of that philosopher, several of whose books, being translated into Latin, were almost every where in the hands of the learned. The third was termed the free method, employed by such as were bold enough to search after truth, in the manner the most adapted to render their inquiries successful, without rejecting the succours of Aristotle and Plato. A reformed system of Peripateticism was first introduced into the schools in the university of Paris, from whence it soon spread throughout Europe; and has subsisted in the universities to this day, under the name of *school philosophy*. The foundation hereof is Aristotle's doctrine, frequently misunderstood, and often misapplied: whence the retainers thereto may be denominated *Reformed Peripatetics*. Out of these have sprung, at several times, several branches, the chief are, the Thomists, Scotists, and Nominalists. The Peripatetic system, after having prevailed with very great and very extensive dominion for many centuries, began rapidly to decline towards the close of the seventeenth century, when the disciples of Ramus attacked it on the one hand, and it had still more formidable adversaries to encounter in Des Cartes, Gassendi, and Newton.

PERIPHERY, in geometry, the circumference, or bounding-line, of a circle, ellipsis, parabola, or other regular curvilinear figure.

PERIPNEUMONY, *Περικνημονια*, formed from *περι*, about, and *πνευμων*, lungs, in medicine, an inflammation of some part of the thorax, properly of the lungs; attended with an acute fever, and a difficulty of breathing. For description, causes, prognosis, and cure, see the System, Genus XII.

PERISCII, *περισκοί*, q. d. *circummbres*, of *περι*, about, and *σκια*, shadow, in geography, those inhabitants of the earth, whose shadows do, in one and the same day, successively turn to all the points of the horizon. Such are the inhabitants of the frozen zones, or those who live within the compass of the arctic and antarctic circles; for, as the sun never goes down to them after he is once up, but moves always round about, so do their shadows; inasmuch that, in the same day, they have their shadows on all sides. See the Treatise on the GLOBES.

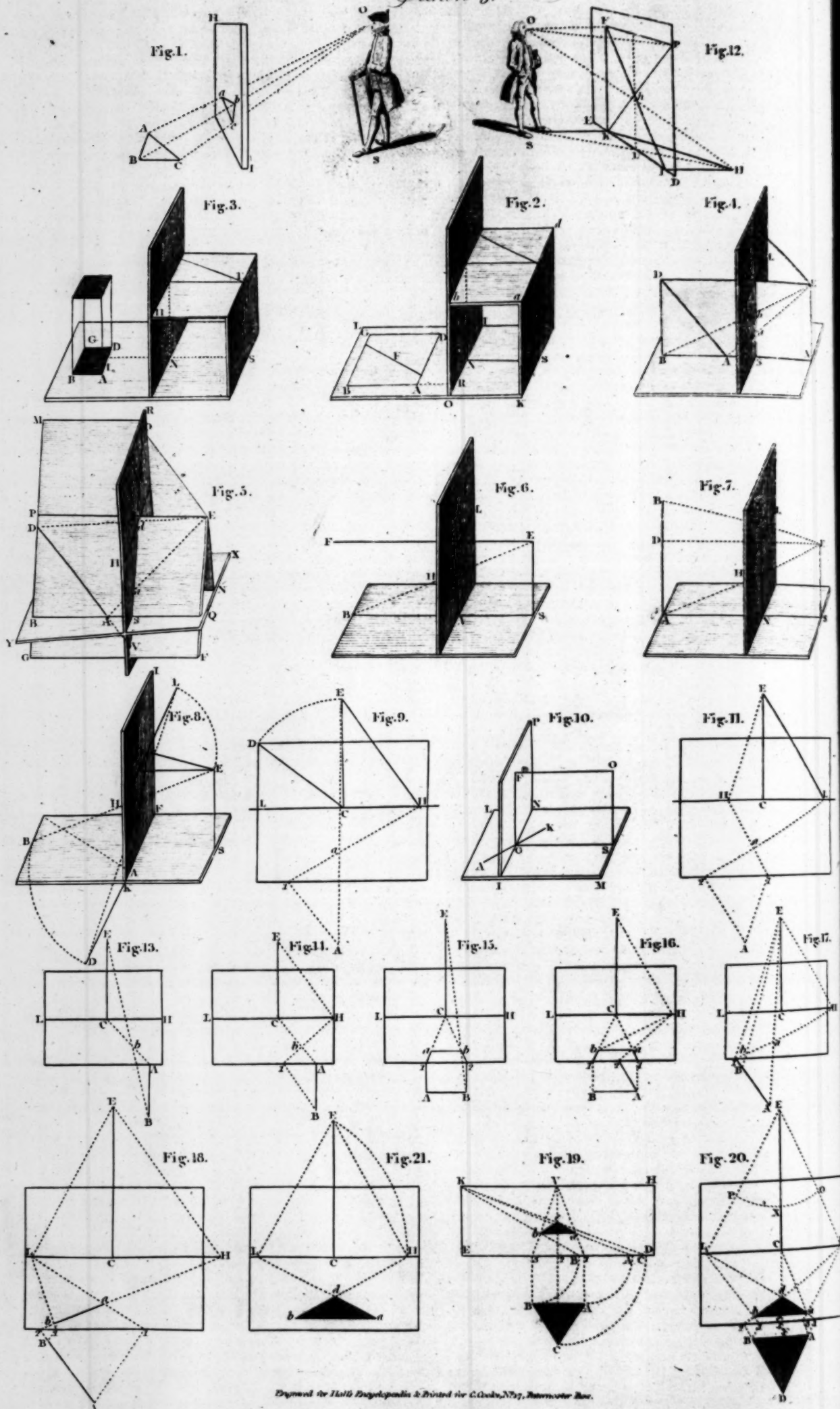
PERISTALTIC, *περισταλτικός*, formed from *περι*, about, and literally implying something driven, or pressed all around, in medicine, a motion proper to the *intestines*, wherein their several parts are successively contracted from above downwards, or from the pylorus to the anus; in a manner somewhat resembling the creeping of a worm; whence it is called the *vermicular motion*. The peristaltic motion is performed by the contraction of the circular and longitudinal fibres, whereof the fleshy coat of the intestines is composed. It is by means hereof that the chyle is driven into the orifices of the lacteal veins, and the excrements are pressed downwards, and at last expelled. When this motion comes to be

Pla-
stotle,
ersons.
inion.
cters;
which
atonic
id the
mong
hy of
those
were
About
s well
t was
led it,
than
venth
hem-
suc-
every
with
outed
and
in-
com-
pro-
time
bout
nce,
their
liang
nits.
phy
ient
oso-
only
ge-
to a
ive,
rich
sto-
hat
tin,
ird
old
d to
urs
was
om
in
by.
un-
eto
ave
he
m,
ni-
ofe
it
n-
g-
ar

of
r,
s,
nd
fe
ne
s,
ic
p,
h
e

d
n
al
n
e
t.
r-
f.
n
d
o
e

Principles of Perspective. See the System
Section 5.



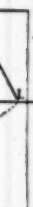


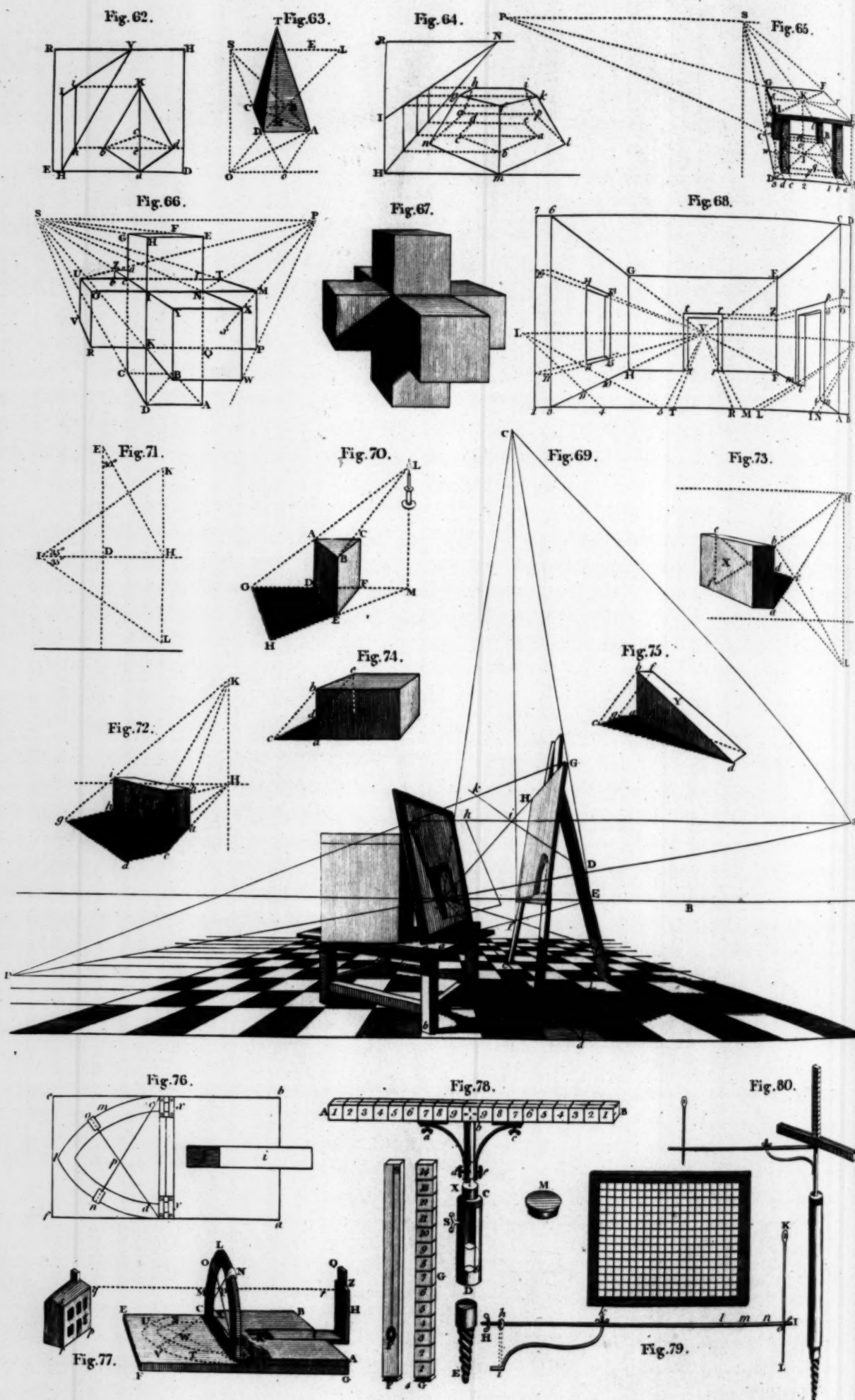
Fig. 17.



Fig. 18.



*(Principles of Perspective. See the System.)
Section 7.*



be depraved, and its direction changed, so as to proceed from below upwards, it produces what we call the *iliac passion*. M. Perault, in an express treatise on the *peristaltic* motion, observes that though it is ordinarily only attributed to the intestines, yet it is really an action common to all those parts of the body, which alter, prepare, and concoct the several humours and spirits, which are the matter and instruments of animal action. In effect, he gives the name to all the motions whereby the cavities of the body are pressed, or compressed.

PERITONÆUM, or **PERITONEUM**, *περιτοναϊον*, or *περιτονον* derived from the verb *περιτινω*, I *sketch all round*, in anatomy, a thin soft membrane, adhering to the inner surface of the musculi transversi, covering and containing all the viscera of the lower belly. See the System, Part III. Sect. I.

PERJURY, in law, is defined by Sir Edward Coke to be a crime committed when a lawful oath is administered, in some judicial proceeding, to a person who swears wilfully, absolutely, and falsely, in a matter material to the issue or point in question. In ancient times it was in some places punished with death; in others it made the false swearer liable to the punishment due to the crime he had charged the innocent person with; in others a pecuniary mulct was imposed. But though it escaped human, yet it was thought, amongst the ancients in general, that the divine vengeance would most certainly overtake it; and there are many severe inflictions from the hand of God upon record, as monuments of the abhorrence in which this atrocious crime is held by the Deity. The souls of the deceased were supposed to be employed in punishing perjured persons. Even the inanimate creation was thought to take revenge for this crime. The Greeks supposed that no person could swear falsely by Styx, without some remarkable punishment; and that no person guilty of perjury could enter the cave of Palæmon, at Corinth, without being made a memorable example of divine justice.—But although perjury was thus held in general abhorrence, notwithstanding the credit which was given to such accounts of divine inflictions, it was so much practised by the Greeks, that *Græca fides* became a proverb. Lovers perjuries, however, were supposed to pass unnoticed, or to be very slightly punished with blackness of the nails, a decayed tooth, or some small diminution of beauty.

The ancient philosophers, however, were so afraid of perjury, that even an oath before a judge was never admitted but for want of other proof. Plato's precept was, "Not to administer an oath wantonly, but on deep grounds, and with the strictest caution." Ulpian gives his opinion thus: "Some are forward to take oaths from a contempt of religion; others, from an extraordinary awe of the Divine Majesty, carry their fear to an unreasonable superstition; so make an equitable decision of a judge necessary." "No man will perjure himself (says Aristotle) who apprehends vengeance from Heaven and disgrace among men." Clinias was so very scrupulous, that rather than take an oath (though lawfully), he suffered the loss of three talents. Perjury, in the time of Philo Judeus, was abominated and capitally punished among the Jews; though since they have much degenerated, having been poisoned with the books of the Talmud, which says, "He who breaks his promissory oath, or any vows he enters into by the year, if he has a mind should be ineffectual and invalid, let him rise the last day of the year, and say, whatever promises, oaths, and vows I may think fit to make in the year following, let them be null, void, and of no effect." Tract. iii. part 3. of the *Talmud*, in the treatise *Nedarim*, ch. 4. And the modern Jews use the same artifice, thinking they may then lawfully deceive the Christians. See *Hieron. ex Dictis Talmud*, c. 3. and *Magister Joannes de Concor. Legum*. tit. iv. c. 7.

In our law, no notice is taken of any perjury but such as is committed in some court of justice having power to administer an oath; or before some magistrate or proper officer invested with a similar authority, in some proceedings relative to a civil suit or a criminal prosecution: for it esteems all other oaths unnecessary at least, and therefore will not punish the breach of them. For which reason it is much to be questioned, how far any magistrate is justifiable in taking a voluntary affidavit in any extrajudicial matter, as is now too frequent upon every petty occasion; since it is more than possible that, by such idle oaths, a man may frequently, *in foro conscientie*, incur the guilt, and at the same time evade the temporal penalties of perjury. The perjury must also be corrupt (that is, committed *mało animo*), wilful, positive and absolute; not upon surprise, or the like: it also must be in some point material to the question in dispute; for if it only be some in trifling collateral circumstance, to which no regard is paid, it is no more penal than in the voluntary extrajudicial oaths before mentioned. Subornation of perjury is the offence of procuring another to take such a false oath, as constitutes perjury in the principal. The punishment of perjury and subornation, at common law, has been various. It was anciently death, afterwards banishment, or cutting out the tongue: then forfeiture of goods; and now it is fine and imprisonment, and never more to be capable of bearing testimony. But the statute, 5 Eliz. c. 9. (if the offender be prosecuted thereon) in-

licts the penalty of perpetual infamy, and a fine of 40l. on the suborner; and, in default of payment, imprisonment for six months, and to stand with both ears nailed to the pillory. Perjury itself is thereby punished with six months imprisonment, perpetual infamy, and a fine of 20l. or to have both ears nailed to the pillory. But the prosecution is usually carried on for the offence at common law; especially as, to the penalties before inflicted, the statute 2 Geo. II. c. 25. superadds a power for the court to order the offender to be sent to the house of correction for a term not exceeding seven years, or to be transported for the same period; and makes it felony, without benefit of clergy, to return or escape within the time. It has sometimes been wished that perjury, at least upon capital accusations, whereby another's life has been or might have been destroyed, was also rendered capital, upon a principle of retaliation; as it was universally by the laws of France. And certainly the odiousness of the crime pleads strongly in behalf of the French law. But it is to be considered, that there they admitted witnesses to be heard only on the side of the prosecution, and used the rack to extort a confession from the accused. In such a constitution, therefore, it was necessary to throw the dread of capital punishment into the other scale, in order to keep in awe the witnesses for the crown; on whom alone the prisoner's fate depended: so naturally does one cruel law beget another. But corporal and pecuniary punishments, exile, and perpetual infamy, are more suited to the genius of the English law; where the fact is openly discussed between witnesses on both sides, and the evidence for the crown may be contradicted and disproved by those of the prisoner. Where indeed the death of an innocent person has actually been the consequence of such wilful perjury, it falls within the guilt of deliberate murder, and deserves an equal punishment; which our ancient law in fact inflicted. But the mere attempt to destroy life by other means not being capital, there is no reason that an attempt by perjury should; much less that this crime should, in all judicial cases, be punished with death. For to multiply capital punishments lessens their effect, when applied to crimes of the deepest dye; and, detestable as perjury is, it is not by any means to be compared with some other offences, for which only death can be inflicted; and therefore it seems already (except perhaps in the instance of deliberate murder by perjury) very properly punished by our present law: which has adopted the opinion of Cicero, derived from the law of the twelve tables, *Perjurii pœna divina, exitium; humana, dedecus*. See. OATH.

PERMUTATION, the truck, or exchange, of one thing for another. See EXCHANGE.

PERORATION, in oratory, the epilogue or last part of an oration, wherein what the orator had insisted on through his whole discourse is urged afresh with greater vehemence and passion. The peroration consists of two parts. 1. Recapitulation; wherein the substance of what was diffused throughout the whole speech is collected briefly and cursorily, and summed up with new force and weight. 2. The moving the passions; which is so peculiar to the peroration, that the masters of the art call this part *sedes affectuum*. See the Treatise on ORATORY, Part II. Sect. 6.

PERRUKE, **PERUKE**, or *Periwig*, was anciently a name for a long head of natural hair; such, particularly, as there was care taken in the adjusting and trimming of. Menage derives the word rather fancifully from the Latin *pilus* "hair." It is derived, according to this critic, thus, *pilus, pelus, pelutus, peluticus, pelutica, perutica, peruca, perruque*. The Latins call it *coma*; whence part of Gaul took the denomination of *Gallia Comata*, from the long hair which the inhabitants wore as a sign of freedom. An ancient author says, that Abalom's perruke weighed 200 shekels.

The word is now used for a set of false hair, curled, buckled, and sewed together on a frame or cawl? anciently called *capillamentum* or "false perruke." It is doubted whether or not the use of perrukes of this kind was known among the ancients. It is true, they used false hair: Martial and Juvenal make merry with the women of their time, for making themselves look young with their borrowed hair; with the men who changed their colours according to the seasons; and with the dotards, who hoped to deceive the Destinies by their white hair. But these seem to have scarce had any thing in common with our perrukes; and were at best only composed of hair painted and glued together. Nothing can be more ridiculous than the description Lampridius gives of the emperor Commodus's perruke: it was powdered with scrapings of gold, and oiled (if we may use the expression) with glutinous perfumes, for the powder to hang by. In effect, the use of perrukes, at least in their present mode, is not much more than 160 years old; the year 1629 is reckoned the epocha of long perrukes, at which time they began to appear in Paris; from whence they spread by degrees through the rest of Europe. At first it was reputed a scandal for young people to wear them, because the loss of their hair at that age was attributed to a disease the very name whereof is a reproach; but at length the mode prevailed over the scruple, and persons of all ages and conditions have worn them, foregoing, without any necessity, the conveniences of their natural hair. It was, however, some time before the ecclesiastics came into the fashion: the first who assumed the perruke were some of the French clergy, in the year

1660; nor is the practice yet well authorised. Cardinal Grimaldi, in 1684, and the bishop of Lavaur in 1688, prohibited the use of the perruke to all priests without a dispensation or necessity. M. Thiers has an express treatise, to prove the perruke indecent in an ecclesiastic, and directly contrary to the decrees and canons of councils. A priest's head, embellished with artificial hair, curiously adjusted, he esteems a monster in the church, nor can he conceive any thing so scandalous as an abbot with a florid countenance, heightened with a well curled perruke.

PERRY, the name of a very pleasant and wholesome liquor, extracted from pears, in the same manner as cyder is from apples. See the article CYDER.

The best pears for perry, or at least the sorts which have been hitherto deemed the fittest for making this liquor, are so excessively tart and harsh, that no mortal can think of eating them as fruit; for even hungry swine will not eat them, nay hardly so much as smell them. Of these the Bosbury pear, the Bareland pear, and the horse pear, are the most esteemed for perry in Worcestershire, and the squash pear, as it is called, in Gloucestershire; in both which counties, as well as in some of the adjacent parts, they are planted in the hedge-rows and most common fields. There is this advantage attending pear-trees, that they will thrive on land where apples will not so much as live, and that some of them grow to such a size, that a single pear-tree, particularly of the Bosbury and the squash kind, has frequently been known to yield, in one season, from one to four hogheads of perry. The Bosbury pear is thought to yield the most lasting and most vinous liquor. The John pear, the Harpary pear, the Drake pear, the Mary pear, the Lullum pear, and several others of the hardest kinds, are esteemed the best for perry, but the redder or more tawney they are, the more they are preferred. Pears, as well as apples, should be full ripe before they are ground. The method of preparing perry is perfectly the same with that of cyder. Only note, that the fruit must be perfectly ripe. Some mix crabs with them to mend the liquor.

PER SE, *of itself*, in the schools, is sometimes opposed to *per accidens*. In which sense, a thing is said to agree with another *per se*, when the agreement is not owing to any accidental event, but is found in the intrinsic principles of things themselves. Philosophers go so far as to consider the mode of a thing existing *per se*, or that which constitutes its existence such; which they call *perseity*, *perseitas*.

PERSECUTION, is any pain or affliction which a person designedly inflicts upon another; and in a more restrained sense, the sufferings of Christians on account of their religion.

Historians usually reckon ten general persecutions, the first of which was under the emperor Nero, 31 years after our Lord's ascension; when that emperor, having set fire to the city of Rome, threw the odium of that execrable action on the Christians, who, under that pretence, were wrapped up in the skins of wild beasts, and worried and devoured by dogs; others were crucified, and others burnt alive. The second was under Domitian, in the year 95. In this persecution St. John the apostle was sent to the island of Patmos, in order to be employed in digging in the mines. The third began in the third year of Trajan, in the year 100, and was carried on with great violence for several years. The fourth was under Antoninus the philosopher, when the Christians were banished from their houses, forbidden to show their heads, reproached, beaten, hurried from place to place, plundered, imprisoned, and stoned. The fifth began in the year 197, under the emperor Severus. The sixth began with the reign of the emperor Maximinus in 235. The seventh, which was the most dreadful persecution that had ever been known in the church, began in the year 250, in the reign of the emperor Decius, when the Christians were in all places driven from their habitations, stripped of their estates, tormented with racks, &c. The eighth began in the year 257, in the fourth year of the reign of the emperor Valerian. The ninth was under the emperor Aurelian, A. D. 274; but this was very inconsiderable: and the tenth began in the 19th year of Dioclesian, A. D. 303. In this dreadful persecution, which lasted ten years, houses filled with Christians were set on fire, and whole droves were tied together with ropes and thrown into the sea. See TOLERATION.

The persecutions of later date are not less dreadful than the ten persecutions under the Roman empire. Those who wish to peruse them, will find them particularly described in Southwell's book of MARTYRS.

PERSEUS, in astronomy, a constellation of the northern hemisphere; whose stars, in Ptolemy's Catalogue, are 29; in Tycho's as many; in Helvelius's 46; See the System, Sect. VIII.

PERSIAN WHEEL, in Hydrostatics, a machine for raising a quantity of water sufficient to overflow lands, bordering on the banks of rivers where the stream is too low to do it alone. See the System, Part II. Art. 7. For representation, see Plate I. (fig. 21.)

PERSICA, the PEACH, is by Linnæus referred to the same class and genus with Amygdalus; however, as they are so commonly reckoned to be different genera, we have thought proper to distinguish them. There are a great variety of peach-trees

planted in the gardens, some of which are preserved only for the beauty of their flowers, but most of them for the sake of the fruit. Of those remarkable for the beauty of their flowers the principal are, 1. The vulgaris, or common peach-tree with double flowers, which is a very great ornament in gardens, producing very large double flowers of a beautiful red or purple colour, and grows to a considerable size. 2. The humilis, or dwarf almond. 3. The Africana, or double flowering dwarf almond. These two reach not above the height of three or four feet, though their flowers are of equal beauty with the former. Of the peach-trees cultivated for the sake of their fruit there is a great number, to describe which particularly, would exceed the proper bounds of this article. For the cultivation of this fruit, see the Treatise on GARDENING, Article *Fruit Garden*; months, January, May, and July.

PERSONIFYING, or PERSONALIZING, the giving an inanimate being the figure, sentiments, and language of a person.

Dr. Blair, in his Lectures on Rhetoric, gives this account of personification. "It is a figure, the use of which is very extensive, and its foundation laid deep in human nature. At first view, and when considered abstractly, it would appear to be a figure of the utmost boldness, and to border on the extravagant and ridiculous. For what can seem more remote from the track of reasonable thought, than to speak of stones and trees, and fields and rivers, as if they were living creatures, and to attribute to them thought and sensation, affections and actions? One might imagine this to be no more than childish conceit, which no person of taste could relish. In fact, however, the case is very different. All poetry, even in its most gentle and humble forms, abounds with it. From prose it is far from being excluded; nay, in common conversation, very frequent approaches are made to it. When we say, the ground *thirsts* for rain, or the earth *smiles* with plenty; when we speak of ambition's being *restless*, or a disease being *deceitful*; such expressions show the facility with which the mind can accommodate the properties of living creatures to things that are inanimate, or to abstract conceptions of its own forming.

"Indeed, it is very remarkable, that there is a wonderful proneness in human nature to animate all objects. Whether this arises from a sort of assimilating principle, from a propensity to spread a resemblance of ourselves over all other things, or from whatever other cause it arises, so it is, that almost every emotion which in the least agitates the mind bestows upon its object a momentary idea of life. Let a man, by an unwary step, sprain his ankle, or hurt his foot upon a stone, and in the ruffled discomposed moment he will sometimes feel himself disposed to break the stone in pieces, or to utter passionate expressions against it, as if it had done him an injury. If one has been long accustomed to a certain set of objects, which have made a strong impression on his imagination; as to a house, where he has passed many agreeable years; or to fields, and trees, and mountains, among which he has often walked with the greatest delight; when he is obliged to part with them, especially if he has no prospect of ever seeing them again, he can scarce avoid having somewhat of the same feeling as when he is leaving old friends. They seem endowed with life. They become objects of his affection; and, in the moment of his parting, it scarce seems absurd to him to give vent to his feeling in words, and to take a formal adieu.

"So strong is that impression of life which is made upon us, by the more magnificent and striking objects of nature especially, that I doubt not in the least of this having been one cause of the multiplication of divinities in the heathen world. The belief of dryads and naiads, of the genius of the wood and the god of the river, among men of lively imaginations, in the early ages of the world, easily arose from this turn of mind. When their favourite rural objects had often been animated in their fancy, it was an easy transition to attribute to them some real divinity, some unseen power or genius which inhabited them, or in some peculiar manner belonged to them. Imagination was highly gratified, by thus gaining somewhat to rest upon with more stability; and when belief coincided so much with imagination, very slight causes would be sufficient to establish it.

"From this deduction may be easily seen how it comes to pass that personification makes so great a figure in all compositions where imagination or passion have any concern. There are three different degrees of this figure, which it is necessary to remark and distinguish, in order to determine the propriety of its use. The first is, when some of the properties or qualities of living creatures are ascribed to inanimate objects; the second, when those inanimate objects are introduced as acting like such as have life; and the third, when they are represented either as speaking to us, or as listening to what we say to them.

"Some of the French writers, particularly Bossuet and Flechier, are worthy of being consulted for instances of this and other ornaments of style. Indeed the vivacity and ardour of the French genius is more suited to this bold species of oratory, than the more correct but less animated genius of the British, who, in their prose works, very rarely attempt any of the high figures of eloquence."

PERSPECTIVE, *perspectus*, the science by which things are ranged in painting according to their appearance in their proper proportions.

SYSTEM OF PERSPECTIVE.

SECT. I.

HISTORY OF PERSPECTIVE.

THE art of perspective owes its birth to painting, and particularly to that branch of it which was employed in the decorations of the theatre, where landscapes were principally introduced, and which would have looked unnatural and horrid, if the size of the objects had not been pretty nearly proportioned to their distance from the eye. The ancients must, therefore, have had considerable knowledge of this art; though the only ancient author from whom we can obtain any information, relative to its antiquity, is Vitruvius; who, in the proem, to his seventh book, informs us, that Agatharcus, at Athens, was the first who wrote on this subject, on occasion of a play exhibited, by Æschylus, for which he prepared a tragic scene; and that afterwards the principles of the art were more distinctly taught in the writings of Democritus and Anaxagoras, the disciples of Agatharcus, which are no longer extant.

The perspective of Euclid and of Heliodorus Larisseus contains only some general elements of optics, that are by no means adapted to any particular practice; though they furnish some materials that might be of service even to the linear perspective of painters. Geminus of Rhodes, who was a celebrated mathematician, in the time of Cicero, hath likewise written on this subject. We may also infer, that the Roman artists were acquainted with the rules of perspective, from the account which Pliny, Nat. Hist. lib. xxxv. cap. 4. gives of the representations in the scene of those plays given by Claudius Pulcher; by whose appearance, he says, the crows were so deceived that they endeavoured to settle on the fictitious roofs. However, of the theory of this art among the ancients we know nothing; as none of their writings have escaped the general wreck of ancient literature in the dark ages of Europe. Perspective must, without doubt, have been lost, when painting and sculpture no longer existed. Nevertheless we have reason to believe, that it was practised much later in the Eastern empire.

John Tzetzes, who lived in the twelfth century, speaks of it as if he was well acquainted with its importance in painting and statuary: and the Greek painters, who were employed by the Venetians and Florentines, in the thirteenth century, seem to have brought some optical knowledge with them into Italy: for the disciples of Giotto are commended for observing perspective more regularly than any of their predecessors in the art had done: and they lived in the beginning of the fourteenth century. The Arabians were not ignorant of this art; as we may presume from the optical writings of Alhazen, who lived about the year 1100, cited by Roger Bacon, when treating on this subject.

Vitellius, a Poindar, about the year 1270, wrote largely and learnedly on optics. Our own friar Bacon, as well as John Peckham, archbishop of Canterbury, treated this subject with surprising accuracy, considering the times in which they lived. The most ancient authors, who professedly laid down rules of perspective, were Bartolomeo Bramantino, of Milan, whose book, entitled *Regole di prospettiva*, *Misure delle Antichità di Lombardia*, is dated 1440; and Pietro del Borgo, likewise an Italian, who was the most ancient author met with by Ignatius Danti, and who is supposed to have died in 1443. This last writer supposed objects to be placed beyond a transparent table, and endeavoured to trace the images, which rays of light emitted from them, would make upon it. But his work is not now extant. However, Albert Durer constructed a machine upon the principles of Borgo, by which he could trace the perspective appearance of objects.

Leon Battista Alberti, in 1450, wrote his treatise *De Pictura*, in which he treats principally of perspective. Balthazar Peruzzi, of Siena, who died in 1536, had diligently studied the writings of Borgo; and his method of perspective was published by Serlio, in 1540. To him, it is said, we owe the discovery of points of distance, to which all lines that make an angle of 45° with the ground line are drawn.

Guido Ubaldo, another Italian, soon after discovered, that all the lines that are parallel to one another, if they be inclined to the ground line, converge to some point in the horizontal line; and that through this point, also, a line, drawn from the eye, parallel to them will pass.

His perspective was printed at Pesaro in 1600, and contained the first principles of the method afterwards discovered by Dr. B. Taylor. In 1583, there was published a book, written by Giacomo Barozzi, of Vignola, commonly called Vignola, entitled, *The two Rules of Perspective*, with a learned Comment, by Ignatius Danti. In 1615 the work of Marolois was printed, in Latin, at the Hague, and engraved and published by Hondius. And in 1625, Sirigatti published a treatise of perspective, which is little more than an abridgement of Vignola's.

The art of perspective has been gradually improved by subsequent geometers, particularly by professors Gravesande, and, in a much greater degree, by Dr. Brook Taylor, whose principles are in a considerable measure new, and far more general than those of any of his predecessors. He did not confine his rules, as his predecessors had done, to the horizontal plane only, but made them general, so as to effect every species of planes and lines, whether they were parallel to the horizon or not; and thus his principles were made universal. Farther, from the simplicity of his rules, the whole

tedious progress of drawing out plans and elevations for any object is rendered entirely useless, and therefore avoided; for by this method, not only the fewest lines imaginable are required to produce any perspective representation, but every figure, thus drawn, will bear the nicest mathematical examination. Moreover, his system is the only one calculated for answering every one of those, who are practitioners in the art of design; because from hence they may be enabled to produce the whole, or only so much of an object as is wanted, and by fixing it in its proper place, may determine its apparent magnitude in an instant. It explains also the perspective of shadows, the reflections of objects from polished planes, and the inverse practice of perspective.

His *Linear Perspective* was first published in 1715; and his new *Principles of Linear Perspective* in 1719, which he intended as an explanation of his first treatise. In 1738, Mr. Hamilton published his *Stereography*, in two vols. fol. after the manner of Dr. Taylor. But the most complete system of perspective, both as to theory and practice, on the same principles, is that of Mr. Kirby, the third edition of which was published in 1768, fol. We have also treatises on this subject by the Jesuit, originally written in French at Paris, translated by Mr. Chambers, and printed at London, in 1702, Highmore, Ware, Cowley, Priestly, Ferguson, &c.

SECT. II.

LINEAR PERSPECTIVE.

Suppose a glass plane H I, Plate I. fig. 1. raised perpendicular on an horizontal plane: and the spectator S, directing his eye O, to the triangle ABC; if now we conceive the rays AO, OB, OC, &c. in their passage through the plane, to leave their traces or vestigia in *a*, *b*, *c*, &c. on the plane; there will appear the triangle *abc*; which as it strikes the eye by the same rays *a* O, *b* O, *c* O, by which the reflected particles of light from the triangle ABC are transmitted to the same; it will exhibit the true appearance of the triangle ABC, though the object should be removed, the same distance and height of the eye being preserved.

The business of perspective, then, is to shew by what certain rules the points *a*, *b*, *c*, &c. may be found geometrically: and hence, also, we have a mechanical method of delineating any object very accurately.

Hence it appears, that *abc* is the section of the plane of the picture with the rays, which proceed from the original object to the eye: and therefore, when this is parallel to the picture, its representation will not only be parallel to the original, but similar to it, though smaller in proportion, as the original object is farther from the picture. If the original is brought to coincide with the picture, the representation will be equal to the original; but as the original is removed farther and farther from the picture, the image of it will become smaller and smaller, and also rise higher and higher in the picture, till at last, when the original is supposed to be at an infinite distance, its image, or representation, will vanish into an imaginary point, exactly as high above the bottom of the picture as the eye is above the ground or original plane, upon which the spectator, the picture, and the original object, are supposed to stand. This may be familiarly illustrated in the following manner: suppose a person at a window looks through an upright pane of glass at any object beyond it; and keeping his head steady, draws the figure of the object upon the glass with a black-lead pencil, as if the point of the pencil touched the object itself; he would then have a true representation of the object in perspective, as it appears to his eye. In order to this, it is necessary, first that the glass be laid over with strong gum-water, which, when dry, will be fit for drawing upon, and will retain the traces of the pencil; and, secondly, that he looks through a small hole in a thin plate of metal, fixed about a foot from the glass, between it and his eye, and that he keeps his eye close to the hole, otherwise he might shift the position of his head, and consequently make a false delineation of the object. Having traced out the figure of the object, he may go over it again, with pen and ink; and when that is dry, put a sheet of paper upon it, and trace it in this with a pencil; then taking away the paper, and laying it on a table, he may finish the picture, by giving it the colours, lights, and shades, as he sees them in the object itself; and thus he will have a true resemblance of the object.

Perspective is either employed in representing the *ichnographies* and ground-plots of objects, as projected on perspective planes; or in *scenographies* and representations of the bodies themselves.

From this general view of perspective, the necessity of it in the art of painting is obvious. Accordingly Leonardo de Vinci observes that the practice of painting ought always to be built upon a rational theory, of which perspective is the guide and gate; and without which it is impossible to succeed, either in designing or in any of the arts depending upon it.

In order to understand the practice of perspective it will be necessary to premise some definitions, and general principles, upon which its various operations depend. Several of these occur in the course of this work, but it may be convenient and useful to give, in this place, a brief and connected view of them.

SECT. III.

DEFINITIONS.

The *point of sight*, in perspective, is that point E (fig. 2.) where the spectator's eyes should be placed to view the picture. The *point of sight*, in the picture, is the same with the centre of the picture

PERSPECTIVE.

Picture, or the point directly opposite to the eye, and the nearest to it, called also the principal point.

If from the point of sight E, a line, EC, be drawn perpendicular to the picture O b g I; the point C, where the line intersects the picture, is called the *centre of the picture*; and EC the principal ray. The *distance of the picture* is the length of the line EC, which is the common section of the vertical and horizontal planes; and if this distance be transferred to the horizontal line on each side of the point C, as is sometimes the case, the extremes are called the *points of distance*: for the points of distance are set off from the point of sight, sometimes on the horizontal line, and sometimes on the perpendicular EC.

As the beauty of perspective depends on the point of distance, the eye ought never to be placed too near the object, nor too far from it. It should never be nearer to the object than half of its largest dimensions, for in this situation the visual angle will be 90° ; and this is the largest angle which the eye can well discover at one cast. If it be made less than 45° , the object will be too much contracted, and the visual angle so small, that the returns in buildings would not be distinguished, and the whole would appear confused. And, therefore, when the visual angle is about 60° , or when the distance of the eye from the extremities of the object is nearly equal to its longest dimension, the object will be seen with the greatest advantage. However, in some cases, such as in painting deceptions, or for pictures with curvilinear objects, the distance should be taken as great as possible: and in drawing agreeable perspective views of small objects, the observer should be considered as viewing them under an angle not exceeding 30° at most.

The real object, whose representation is sought, whether it be a line, point, or plane figure, is the *original object* and the *original plane*, called also the *geometrical plane*, is that plane upon which the real object is situated: thus the ground or bottom plane KL is the original plane, and ABGD is the original object. The line OI, in which the ground plane cuts the bottom of the picture, is called the section of the original plane, *ground line*, *line of the base*, or *fundamental line*.

If an original line AB be continued, so as to intersect the picture, the point of intersection R is called the intersection of that original line, or its *intersecting point*. The *horizontal plane*, is the plane *abgd*, which passes through the eye, parallel to the horizon, and cuts the perspective plane or picture at right angles; and the *horizontal line* *bg* is the common intersection of the horizontal plane with the picture. The *vertical plane* is that which passes through the eye at right angles to the ground plane, and perpendicular to the picture, as ECN; and the *vertical line* is the common section of the vertical plane and the picture, as CN.

The *line of station* SN is the common section of the vertical plane with the ground plane, and perpendicular, to the ground line OI.

The *line of the height of the eye* is a perpendicular, as ES, let fall from the eye on the ground plane. This height, which determines that of the horizontal line from the bottom of the picture, should never be so great as the distance of the eye. In easel-pieces, or moveable pictures, the height of the eye is left entirely to the discretion of the artist, but it is observed in general, that low horizons have a much better effect than high ones; for which reason the height of the horizontal line should never exceed one half of the height of the picture; and perhaps the most proper height would be one third part. However if the picture be a fixed one, then the height of the horizontal line must be exactly level with the spectator's eye. The size of the picture is to be regulated by the distance and height of the eye.

The *vanishing line* of the original plane, is that line where a plane passing through the eye, parallel to that original plane, cuts the picture; thus Hg, (fig. 3.) is the vanishing line of ABGD. It is plain that no point in the original plane can have its image in the picture above the line Hg, as long as the position of the picture and the eye remains the same: and that if the original plane ABGD were infinitely extended beyond the picture, yet its perspective appearance, in this case, would be a finite space, bounded by the vanishing line Hg. It is also plain, from this definition, that if two or more planes, ABGD and T, are parallel to each other, they will have the same vanishing line Hg.

The *vanishing point*, of the original line is that point where a line drawn from the eye, parallel to that original line, intersects the picture: thus C and g are the vanishing points of the line AB, KI. Hence it follows, that the vanishing points C and g of the lines AB, KI, in any original plane ABGD, are the vanishing line of that plane. If from the point of sight a line be drawn perpendicular to any vanishing line, the point where that line intersects the vanishing line, is called the centre of that vanishing line, and the *distance of a vanishing line* is the length of the line which is drawn from the eye, perpendicular to the said line.

Measuring points, are points from which any lines in the perspective plane are measured, by laying a ruler from them to the divisions laid down upon the ground line. The *measuring point* of all lines parallel to the ground line is either of the points of distance on the horizontal line, or point of sight. The *measuring point* of any line perpendicular to the ground line, is in the point of distance on the horizontal line; and the *measuring point* of a line oblique to the ground line is found by extending the compasses from the va-

nishing point of that line to the point of distance on the perpendicular, and setting it off on the horizontal line

SECT. IV.

PROPOSITIONS.

Having explained the principal terms that occur in perspective, we shall farther premise some general propositions, from which the practical operations result.

I. In the representation *a b*, (fig. 4.) of a line, A B is part of a line SC, which passes through the intersecting point S, and the vanishing point C, of the original line A B. For the plane BDEN, passing through the eye E and the original line A B, will pass through the intersecting point S, and the vanishing point C, and cut the picture in the line SC. And since the visual rays A E, B E, drawn from the extremities of the line to the eye, are in the plane B D E N, and consequently their sections *a b*, with the picture, are in the section SC of that plane with the picture *a b* must be the projections of A B. But B E A is a plane of rays which form the projection *a b* of the whole line A B, and as B E A is in the plane B D E N, the section *a b* must be a part of the section SC, which passes through S and C. Hence it follows, that, whatever be the situation of any original line, its representation upon the picture will always be in that line which is drawn through its intersection and vanishing point. For let the oblique line A D, (fig. 5.) be in the plane G F E O M, whose section with the picture is V O. Continue D A to cut the picture in V, and draw its parallel E O to cut the picture in O, which will be the vanishing point of A D. From the extremes of the line A D produce the rays A E, D E, to the eye E, and *a d*, the image of A D, is part of the line V O, which passes through the intersecting point V, and the vanishing point O.

II. If the original plane is parallel to the picture, it can have no vanishing line upon it, consequently the representation will be parallel, because a parallel plane, that passes through the eye, can never cut the picture, and consequently can produce no vanishing line upon it. Nor can lines parallel to the picture have any vanishing points upon it; but their images will be parallel to the originals. If the original is perpendicular to the ground line, as A B, (fig. 4.) then its vanishing point will be in C, the centre of the picture, or point of sight; because EC is perpendicular to the picture, and, therefore, parallel to A B. All lines, which are parallel to each other, but not parallel to the picture, will have the same vanishing point, because a line which passes through the eye, being parallel to one of them, is parallel to all the rest; and, therefore, they can have but one vanishing point, whatever be their number.

III. The image of a line bears a certain proportion of its original. In this proposition there are three cases; for the original line may be perpendicular, parallel, or oblique to the plane of the picture. In the first case, let A B (fig. 6) be the original line, consisting of three equal parts of which EC contains two; then $EC + AB = ES =$ five parts. Divide AC into five equal parts, and the ray B E will pass through *b*; and $Ab : AC :: BA : BA + CE (= BS)$, i. e. the image is to the distance between the vanishing point C and the intersecting point A, as the original object is to its own length added to the distance of the eye from the picture. See Simpson's Geometry, th. 12. book vii. Hence it follows that $AC - Ab = Cb : AB + CE - AB = CE :: AC : AB + CE$, or $Cb : AC :: CE : AB + CE$, i. e. the distance between the vanishing point of a line and any point *b* in its image is to the distance between the vanishing point and the intersecting point as the distance EC is to $AB + CE$. From a view of the figure it is also evident, that $Ab : ES :: AB : BS$, i. e. the height of the point *b* in the picture is to the height of the eye as the distance of the objective point from the picture is to the sum of the same distance, and that of the eye from the picture.

In the second case, when the original line is parallel to the plane of the picture, the images *a b* of a line A B, (fig. 7.) parallel to the picture is to its original A B, as the distance EC of the image is to the distance ED of the original line. Suppose the figure constructed, and it is plain that the triangles EBD, ECh, and ECa, E D a, are respectively equiangular, because *a b* is parallel to AB: and, therefore, $Cb : DB :: EC : DE$, and $Ca : DA :: EC : DE$; consequently $ab : AB :: EC : ED$. In the third case, when the original line is oblique to the picture, the image *A b* of the oblique line A B, (fig. 8) is to the distance AV between its vanishing point V, and intersecting point A, as the length of the line A B is to the sum of AB and EV, the distance of the vanishing point V from the eye. The lines A B and EV are parallel by construction; therefore the triangles EVb and ABb are equiangular; therefore, $Vb : Ab :: EV : AB$, i. e. the distance between the vanishing point of an oblique line, and any point of its image, is to the remaining part of AV, as the distance of the vanishing point is to the original line: and $Ab : Ab + bV = AV :: AB : AB + EV$.

IV. The image of a line may be determined by transferring the length or distance of the given line to the intersecting line; and the distance of the vanishing point to the horizontal line, i. e. by bringing both into the plane of the picture. Let AB be the original line, whose vanishing point is V, and produce the ground line FA, and the vanishing line HV, and draw AV. From the intersecting point A transfer the line AB to D, and from V transfer EV to L, then draw the lines BE and DL, which will both pass through the same point *b*, and

perpen-

believe,
which

of a line
nishing
passing
gh the
he pic-
drawn
e B D
e, are
be the
form
in the
n S C,
what-
upon
rough
e line
with
, and
be the
A D
age of
erfec-

va no
allei,
er cut
upon
oints
f the
then
point
here-
ther,
oint,
one
have

inal.
may
ture.
g of
B=
ray
(=
oint
own
See
that
A B
be-
ge is
ling
the
the
the
n of

ane
the
s to
on-
C a,
B :
C :
afe,
of
its
the
ish-
by
an-
be-
of
the
=

gib
e of
into
ing
ing
fer
the
b,
and

(Principles of Perspective for the System.)
Section 6.

Fig. 39.

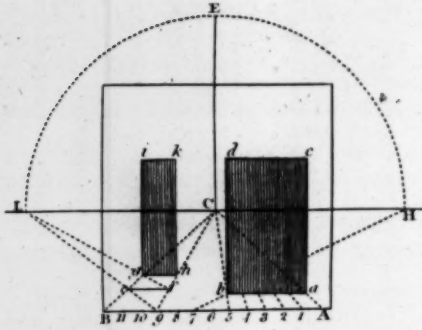


Fig. 40.

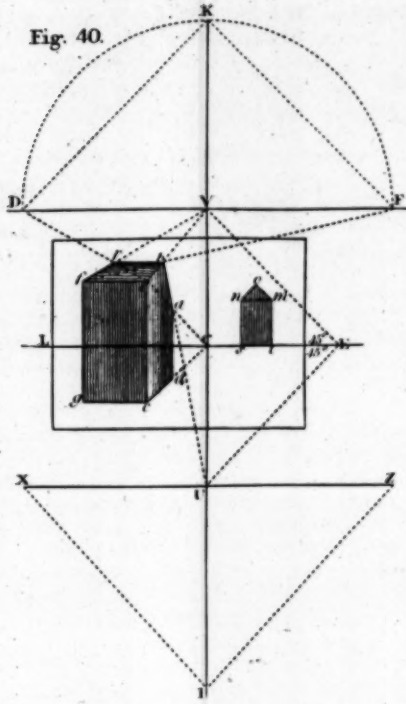


Fig. 41.

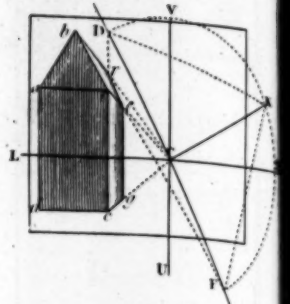


Fig. 42.

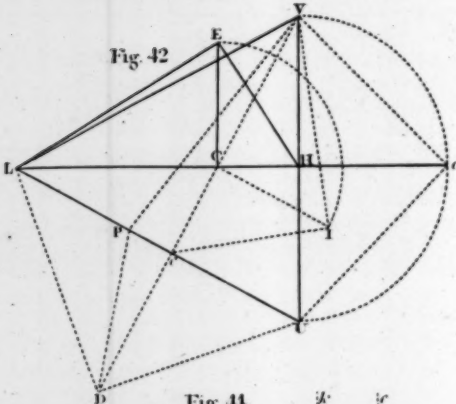


Fig. 43.

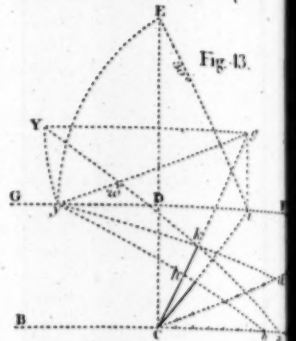


Fig. 44.

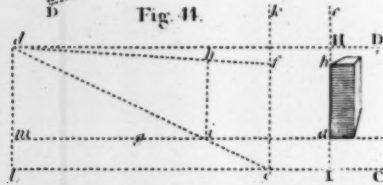


Fig. 45.

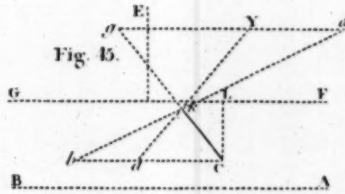


Fig. 46.

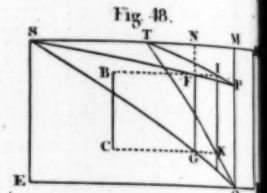


Fig. 47.

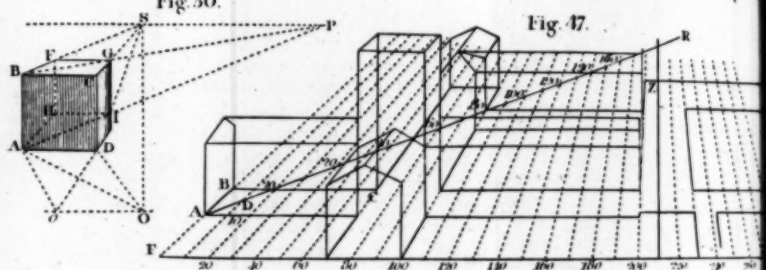


Fig. 48.

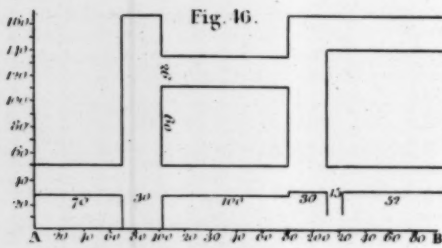


Fig. 49.

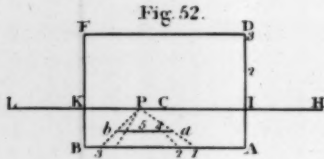


Fig. 50.

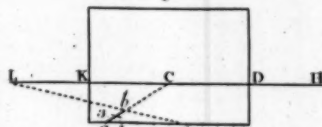


Fig. 51.

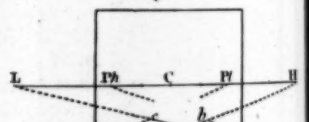


Fig. 52.

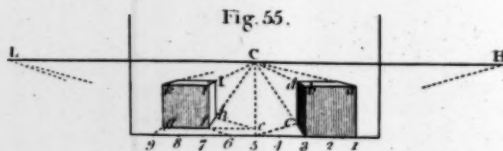


Fig. 53.

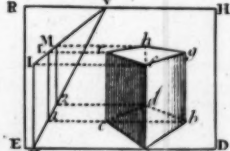


Fig. 54.

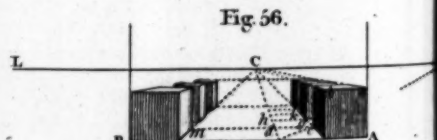


Fig. 55.

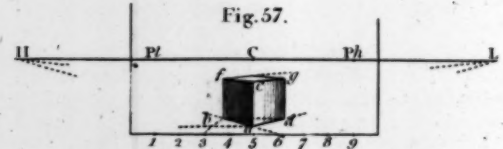


Fig. 56.

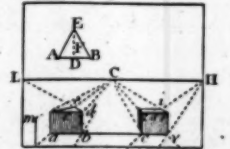


Fig. 57.

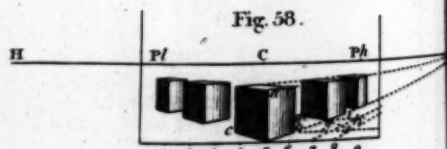


Fig. 58.

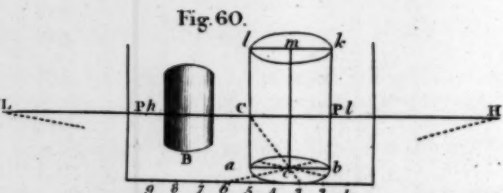


Fig. 59.

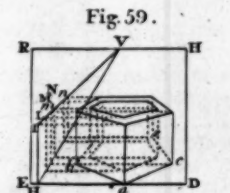
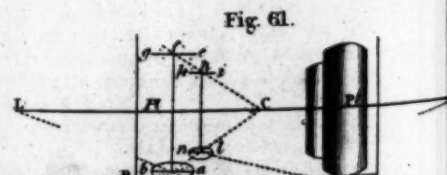
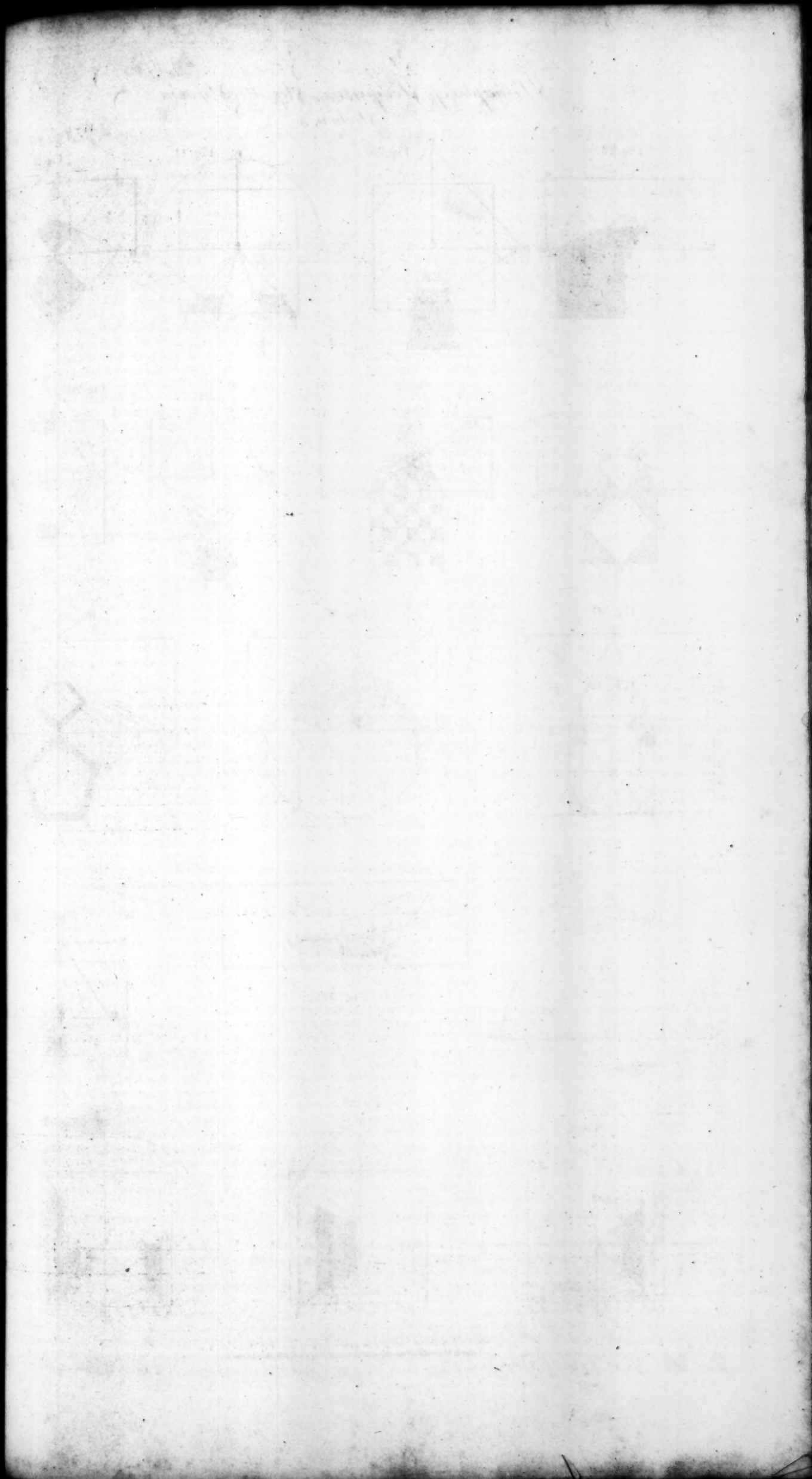
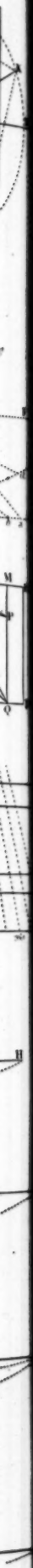
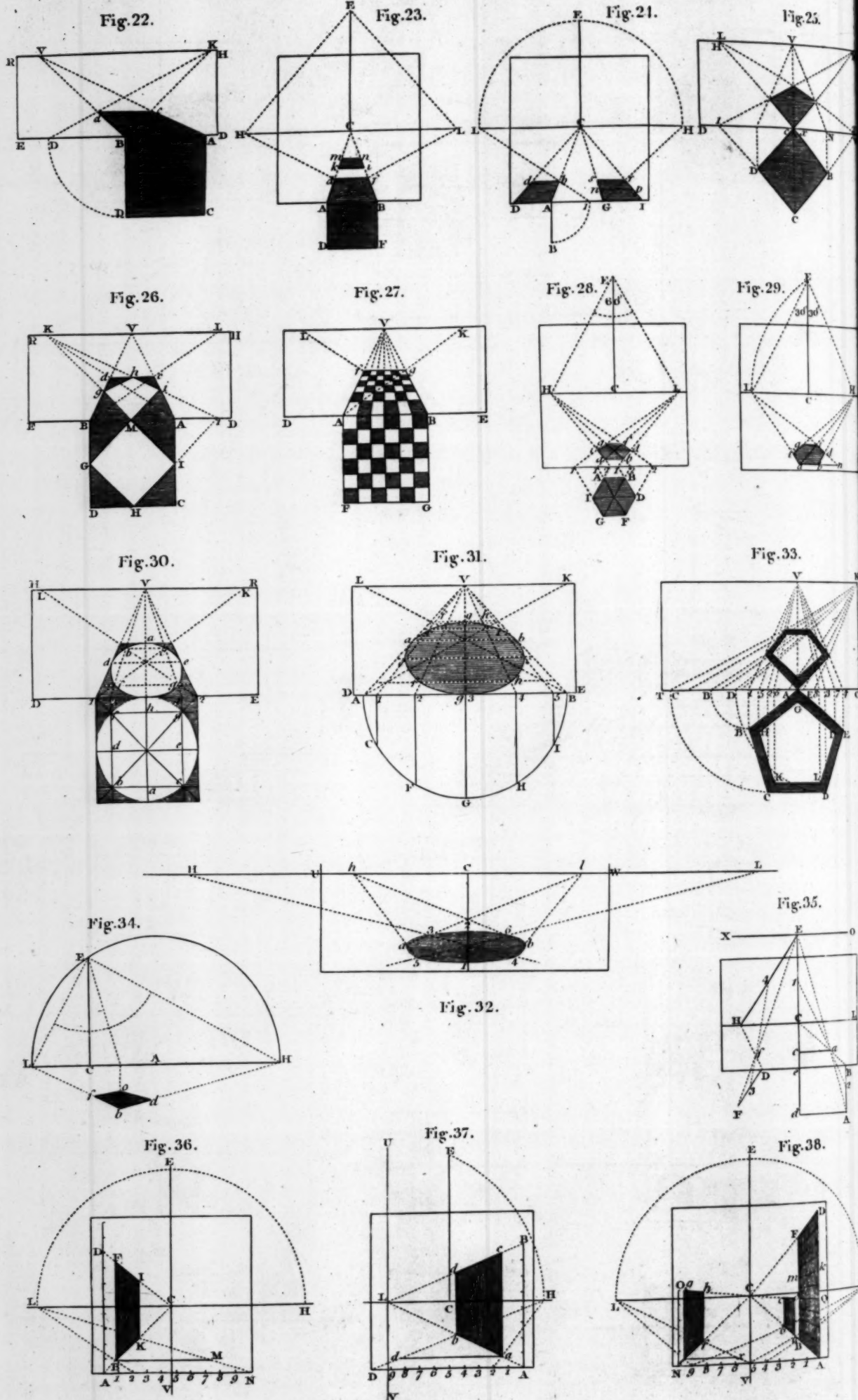


Fig. 60.





Principles of Perspective. See the System.
Section 3.



PERSPECTIVE.

and give $A b$ for the image of A, B . See Simpson's Geom. book vii. th. 12. cor.

Having premised the general principles of *perspective*, we shall now subjoin some examples of the practice of *ichnographic perspective* in the following problems.

S E C T. V.

ICHOGRAPHIC PERSPECTIVE.

I. To find the representation of an objective point A .—From A , (fig. 9) draw any line at pleasure, as $A 1$, intersecting the bottom of the picture in 1 ; and from the eye E draw $E H$ parallel to $A 1$, intersecting the horizontal line in H ; which will be the vanishing point of $A 1$; draw $H 1$, and from A a line to E , intersecting $H 1$ in a ; and a will be the representation of the original point A . Otherwise, draw $A 1, A 2$, (fig. 11) at pleasure, intersecting the bottom of the picture in 1 and 2 ; and from the eye E draw $E H$, parallel to $A 1$, and $E L$ parallel to $A 2$; then draw $H 1$ and $L 2$, which will intersect each other in a , the representation of A .

There is also another method of resolving this problem, or of exhibiting the *perspective* appearance h , of an objective point H (fig. 12). From the given point draw $H I$ perpendicular to the fundamental line $D E$. From the fundamental line $D E$ cut off $I K = I H$; through the point of sight F draw a horizontal line $F P$; and make $F P$ equal to the distance of the eye $S L$. Lastly, from the point I to the point of sight F , draw $F I$; and from K to the point of distance P , the line $P K$. The intersecting h is the appearance of the objective point. For $O F$ is parallel to $H I$, therefore F is the vanishing point of $H I$; and since the representation of $H I$ is in the line $I F$, and consequently the image of the point I is in the same line; and since $O P$ is parallel to $H K$, because the triangles $O F P$ and $H I K$ are isosceles and right-angled, and consequently equiangular; and $O F$ being parallel to $H I$, $F O H = O H I$, therefore $P O H = O H K$; P will be the vanishing point of $H K$, and the image of the point H will be found somewhere in the line $K P$; consequently, it must be exhibited in h , the common intersection of $L F$ and $K P$.

Hence, 1. since the appearance of the extreme points of a right-line being given, the appearance of the whole line is given; the *ichnographic* projection of any rectilinear figure may be had by this method. And, 2. since any number of points of a curve line may by this means be projected on the *perspective* plane; the projection of curve lines may likewise be effected after the same manner. And, 3. therefore, this method will suffice for mixtilinear figures; and is consequently universal.

II. To find the representation of a line $A B$ (fig. 13) which is perpendicular to the ground line of the picture. The point C , where $E C$ intersects the horizontal line, is the vanishing point of $A B$; and, therefore, if $A C$ be drawn, and from B be drawn $B E$, intersecting $A C$ in b ; $A b$ will be the image of $A B$.

Otherwise, from B (fig. 14) draw $B 1$ at pleasure, intersecting the ground line in 1 ; and from the eye E draw $E H$ parallel to $B 1$, intersecting the horizontal line in H ; then H is the vanishing point of $B 1$; and therefore, drawing $A C$ and $1 H$, the point b of their intersection will determine the required image $A b$.

III. To determine the image of a line $A B$ parallel to the ground line. Draw $A 1, B 2$ (fig. 15) perpendicular to the ground line, and C will be the vanishing point of those lines; draw $1 C, 2 C$, and $B E$ intersecting $2 C$ in h ; then draw $a b$ parallel $H L$, and it will be the image of $A B$.

Otherwise, by two vanishing points: draw $A 2$ (fig. 16) at pleasure, intersecting the ground line in 2 ; and draw $E H$ parallel to $A 2$, then H is the vanishing point of $A 2$; draw $2 H$ intersecting $1 C$ in a ; and the parallel line $a b$ will be the image required.

IV. To exhibit the image of a line $A B$ oblique to the picture. Produce $A B$ (fig. 17) to the picture, and draw $E H$ parallel to it; from 1 draw $1 H$, and from the extremities A and B draw lines to E , which will intersect $1 H$ in a and b and $a b$ is the image of $A B$.

Otherwise; from $A B$ (fig. 18) draw $A 1, B 1$, parallel to each other; and from E draw $E L$ parallel to $A 1, B 1$; then draw $1 L, 1 L$ intersecting $2 H$ in a and b ; and $a b$ is the representation of $A B$. The problems now laid down will serve for determining the situation of all objects that are supposed to lie upon the ground.

V. To find the perspective appearance of a triangle $A B C$, (fig. 19) whose base $A B$ is parallel to the fundamental line $D E$. To the fundamental line $D E$ draw a parallel at an interval equal to the altitude of the eye. Assume a fundamental point V , opposite to this, either directly or obliquely, as the case requires. Transfer the distance of the eye from V to K . From the several angles of the triangle $A B C$, let fall perpendiculars, $A 1, C 2, B 3$; set off these perpendiculars upon the fundamental line $D E$ opposite the point of distance K . From $1, 2, 3$, draw right-lines to the fundamental or principal point $V 1, V 2, V 3$. From the points A, B , and C , of the fundamental line $D E$ draw other right-lines $A K, B K, C K$, to the point of distance K .

Since a, b , and c are the appearances of the points A, B , and C ; the right-lines $a c, a b, b c$, being drawn, $a c b$ will be the appearance of the triangle $A B C$. After the same manner is a triangle projected on a plane where the vertex C is opposed to the eye; all here required is, that its situation on the geometrical plane be changed, and the vertex C be turned towards the fundamental line $D E$. Otherwise, produce $D A$ and $D B$ (fig. 20) to the ground line, and

draw $E L$ parallel to $A D$, and $E H$ parallel to $B D$; then draw $1 L$ and $2 H$ intersecting each other in d ; and d will be the representation of the angular point D . From B draw $B 1$ parallel to $A 1$, and L will be its vanishing point; therefore draw $1 L$ intersecting $2 H$ in the point b , and b will be the representation of the angular point B ; and since $A B$ is parallel to the bottom of the picture, from the point b , draw $b a$ parallel to the ground line, and the image of the triangle will be completed: or it may be done by drawing $A 3$ perpendicular to the bottom of the picture, and then $3 C$ cutting $1 L$ in the point a , &c. If this triangle be equilateral, it may be easily divided into two equal parts, by describing from E , with any radius, one arc $O P$, bisecting it in X , and drawing $E C$: from C draw a line through d , intersecting $a b$ in c . This is evident, because C is the vanishing point of $D F$. The triangle may be also projected by having only one side $a d$ (fig. 21) given: let this be produced to its vanishing point L , and draw $L E$; then at L , with the distance $L E$, describe the arc $H E$, intersecting the horizontal line in H , and H is the vanishing point of the other side $b d$; and by drawing $a b$ parallel to the horizontal line, the representation will be completed.

This method furnishes a very useful rule for shortening the operations in *perspective*. For suppose $a L$ to be a line given in *perspective* (that is to be drawn upon the picture) to any vanishing point L ; and let it be required to cut off a part $a d$, of the line $a L$, to represent a given length. From the end a of the line $a d$, draw $a b$ parallel to the horizontal line $H L$, and call $a b$ the representation of a parallel line upon the picture; then from L , the vanishing point of $a d$, transfer the distance $L E$ to H : from H draw a line to b , intersecting $a L$ in d , then will $a d$ represent the length of the line $a b$. Or, if $a d$ be a line given in *perspective*, and it be required to find the length of the parallel line $a b$, the same process will serve; for a line, drawn from H through d , will cut off $a b$ to represent a length (in *perspective*) equal to $a d$; because the whole figure $a b d$ being the representation of an equilateral triangle, its sides are all equal in the original figure; consequently, in either of the above cases, $a b$ and $a d$ must represent lines which are equal to each other.

VI. To exhibit the perspective appearance of a square $A B D C$ (Plate II. fig. 22) seen obliquely, and having one of its sides $A B$ in the fundamental line. The square being viewed obliquely, assume the principal point V in the horizontal line $H R$, in such manner as that a perpendicular to the fundamental line may fall without the side of the square $A B$; at least may not bisect it; and make $V K$ the distance of the eye. Transfer the perpendiculars $A C$ and $B D$ to the fundamental line $D E$; and draw the right-lines $K B, K D$, as also $A V, V C$. Then will A and B be their own appearances; and c and d the appearances of the points C and D . Consequently $A c d B$ is the appearance of the square $A B D C$. If the square $A C B D$ should be at a distance from the fundamental line $D E$; which yet rarely happens in practice; the distance of the angles A and B must likewise be transferred into the fundamental line: as is evident from the preceding problem. And since, even the oblique view is not very common; in what follows, we shall always suppose the figure to be posited directly opposite to the eye; unless where the contrary is expressly mentioned. Thus: let the original square be $A B F D$ (fig. 23.) Draw $A C, B C$, to the vanishing point C of the perpendicular sides $A D, B F$; from the eye E draw $E H$ and $E L$ parallel to the diagonals $B D$ and $A F$: then from A and B draw lines to L and H , intersecting $A C$ in d , and $B C$ in f ; then $d f$, being drawn, completes the representation.

Having found the image of one square, that of any other, $i k m n$, may be easily found, by supposing $i k$ to be one side of the image, and drawing from i and k , $i C$ and $k C$; then from i draw $i H$, and from k draw $k L$, which will give the depth of the square. Or one diagonal only will be sufficient. Thus: $A L$ intersects $B C$ in f ; therefore, draw $f d$ parallel to the horizontal line.

With respect to squares thus situated, we may observe, that the vanishing points H and L of their diagonal, are exactly as far from the centre of the picture, or point of sight, as from the eye. For $H C$ and $L C$ are each equal to the distance $C E$; and, therefore, by setting off $C H$ or $C L$ equal to $C E$, the lines $E H$ and $E L$ may be omitted.

There are other methods of resolving this problem: thus (in fig. 24) if only the height $A B$ of the square be given; set off $A D$ and $A 1$ equal to $A B$; from A and D draw lines to C , and make $C L = C E$; draw $1 L$ intersecting $A C$ in b ; then will $A b$ be equal to $A 1$; draw $b d$ parallel to the horizontal line, and the representation will be completed. Or, if one side $G I$ be given, draw lines from G and I to C ; make $C H = C E$; from H draw $H G$, intersecting $I C$ in r ; and draw the parallel $r s$. Or, if the middle diameter $n p$ be given, bisect $n p$ in o ; from C draw lines through the extremes $n p$; from H produce a line through o , intersecting $I C$ in r , and $G C$ in G ; lastly from r and G draw the parallels $G I, r s$, which complete the figure.

VII. To exhibit the appearance of a square $A B C D$ (fig. 25) whose diagonal $A C$ is perpendicular to the fundamental line. Continue the sides $D C$ and $C B$ till they meet the fundamental line in 1 and 2 . From the principal point V set off the distance of the eye to K and L . From K to A and 1 draw right-lines $K A$ and $K 1$; and from L to A and 2 , the right-lines $L A$, $L 2$. The inter-

PERSPECTIVE.

sections of these lines will exhibit the appearance of the square $ABCD$ viewed angle-wise.

VIII. To exhibit the appearance of a square $ABCD$ (fig. 26) wherein another, $IMGH$, is inscribed; the side of the greater, AB , being in the fundamental line; the diagonal of the less, perpendicular to the fundamental. From the principal point V , set off, each way, on the horizontal line HR , the distances VL and VK ; draw VA and VB ; and KA and LB ; then will $ACDB$ be the appearance of the square $ACDB$. Produce the side of the inscribed square IH , till it meets the fundamental line in i ; and draw the right-lines $K1$, and KM ; then will $ihgm$ be the representation of the inscribed square $IHGM$. Hence is easily conceived the projection of any figures inscribed in others.

IX. To exhibit the PERSPECTIVE of a pavement, consisting of square stones, viewed directly. Divide the side AB (fig. 27) transferred to the fundamental line DE into as many equal parts as there are square stones in one row. From the several points of division, draw right-lines to the principal point V ; and from A to the point of distance K , draw a right-line AK ; and from B to the other point of distance L , draw another LB . Through the points of the intersections of the corresponding lines, draw right-lines on each side, to be produced to the right-lines AV and BV . Then will $AfgB$ be the appearance of the pavement $AFGB$.

X. To determine the representation of a regular hexagon $ABDFGI$ (fig. 28) when one of its sides is parallel to the ground line. Produce the several oblique sides to intersect the ground line, and parallel to these draw EH and EL ; then H will be the vanishing point of AI and DF , and L will be the vanishing point of BD and IG . Through the angular points A , F , B , and G , draw $F1$, $G2$, which being parallel to the sides BD and AI , will have L and H for their vanishing points: from 1 draw $1L$, and from 2 draw $2H$, intersecting each other in i , then i will be the representation of the corner I . From 1 draw $1L$, intersecting $2H$ in a ; and a will be the representation of the corner A , and ai that of the side AI ; then draw $1L$ and $2H$, and b will be the representation of B ; and ab , being drawn, will be the image of AB , &c. In the same manner the image of an octagon may be determined. This method will likewise serve for the representation of a circle; for having found eight points in the circumference, they will be sufficient guides for drawing the figure. This problem may be resolved by only having one side bd (fig. 29) in the representation given. Through the corner b draw a line an parallel to the horizontal line; and produce bd to its vanishing point H ; from H draw HE , and make $HL = HE$; then from L draw a line through d , intersecting an in n ; then bn represents a line equal to the original of bd ; make $ab = bn$ and a is the representation of one parallel side; from d draw dL , and from a draw aH , cutting dL in f ; then f is another corner; df represents another side. Again, from d draw di parallel to the horizontal line, and aL cutting it in i ; and i is another corner, and ai another side; lastly, draw Hi and the parallel fg , and the representation is completed.

XI. To exhibit the PERSPECTIVE of a circle. If the circle be small, circumscribe a square about it. Draw diagonals and diameters ha and de (fig. 30) intersecting each other at right-angles; and draw the right-lines fg and bc parallel to the diameter de through b and f ; as also through c and g draw right-lines meeting the fundamental line DE in the point 3 and 4 . To the principal point V draw right-lines $V1$, $V3$, $V4$, $V2$; and to the points of distance of L and K , draw the right-lines $L2$ and $K1$. Lastly, connect the points of intersection, a, b, d, f, h, g, e, c , with arcs $ab, bd, df, &c.$ Thus will $abdefghgcca$, be the appearance of the circle.

If the circle be large, on the middle of the fundamental AB (fig. 31) describe a semicircle; and from the several points of the periphery, C, F, G, H, I , &c. to the fundamental line, let fall perpendiculars $C1, F2, G3, H4, I5$, &c. From the points $A, 1, 2, 3, 4, 5$, &c. draw right-lines to the principal point V , also a right-line from B to the point of distance L ; and another from A to the point of distance K . Through the common intersections draw right-lines, as in the preceding problem; thus shall we have the points, c, f, g, h, i , which are the representations of C, F, G, H, I ; and these being connected as before, give the projection of the circle.

The easiest and best method for putting a circle into perspective seems to be the following; which admits also of universal application. Let ab (fig. 32) represent the diameter of the given circle: bisect it in c for the centre; make CH, CL , each equal to UW the breadth of the picture; divide CH, CL , each into five equal parts; and make Ch, Cl , each equal to two parts and one-fourteenth. From H produce a line at pleasure through the centre c ; from h , draw two lines through the extremities a, b , intersecting $H4$ in the points 3 and 4 ; do the same by the line $L5$ with the point l ; then draw a line from C through the centre c ; from H draw lines through a and b , intersecting $C1$ in 1 and 2 ; and having thus obtained eight points in the image of the circumference of a circle, the outlines may be very accurately drawn through these points. Hence appears, not only how any curvilinear figure may be projected on a plane; but also how any pavement, consisting of any kind of stones, may be delineated in perspective. Hence also appears what use the square is of, in perspective; for even in the

second case we use a square divided into certain areolæ, and circumscribed about the circle; though it be not delineated on the geometrical plane in the diagram.

XII. To exhibit the PERSPECTIVE of a regular pentagon, having a broad limb, terminated by lines parallel thereto. 1. From the several angles of the exterior pentagon A, B, C, D, E , (fig. 33) to the fundamental line TS , let fall perpendiculars $AO, B1, C2, D3, E4$; which, as in the former, transfer to the fundamental line. Connect the points $1, 2, 3, 4$, to the principal point V ; and the points $1, 2, 3, 4$, to the point of distance K . Thus will the common intersections represent the appearance of the exterior pentagon. 2. If now, from the inner angles G, H, K, L, I , the perpendiculars $GO, H5, K6, I7, L8$, be, in the like manner, let fall; and the rest be done as in the former, we shall have the representation of the inner pentagon. The pentagon $ABCDE$, therefore, with its limb, is represented in perspective. This problem is added for the sake of an instance of the projection of a figure that has a broad limb, or edge. It must be here observed that if the magnitude of the several parts of an object be given in numbers, together with the height and distance of the eye; its figure is to be first constructed by a geometrical scale; and the fundamental point, with the point of distance, to be determined by the same. Nor is it always necessary, that the object be delineated under the fundamental line; in the projection of squares and pavements it is left let alone. But where it is necessary, and space is wanting, draw it apart; find the divisions in it, and transfer them to the fundamental line in the plane. Threads being hung in the principal point, and the point of distance, and thence stretched to the points of the divisions of the fundamental line; the common intersection of the threads will give the projection of the several points without confusion; a thing much to be feared from the multiplicity of lines to be drawn.

XIII. Having given the centre C of the picture (fig. 34) the vanishing line HL and two vanishing points, H, L , of a square $abcd$; to find the distance of the picture. Bisect HL in A ; from A with the radius AH (or AL) describe the arc LEH ; from C draw the perpendicular CE to touch the arc LEH , and EC will be the distance of the picture. For drawing LE and HE , which will make a right-angle at E , and EH, EL , are parallel to the originals of b, d, bf , and consequently CE is the true distance of the eye, &c.

XIV. Having given the representation of two lines Ba, Df ; (fig. 35) to find their originals BA, DF . From the intersecting point B , draw BA parallel to CE ; from E draw a line through a intersecting AB in A ; then BA is the original of Ba . Again, from the vanishing point H , draw EH ; and from the intersecting point D , draw CF parallel to EH ; then from E , draw FE through the point f , which gives DF for the original Df .

N.B. These two last articles comprehend a part of what Dr. Taylor calls *inverse practice* of PERSPECTIVE.

Having in the preceding problems illustrated the principles and practice of perspective, as it relates to objects situated upon the ground plane, we shall now give a brief account of the method of representing objects that are perpendicular and oblique to it; observing, in general, that those which are parallel to the ground plane may be drawn by the help of those that are perpendicular to it; and that lines perpendicular to the ground plane must be represented by lines perpendicular to the ground line, wherever they are situated. In order to determine the vanishing lines and vanishing points of planes which are perpendicular to the ground, we may suppose these planes to be either perpendicular to the picture, or oblique to it. Let the square plane $BKIF$ (fig. 36) be perpendicular to the picture, so that the top and bottom of it vanish into C , its centre. Draw the line EV through C , and perpendicular to HL , and EV will be the vanishing line of the plane $BKIF$. And since CH is perpendicular to the vanishing line EV , C is the centre of that vanishing line; and as CH is equal to the distance of the eye, H will be the transposed place of the eye, and HC the distance of the vanishing line EV . But if the plane $abcd$ (fig. 37) is oblique to the picture, then the top and bottom of it will not vanish into its centre C , but into the point L , on one side of the centre. Draw a line through the vanishing point L , perpendicular to the horizontal line; then VU is the vanishing line of the plane $abcd$. And because CL is perpendicular to the vanishing line VU , L will be the centre of that vanishing line. Again draw EL , and this will be the distance of the eye E from the vanishing line VU ; and this distance, transferred to H , will give H for the transposed place of the eye, and HL for the transposed distance of the vanishing line VU .

XV. To find the representations of planes, whose bases are perpendicular to the ground line of the picture. E. gr. Let one corner A of the plane $ABFD$ (fig. 38) be at the bottom of the picture; and let it be required to draw the representation of a plane ten feet high, and four feet wide. From A , upon the ground line, make a scale of equal parts, representing feet at pleasure; from A draw AD perpendicular to this line, and produce it at pleasure: upon AD set ten feet from A upwards, and draw DC to the centre C , and from A draw AC ; make $CH = CE$, and draw $H4$ intersecting AC in B ; then $AB = 4$ feet; therefore from B draw BF parallel to AD , and $ABFD$ will be the representation required. Let the plane, whose representation $efgh$ is required to be four feet wide, and

PERSPECTIVE.

and five feet high, and its nearest corner e be one foot from the bottom of the picture. Draw CN at pleasure; make $CL = CE$; and set off one foot from N to g , and draw Lg intersecting CN in e ; and e will be one foot from the bottom. Take four feet more, as g ; and draw $5L$ intersecting CN in f , and ef is equal to 4 feet; draw NO perpendicular to the bottom of the picture, and make it equal to 5 feet; draw eg, fh , parallel to NO , and draw OC , which will complete the proposed representation. Otherwise: from e draw ex parallel to NA , intersecting $L5$ in x ; then ex will be 4 feet; make eg to ex as 5 is to four, and draw gC . In the same manner we may determine the image $abcd$ of a plane, 4 feet square, removed five feet into the picture, and whose lower edge is in the line AC . From A , where CA intersects the ground line, set off 5 feet for its distance, as $A5$, and 4 feet for its breadth, as g ; draw $H5$ and $H9$, intersecting AC in a and b ; and then ab is the representation of its depth: draw ad, bc , parallel to AD , and make AQ four feet; then draw QC , which completes the figure.

Having B given as one angular point of a square plane, and BM for its height and breadth upon the picture; thence to determine the representation of the whole plane $BFIK$ (Fig. 36). From the corner B , draw the perpendicular BF ; make $BF = BM$, and draw ML intersecting AC in K ; draw KI parallel to BF ; then FC completes the figure. If the representation be determined, and it be required to find the length and breadth of the original; produce CB to A ; at A erect a perpendicular AD ; from L produce lines through B and K , intersecting the bottom of the picture in N and 2 . The space $2N$ comprehends eight feet, and therefore BK represents eight feet. For the height BF , produce CF to D , and the space AD contains eight feet. $N.B.$ The vanishing lines of planes perpendicular to the ground are perpendicular to the horizontal line, and always pass through the vanishing point of those planes: thus the vanishing line EV passes through C ; and EV is the vanishing line of the plane $BFIK$, as is evident by turning the figure, and considering EV as the horizontal line, H as the eye, HE as its distance, and $BFIK$ as the representation of a square lying upon the ground; so that, in this example, we have the vanishing line HL of planes parallel to the ground, and also the vanishing line EV of planes perpendicular to the ground, connected together.

XVI. To determine the representations of planes that are parallel to the picture. *E.g.* Let the plane $abcd$, Plate III. (Fig. 39) five feet wide, and eight feet high, be removed two feet from the bottom of the picture. From A and 5 , draw AC and $5C$; make $CH = CE$, and draw $7H$, intersecting $5C$ in b ; then $5b$ represents a length equal to 5 or 2 feet; draw ab parallel to the ground line, cutting AC in a , which will give the length of the lower side; erect the perpendicular ac, bd ; make bd equal to 8 feet, and draw the parallel dc . If the plane $ghik$ be 9 feet high, and 3 feet wide, and 6 feet from the bottom of the picture; draw a line at pleasure from C , as $C9$; take 3 feet, and draw another line from B to C ; from L draw $L9$, intersecting BC in e ; then eB represents three feet; from e draw the parallel ef , and from L produce Lf , intersecting $5C$ in g , which gives eg for a perspective length representing ef . Now gf and fb are the representations of two squares, whose sides are all equal in the original figures; and therefore all the sides $ef, eg, &c.$ represent equal lines, and consequently gh represents the depth of 6 feet, and hg the parallel width of 3 feet. Draw the perpendiculars hk, gi ; and make gi three times the length of gh ; and draw ik parallel to gh .

XVII. To find the representation of planes that are oblique to the ground line or bottom of the picture. Let $abcd$ (Fig. 37) be eight feet high, eight feet wide, and two feet from the bottom of the picture; let L be its vanishing point, and AL the line in which the plane is to stand. Draw AB perpendicular to the bottom of the picture; set 8 feet upon it, and draw BL , transferring LE to H ; take $A2 = 2$ feet, and from 2 produce $2H$, intersecting AL in A ; then Aa represents a line equal to $A2 = 2$ feet. Again, from 2 feet set off 8 feet, and draw DH intersecting AL in b ; then ab represents the length of 8 feet; draw ac and fd parallel to AB .

When the representation is not to be of any particular dimension, the operation is exceedingly simple. Let AB (Fig. 38) be one side given, and AD its height; from A and B draw AD, BF , perpendicular to the bottom of the picture; and from C draw CF . $N.B.$ The vanishing point C of the line AB is the vanishing point of every line $Qd, mk, &c.$ parallel to AB . For the application of these operations in determining the perspective of solid figures, see Sect. VII.

As to objects that are inclined to the ground, such as pediments, roofs of houses, &c. it is proper to observe, that this part of perspective was little, if at all, understood by any authors before Dr. Taylor; who has shewn that inclined objects have their proper vanishing lines and points, as well as those which lie flat upon the ground, or are perpendicular to it; and that the method for determining the appearance of objects in either case is exactly the same. For the illustration of this method, let $adcgfi$ (Fig. 40) represent the body of a house; the side $cigf$ being parallel, the other side ad hath its vanishing line VU , which passes through the centre of the picture, and is perpendicular to the horizontal line; and it is evident, that the roof is formed by two inclined planes, one leading towards the eye, the other from it.

These inclined planes have their proper vanishing lines and vanishing points upon the picture, as well as those which are either parallel or perpendicular to the ground. It has been already shewn (see fig. 36) that VU , continued, is the vanishing line of all the lines which can be drawn within the plane $adci$; however, let us here turn the figure, and call C the centre of the picture, CE the distance of the eye, and VU the horizontal line; $adci$ the representation of a parallelogram, and abi a triangle joined to the end of it. Let us next suppose the line fr to be the bottom of the square $fi br$, whose vanishing point is V , and the vanishing points of its diagonals are D and F ; let $cigf$ represent a parallelogram even with the eye, which will complete the representation of a solid body, like the model of a house, laid upon that side, which by workmen is called the gable end. If this be a true representation, that is, if VU be the vanishing line of $abid$, and DF the vanishing line of $ibfr$, then turning the figure in any position cannot make any alteration in the perspective, because VU and DF will be invariably the vanishing lines of $abid, bfr, &c.$ The planes $abi, brfi$, are joined by the line ib , the vanishing point of which is V ; and because the original of fr is parallel to the original of ib , both ib and fr will vanish into the same point V ; or into that point where the vanishing lines VU and DF cross each other; for the vanishing point V must be in the line VU , which is the vanishing line of the plane $adci$, and it must be also in the vanishing line DF of the inclined plane bfr ; for the line ib is the common section of both planes; therefore its vanishing point must be the intersection of the vanishing line of those planes.

XVIII. To find the vanishing line of the inclined plane, $bifr$, and also the centre and distance of it. Let EL be the horizontal line; C the centre of the picture, CE its distance, $adcgfi$ the body of a house, and UV the vanishing line of its side $adci$. Upon the horizontal line, or parallel to it, draw st , then the figure $stomn$ will be a small module of the perpendicular plane $adci$; or, in other words, let om be the inclination of the inclined plane with nm supposed to be 45° . From the eye E draw EV parallel to mo intersecting the vanishing line VU in V ; through V draw DF parallel to the horizontal line EL ; then is DF the vanishing line required, V its centre, and EV its distance. In order to find the representation of the plane $bifr$, supposing it to be a perfect square, &c. let ib be the representation of one side of the square, whose vanishing point is V . Produce the perpendicular CV at pleasure; make VD, VK, VF , each equal to the distance EV of the vanishing line DF ; then VK the distance of EV , transposed to K ; and because VD, VF , are each equal to VK ; therefore D and F are the vanishing points of the diagonals ir and fb . From the points i and b draw if, br , parallel to the vanishing line DF ; from D draw Di cutting br in r ; then rb is cut off to represent another side of the square; from V draw a line through r , intersecting if in f , which completes the perspective of a square in this position. This may also be done by merely giving the inclination of the plane; suppose it 45° ; at the eye E make an angle with the line EC of 45° ; and draw EV intersecting UV in V ; make VF, VD , each equal to VE ; then V is the vanishing point of the sides ib, fr ; and DF the vanishing points of the diagonals; from whence the figure may be completed as before. The vanishing line, its centre, and the distance of the opposite inclined plane, are determined in the same manner.

XIX. To find the vanishing line of the roof $ibrf$, &c. (fig. 41) when the gable end abi is parallel to the picture, and to determine the whole representation. Having drawn the body of the building ag , and also the gable end abi ; observing that the inferior part if , of the roof vanishes into C , the centre of the picture, and consequently the upper part br will vanish into the same point, both being supposed parallel in the original figure; draw bC , and from f the line fr parallel to ib , which completes the side of the roof $ibrf$, without the vanishing line proposed. But since the roof $ibrf$ has an inclination with respect to the picture, in order to determine its proper vanishing line, through the vanishing point C draw FD parallel to ib or rf ; then FD is the vanishing line of the inclined plane $ibrf$. From C , the centre of the vanishing line FD , produce CK perpendicular to FD ; make $CK = CE$, the distance of the eye; and CK is the distance of the vanishing line FD , and K the transposed place of the eye, *E.g.* Having given ib for one side of a square roof, and found its vanishing line FD , and its distance CK , to complete the representation of the roof. Make CF, CD , each equal to the distance of the eye CK ; then F and D are the vanishing points of the diagonals of a square. From i and b produce lines to C ; and from the same points draw lines to F and D intersecting bC, iC , in r and f ; draw rf , which will be parallel to ib , and complete the representation required.

XX. Having given the vanishing line of any inclined plane, and one vanishing point of that plane, together with the centre and distance of the picture, shall proceed to determine the vanishing line of another plane, making a given angle with the plane whose vanishing line is VU . Let VL (fig. 42) be the vanishing line of any inclined plane, V one vanishing point, C the centre, CE the distance of the picture, and abi the angle of inclination of the two original planes;

PERSPECTIVE.

planes; if this be a right-angle, from V draw a line through C, as VD; make CI perpendicular to VD, and CI=CE; draw VI, and at I make $\angle VIC = a b i$, the given angle, and draw Ic intersecting VD in c; through c draw LU parallel to IC, intersecting VL in L, and UL is the vanishing line required. If the plane, whose vanishing line is VU, were inclined at an angle of 60° , and it were required to find its vanishing line; through the centre of the picture draw VD, and find the vanishing line LU of a plane perpendicular to that plane whose vanishing line is VU; produce CD, and make $CD=IC$, the distance of LU; draw DU, which makes an angle at D of 60° , and draw DP; lastly draw PV, which is the vanishing line required. In order to find the centre and distance of the vanishing line UL; from C draw CD perpendicular to UL, and CI perpendicular to CD, and make CI=CE, and CI is the distance of UL; make $CD=CI$, which is the distance to be used for determining the representations of any planes that vanish into the line UL. Suppose L the vanishing point of one side of a square, draw DU at right-angles with DL, and U will be the other vanishing point of the said square. For the further illustration and application of these rules, we must refer to Mr. Kirby's comprehensive work, entitled, Dr. Brook Taylor's method of *Perspective made easy*, &c. 3d edit. 1768.

XXI. To fix points in perspective lines, or to divide these lines so as to intercept any lengths that may be required in them. Lines parallel to the ground line may be divided, by dividing the ground line, and either laying a ruler from these divisions to the point of distance in the horizon, or drawing lines to them from the point of sight D. Lines perpendicular to the ground line are divided, by setting off divisions from the place where they meet the ground line, and drawing other lines from them to the point of distance. Lines oblique to the ground line may be divided, by setting off, on the ground line, any number of divisions from the point where the line to be divided intersects it; as from C to b (fig. 43) taking the distance from the vanishing point i of the line to the point of distance E in the perpendicular DE, and setting off along the horizontal line to y; and from the point thus determined, drawing a line y b to the point on the ground line bounding the number of divisions; this line will intersect Ci, the representation of the given oblique line in h, the point required. See articles XV. XVI. and XVII. in this section.

If a single point in a given situation upon the ground plane be required, its place in the *perspective* plane may be found by supposing it to be the intersection of two lines, the situation of which is given: as by supposing one of them to be drawn through it perpendicular to the ground line, and the other to be a line drawn from the point of distance, and intersecting it at a great distance from the ground line: or, it might be found by drawing lines making any given angle with the perpendicular, and intersecting them at proper distances from the ground line. To divide lines not lying in the ground plane, but perpendicular to it, let a c (fig. 44.) be the image of a line perpendicular to the ground plane, and let a number of divisions, e. gr. five, be cut off from the point a. Take at pleasure (generally beyond the bounds of the picture) any point d in the horizontal line; from thence draw a line d e to any point e in the ground line; set off five divisions from e to f in the perpendicular e h, and draw the line f d; draw a line from the foot a of the object, parallel to the ground line, intersecting d e in i, and raising a perpendicular from i to d f, find h and the line i h contains the five measures required, which are to be set off from a to b in the given line a c; and thus a b will be equal to f e. The lines d e and e h will serve to measure any other lines perpendicular to the ground plane, always drawing a line parallel to the ground line from the foot of the object to be measured to the line d e, and proceeding as above. It is evident, that any row of objects of the same height, standing upon the ground plane, on a line perpendicular or oblique to the ground line, must appear to diminish, till they vanish in the horizontal line; consequently, the triangle d f e will contain in it perpendicular lines equal to the apparent heights of all objects that are of the height of f e; and this will be the case wherever the point d is taken in the horizontal line; for it will be invariably $i h : e f :: d i : d e :: d m : d l :: H a : H I$.

To measure a line oblique to the ground plane: let the line be C g (fig. 43) and let eight divisions be cut off from C. For this purpose draw CN parallel to y g, and C N being considered as a new ground line, set off the given number of divisions from C to a; join a and y with a line intersecting the given line in k; and C k will be the part required; or from the vanishing point g of the given line C g take g y parallel to the ground line A B, and equal to g y; on the ground line set off the given length from C to a, and a line joining a and y will cut off the required part C k. In the first method, the triangles k g y and k C a are similar; whence $g k : k C :: g y : C a$; but g y is equal to g a, the distance of the eye from the vanishing point g, and C a is equal to the given oblique line by construction: therefore the extreme point of it will be represented by k. See proposition III. in Section VII.

In the second method, since g y is drawn parallel to C a, we have $g : k C :: g y : C a$; but g y and C a are equal to g y and C a, and consequently equal to g a, and the given oblique line respectively. If the line C g does not stand upon the ground line, but is an in-

definite line standing on the ground plane at C (fig. 44) and it is proposed to cut off a part of it from C, equal, e. gr. to ten divisions; find the point y as above; from C, parallel to the ground line, draw C b, from which cut off (Art. 21, in this section) a part C a, equal to ten divisions, and a line joining y and a will cut the given line C g in k, the point sought. If several other divisions in C g be required, make C b equal to the absolute length of ten divisions, and through k draw b k, cutting g y produced in d; and d will be a measuring point for the line C g; so that the divisions themselves may be set upon C b at once, and lines drawn from thence to d will cut the given line C g in the desired points. The point d may be found at once by taking g d to g y as the height of the eye is to the perpendicular C L.

In the foregoing explication of the theory and practice of *perspective*, regard has been merely had to the appearance of objects upon an upright picture, which is generally chosen for *perspective* representations; but there are some cases in which the situation of the picture is parallel or inclined to the ground, such as ceilings, inclined walls, &c. The representation of objects upon such kind of surfaces is deducible from the same principles, and determined after the same manner. The rules for drawing the appearance of objects upon the parallel picture are exactly the same as those for drawing the appearance of objects upon the perpendicular picture; observing that those objects, which in the parallel picture are to be represented as erect, must be determined as those which lie flat on the ground in the perpendicular picture; those which are parallel in one picture as those which are parallel in the other; and those which are oblique, after the same manner: or, more generally, however original planes are situated, the vanishing lines of those planes must always be determined by imagining a plane to pass through the eye parallel to those planes, &c. for by this means all their representations may be completed. The inclined picture is seldom used; but those whose wish to acquaint themselves with this kind of *perspective*, may find ample information in Mr. Kirby's elaborate works.

SECT. VI.

PERSPECTIVE OF BUILDING, &c.

In the practice hereof great regard is had to the height of the horizontal line; all above the horizontal being seen in the upper part, and all below it in the under part; whence *perspective* becomes divided into the high and low sight; both which may be illustrated by what follows:

To represent a building (e. gr. palace, college, &c.) in *perspective*.

1. Take the ichnography, or ground-plan of the building; its lengths, breadths, and depths, by actual measuring: and take its altitude with a quadrant. 2. Make a scale divided into two or three hundred equal parts; either actually, or so as that each division signify ten parts: by this scale lay down the ground plan; as in fig. 46. This done, having a long rule, and a square, which by sliding on the rule helps you to draw your perpendiculars easier, reduce it into perspective, in its scenographic appearance. Then having drawn a line towards the bottom of the paper for the front or base line, as F (fig. 47) divide it into as many equal parts as you find the building has in the ichnography, or more, if you please; this will serve for a scale to determine the several heights, &c. and to those divisions, with a black-lead pencil, draw lines from the centre, when you have chosen it; which choice requires judgment on two accounts. 3. For if the centre be too nigh the front line, then the depth of the whole building will be fore-shortened too much; and if too far off, it will not be fore-shortened enough. This may be illustrated thus: set an open tankard, or the like, on a stand, so as that it be a little lower than your eye; if you be at a great distance from it, you can see very little or nothing into it; if you come nigher to it, by degrees, you will perceive the farther edge seem to be raised a little higher than that next you, so that you may see a little way into it; if you come very nigh it, you see too deep into it, or more than can be well expressed in picture. We shall therefore find some one place, which we must conclude the most convenient for the draught, and which may be in general determined to be as far off the front-line, as the front is long: this rule, though it has just grounds, yet we sometimes dispense with, *pro re nata*, that we may express things with the better appearance.

4. Consider how to place this centre with such advantage as that you may express those things most, which are chiefly designed; for as to the bottom and top lines of the sides of the building, that run from us in or nigh the direct lines to the centre, though you see the upper part very well, yet the sides that fall between the ground-line and top fall so very near one another, that it would be difficult to express particulars in them; so that the centre must be well chosen in reference to this. Those buildings, therefore, which you would see most of, must be placed as far off as you think convenient from the direct line that runs to the centre: and the farther they are, the plainer they will be. Place then those things you would see least of, nighest the direct line; and see whether the others fall according to your mind; but this must be done after you have drawn your diagonal, which is the next thing.

5. Having pitched on your centre, and having from it drawn lines to every division of the front-line; you are to determine your diagonal A R, thus: having, with a pair of compasses, measured the

PERSPECTIVE.

the length of the front line, take your compasses, and putting one foot in the centre, see where the other will reach in the horizon (on both sides, if you please); where it rests from that point draw a thwart line to the last division of the front; and this will be truly drawn, or pretty nigh to the truth. That it is so, you may consider how it falls in respect of the two last centre lines; for if where the next line from the last is intersected by the diagonal, you draw a parallel to the front between them; as at A 10, you will have a rhombus; if then all the sides be pretty equal, you may be sure you are nigh the right; but if the sides that run towards the centre be too long, then things will not be fore-shortened enough; and if the sides be not long enough, they will be fore-shortened too much.

6. After the front line is thus divided, the centre fixed, and the diagonal placed, take the breadth of the chapel AB, which in the ichnography is shewn to be twenty parts: because this line is perpendicular, it must run towards the centre; therefore reckon twenty in the diagonal, and the rule laid parallel to the front in that point will give you a point in the centre-line, which will give the breadth of the chapel; and consequently a line drawn from A to B puts it into the ichnographic perspective. The length of the chapel being seventy divisions in the front line, reckon seventy from B, parallel to the front line, and there you will have a point C. The depth of the building from the chapel northward being one hundred and fifteen from the chapel, I reckon from D (where it cuts the diagonal at ten) onwards in the diagonal; and at one hundred and fifteen in the diagonal with my rule, as before, parallel in this place in the front, I have the point Z in the central line. Its breadth being thirty, I reckon three divisions, and there is the just breadth there; and soon in every particular part. Having placed the ichnography in perspective, you may then give every thing its proper height thus:

7. The height of the chapel being thirty, I reckon thirty on the front line; and with this length by a square applied to the front-line, I drop a perpendicular to that height; and so where the other side of the chapel is placed, having reckoned the height upon a supposed parallel, there I draw another line on that height; then joining these several heights by several lines, you have the profiles of each building. To diversify these several lines, that they confound you not, make the ichnography, when you lay it into perspective, in discontinued crooked lines, the heights in pricked lines, and the tops of each building in continued lines, as the centre lines are in the table. You will likewise find the centre, though it is not here expressed, as likewise the point of distance, by continuing the diagonal up to the supposed horizon, where it and the eye are placed. Having done thus, your art must be employed for the particular expression of things, by drawing and shadowing, which is the life of this half-formed figure, which we leave to the painter. It remains that we speak of the low sight: and here we suppose the horizontal line just the height of the eye, about five feet from the basis: though it is generally placed higher, even to a third part of the height of the building, that the side building may be expressed the more gracefully. The diagonal is best determined by dividing the last division of the basis line into five parts at G, taking four of these, sometimes the whole five, because we determined before that the length of the front-line was the distance of the eye in the horizon from the point of distance; but here we take four, and then make this the distance in the horizon between the eye and the point of distance. You may then either graduate the plan at the several intersections of the diagonal with the centre-lines, or else suppose it so; and then raise the buildings as you will find by perspectives enough of this sort every where to be met with.

SECT. VII.

SCENOGRAPHY.

Is a representation of a body on a perspective plane, or a description thereof in all its dimensions, such as it appears to the eye. The ichnography of a building, &c. represents the plan, or ground-work of the building; the orthography the front, or one of the sides; and the scenography the whole building, front, sides, height, and all raised on the geometrical plan.

To exhibit the SCENOGRAPHY of any Body. 1. Lay down the basis, ground-plot, or plan, of the body, in the perspective ichnography, according to the method laid down in Section V. 2. Upon the several points of the plan raise the perspective heights: thus will the scenography of the body be completed, excepting that a proper shade is to be added. The method of raising the heights is as follows:

On any point given, as C (fig. 48) to raise a perspective altitude, answerable to an objective altitude PQ. On the terrestrial line raise a perpendicular PQ, equal to given the objective altitude. From P and Q, to any point, as T, draw right-lines, PT and QT. From the given point C, draw a right-line CK, parallel to the terrestrial line DE, meeting the right-line QT, in K. In the point K, upon the line KC, erect a perpendicular IK. This IK is the scenography altitude required. See Section V. Art. XXI. The application of this general method of drawing the scenography of a body is not so obvious in every case, but that it may be necessary to illustrate it a little by a few examples.

To exhibit the SCENOGRAPHY of a Cube, viewed by an angle. 1. As the basis of a cube viewed by an angle, standing on a geometrical plane, is a square viewed by an angle: draw a square viewed angular-wise. 2. Raise the side HI (fig. 49) of the square per-

pendicularly on any point of the terrestrial line DE; and to any point, as V, of the horizontal line HR, draw the right-lines V I and VH. From the angles d, b, and c, draw c 1, and d 2, &c. parallel to the terrestrial line DE. 4. From the points 1 and 2, raise L 1 and M 2, perpendicular to the same. Lastly, since HI is the height to be raised in a, L 1, in c and b, and M 2 in d; in a raise the line fa perpendicular to a E; in b and c, raise bg and ce perpendicular to bc 1; and, lastly, raise dh perpendicular to d 2, and make af=H I, bg=ce, c=L 1, and hd=M 2; if, then, the points g, h, e, f, be connected by right-lines, the scenography will be complete.

Otherwise: let AB (fig. 50) be the breadth of either of the six equal square sides of the cube AG, O the place of the observer, almost even with the edge CD of the cube, S the point of sight, SP the horizon parallel to AD and P (SP being made equal to SO) the point of distance. Make ABCD a true square, draw BS and CS to the point of sight, and BP to the point of distance, intersecting CS in G; then draw FG parallel to BC, and the uppermost perspective square side BFGC of the cube will be finished. Draw DS to the point of sight, and AP to the point of distance, intersecting DS in I; then draw GI parallel to CD; and, if the cube be opaque, as if wood or metal, all the outlines of it will be finished, and then it may be shaded as in the figure. But if you want a perspective view of a transparent glass cube, all the sides of which will be seen; draw AH towards the point of sight, FH parallel to BA, and HI parallel to AD; then AHI D will be the square base of the cube, perspective parallel to the top BF GC; ABFH will be the square side of the cube, parallel to CG ID, and FGIH will be the square side parallel to ABCD.

Having the representation of one cube, that will be sufficient for any number of the same size, provided that they all stand in the same line, or at the same distance from the bottom of the picture. If the cube were above the horizontal line, the representation of it is found in the same manner.

Again: to exhibit the representation of a cube with the fewest possible lines within the picture. Divide the bottom and one side of the picture (fig. 51) into any number of equal parts, which may be considered as feet; let the proposed representation be six feet from the bottom of the picture, and four feet in diameter; and let CH or CL be half the distance of the eye, and C the centre of the picture. From r draw a line to C; from q produce one to H, cutting r C in v, from v draw a parallel line; then a line from p to H, which gives tv for the bottom of the cube. Upon the line tv make the square, and bisect the upper side in e; from e produce a line to C; and another from s to H, which gives the corner i; whence the representation may be completed. Mr. Kirby has proposed the following universal rules for exhibiting the true perspective representations of any objects, and applied them to a variety of elegant drawings in architecture, &c.

Rule I. To determine the perspective length of any given line ab (fig. 52) parallel to the horizontal line, and to divide it so as that it may represent any number of equal or unequal parts. Divide the bottom AB of the picture into any given number (e. gr. ten) of equal parts, and let this be a scale for adjusting the proportions of such objects as are to be drawn upon the picture. Let a be one end of the line proposed, and from a draw at pleasure the parallel ab. From any point, as 1 on the scale, draw a line through a, to cut the horizontal line in P. Let the space between 1 and 3 be the real length of the proposed line on the scale, and from 3 draw a line to P, cutting ab in b, and ab will represent a length equal to the space 13. In order to divide ab into any number of equal or unequal parts, mark on the scale the given proportion, and from thence draw lines to P, which will intersect ab in the points proposed. If ab be a perspective line given, and its length be required; draw a line from any point of the horizontal line through the ends of ab to the scale, and these will shew its length. Then ab represents six parts, as feet, &c. according to the nature of the design.

Rule II. To cut off a part ab (fig. 53) of the line a C, that vanishes into the centre of the picture, so as to represent any given length, and to obtain any number of perspective divisions upon it. From C set off the width IK of the picture to L, for the distance of the eye. From L to any point, as 2 on the scale, draw L 2 cutting a C in b, and ab will represent the length a 2. In the same manner, lines drawn from any divisions on the scale to L, will cut a C so as to give the perspective of such divisions.

Rule III. To cut off a part ab (fig. 54) of the line a H, that vanishes into one of the points of distance H; and to divide it. Divide the distance CH or CL into five equal parts, and make the dot at Ph two parts one-fourteenth from C. From any division on the scale, as 1, draw a line Ph, cutting a H in b; then will ab represent the length a 1. To divide ab, set off the real lengths of those parts on the scale, and draw lines to Ph, which will cut ab in the proposed points. For the line a c, which vanishes into the point of distance L, make the dot at Pl the same distance from C as Ph is from C. From Pl draw a line to any point, 2, and a c will be the perspective of a 2, &c. The first of these rules is adapted to the sides of such objects or buildings as directly front, or are even with, the eye; the second to those which run directly from the eye; and the third to such as are viewed angle-ways, and

PERSPECTIVE.

in such manner that both sides have an equal degree of obliquity. Mr. Kirby has added a fourth rule; for which, being only wanted occasionally, we shall refer to his *Perspective of Architecture*, &c. p. 5. For the application of the first and second of the preceding rules, in drawing the representations of squares and circles, see SECTION V. Art. VI. and XI. For the farther use of these rules: Let it be required to put a parallel cube of two feet square, and placed at the bottom of the picture, in perspective. Draw the front side ab 1 3 (Fig. 55) and lines from b , a , 3 to C ; then from 5 draw a line to H , and from c the perpendicular cd , and from d another parallel, as in the figure. Let the same figure be placed at the distance of one foot within the picture. A line drawn from 6 to L will give the corner f , by Rule II. Draw a line from 5 to C , and the parallel fe ; make $fg = fe$, and draw the front side fig ; a line drawn from e to L gives the point h ; from h draw the perpendicular $h1$, and from 1 another parallel.

To exhibit the perspective of several cubes placed behind one another. Draw the front side Aa 2 (Fig. 56) from a , b , 2, draw lines to C , and complete the first cube as above. Again, draw a line from 4 to C , and the parallel cd ; then from d draw a line to H , which gives a space to represent the breadth of one cube; from g draw the parallel gh , and a line from h to H will give the breadth of another cube; from g and n draw perpendiculars cutting bC , and from these intersections draw the parallels for the top. For obtaining the same number of cubes on the opposite side: upon 8 B draw the front side; from 8, and the two upper corners, draw lines to C ; and from the several real corners of the cubes already drawn, produce parallels em , intersecting 8 C from these intersections, draw perpendiculars for the sides, and then the parallels for the tops, &c.

To find the perspective appearance of an oblique cube two feet square; the nearest corner being one foot from the bottom of the picture. Find, by Rule II. the corner a (Fig. 57) by the first, the length ab ; by the third, the depth at a ; and draw the parallel cd , which gives the other side ad . From c , a , d , draw the perpendiculars c , f , a , e , dg ; and $ae = ab$; then from e draw lines to H and L ; and from f and g lines to H and L .

To exhibit several oblique cubes behind one another, both to the right and left. Draw the first from the point 5 (Fig. 58); draw lines from 5 to H and L ; and a line drawn from 7 to P gives the side $5b$; draw the parallel bt and the perpendiculars for the upright edges; and make $5a$ equal to 57, and draw lines from a to H and L , and from d to L , and from c to H , which completes one cube. Let the spaces between the cubes be three feet; draw a line from 8 to L , and another from b , and then the parallel bf , of three feet; and a line from f to P gives bg to represent bf , by Rule III. From 7 draw a line to L , and from g the parallel gh , which represents two feet, or the breadth of one cube; then from h draw a line to P , which gives the side gi ; and draw a line from g to H , and from c to L , which will give the other side gm . Again, from g , m , i , draw perpendiculars; and then intersections with the lines drawn from the top of the first cube to L , will determine the height of two sides; and by drawing the other lines to H , as nH , we shall complete another cube; and so on. The figures on the right hand side are found from those which are already drawn by means of parallel lines.

N.B. The representation of the cube prepares the way for the projection of all the regular solids; and we have, therefore, been more diffuse in illustrating the method of doing it.

To exhibit the SCENOGRAPHY of a hollow quinquangular prism. 1. Since the base of a hollow quinquangular prism, standing on a geometrical plane, is a pentagon, with a limb, or breadth, of a certain dimension, find the appearance of this pentagon on a table, or plane.

2. On any point, as H , of the terrestrial line DE (Fig. 59) raise a perpendicular HI , equal to the objective altitude; and to any point, as V , of the horizontal line HR , draw the lines HV and IV . 3. From the several angles, a , b , d , e , c , of the perspective ichnography, both the internal and external ones, draw lines, as $b2$, $d3$, &c. parallel to the terrestrial line; and from the points 1, 2, 3, raise perpendiculars to the same, as $L1$, $M2$, $n3$. If these, then, be raised in the corresponding points of the ichnography, as in the second article, the scenography will be complete.

Another method of representing a prism. Let ab (Fig. 51) be the width of the bottom; from C draw lines through a , b , in order to obtain the real width of the line ab , viz. five feet; at the point n erect the perpendicular nm , and make it equal to the real height of the prism, viz. four feet; draw the front side $abdf$. Make an equilateral triangle ABE , whose sides are equal each to ab ; bisect this triangle by the line DE , and divide DE into two equal parts in F ; bisect also fd in c ; and draw cC ; then take DF , and set it from c to l , and draw lL , intersecting cC in e ; lastly, draw fe , and de , which complete the figure.

To exhibit the SCENOGRAPHY of a cylinder. 1. Since the base of a cylinder, standing on a geometrical plane, is a circle, seek the appearance of a circle. In the points a , b , d , f , g , h , e , c , (Fig. 30, Plate II.) raise the apparent altitudes, as in the preceding articles. If, now, their upper lines be connected by curve lines, as in the base, a , b , d , f , g , h , e , c , the scenography of the cylinder will be complete.

It is evident that those lines are to be omitted, both in the plan, and in the elevation, which are not exposed to the eye, though they are not to be disregarded from the beginning, as being necessary for the finding of other lines. E. gr. in the scenography of the cube, viewed anglewise, the lines bd and dc (Fig. 49) in the base, and dh in the elevation, are hidden from the eye, and are therefore in the description. But since the upper point h is not to be found, unless the point d be had in the ichnography; nor can the lines gh and he be drawn without the height dh ; the appearance of the point d is as necessary to be determined in the operation, as the height hd .

Another method. Let the proposed cylinder (Fig. 60) be four feet in diameter, six feet high, and three feet from the bottom of the picture; and let the centre be in the line 3 C . Find the point a , by Rule II. above, and the diameter ab by Rule I. With this diameter find the perspective of a circle. See Sect. V. Art. XI. Divide ab into four feet, by Rule I. From c draw the perpendicular cm ; then take one foot from ab , and from c set it six times to m : through m draw the parallel kl , and make it equal to the lower diameter ab ; with kl find the perspective of another circle, and from the outer part of each oval draw lines, as al , bk , which will complete the proposed representation.

For two cylinders behind one another. Let the centres c and m , Plate III. (Fig. 61) of the cylinder be in the line 9 C , and let each be two feet in diameter, and five feet high; let the centre of the first cylinder be only one foot from the bottom of the picture, but that of the other six feet. By Rule I. and II. we may obtain the centre c , and the diameter ab of the first cylinder, and the whole operation is the same as in the last case. By the same rules we find also the centre m , and diameter ln , of the farther cylinder; and by drawing a line from f to C , we shall have the height of it.

To exhibit the SCENOGRAPHY of a pyramid, standing on its base. Suppose, e. gr. it were required to delineate a quadrangular pyramid, viewed by an angle. 1. Since the base of such a pyramid is a square seen by an angle, draw such a square. 2. To find the vertex of the pyramid i. e. a perpendicular let fall from the vertex to the base, draw diagonals mutually intersecting each other in Plate IV. (Fig. 62). 3. On any point, as H , of the terrestrial line DE , raise the altitude of the pyramid HI ; and drawing the right-lines HV , and IV , to a point of the horizontal line HR , produce the diagonal db , till it meet the line VH in h . Lastly, from h draw hi parallel to HI . This, being raised on the point e , will give the vertex of the pyramid K ; consequently, the lines dK , Ka , and Kb , will be determined at the same time. After the like manner is the scenography of a cone delineated.

Another method. Let AD (Fig. 63) be the breadth of either of the four sides of the pyramid $ATCD$, as its base $ABCD$, and MT its perpendicular height. Let O be the place of the observer, S his point of sight, SE his horizon, parallel to AD , and perpendicular to OS ; and let the proper point of distance be taken in SE , produced toward the left hand, as far from S as O is from S . Draw AS and DS to the point of sight, and DL to the point of distance, intersecting AS in the point B . Then from B draw BC parallel to AD , and $ABCD$ shall be the perspective square base of the pyramid. Draw the diagonal AC intersecting the other diagonal BD at M , and this point of intersection shall be the centre of the square base. Draw MT perpendicular to AD , and equal to the intended height of the pyramid; then draw the straight lines AT , CT , and DT ; and the outlines of the pyramid, as viewed from O , will be finished; and the whole may be so shaded as to give it the appearance of a solid body. If the observer had stood at o , he could have only seen the side ATD of the pyramid; and two is the greatest number of sides that he could see from any other place of the ground.

To exhibit the SCENOGRAPHY of a truncated pyramid. Suppose the truncated pyramid quinquangular. 1. Then, if from the several angles of the upper base be conceived perpendiculars let fall to the lower base, we shall have a pentagon, with another inscribed therein, whose sides are parallel to those of the former; this coincides with a pentagon, furnished with a rim, or breadth, &c. and may, therefore, be delineated in the same manner. 2. Raising the altitude of the truncated pyramid IH (Fig. 64) determine the scenographic altitudes to be raised in the points a , b , c , d , e . If, now, the higher points f , g , h , i , k , be connected by the right-lines, and the lines lk , fm , gn , be drawn, the scenography will be complete. By drawing two concentric circles in a geometrical plane, and doing every thing else as in this problem, the scenography of a truncated cone will be drawn.

To put two equal figures in perspective, one of which shall be directly over the other, at any given distance from it, and both of them parallel to the plane of the horizon. Let $ABCD$ (Fig. 65) be a perspective square on a horizontal plane, S being the point of sight, and SP the horizon, parallel to AD , and P the point of distance. Suppose AD , the breadth of the square, to be three feet, and that such another square, $EFGH$, is to be placed directly above it, parallel to it, and two feet from it. Make AH and DH perpendicular to AD , and two-thirds of its length; draw EH , which will be equal and parallel to AD ; then draw ES and HS to the point of sight S , and EP to the point of distance P , intersecting HS in the point G ; then draw FG parallel to EH , and you will have

PERSPECTIVE.

two perspective squares, $ABCD$, and $EFGH$, equal and parallel to one another, the latter directly above the former, and two feet distant from it. By this method shelves may be drawn parallel to one another, at any distance from each other, in proportion to their length.

To represent a double cross in perspective. Let $ABCD$, and $EFGH$ (fig. 66) be two perspective squares, equal and parallel to one another, drawn by the last operation, whose distance is equal to the given height of the upright part of the cross; S being the point of sight, and P the point of distance, in the horizon PS , taken parallel to AD . Draw AE , DH , and CG ; then $AEDH$, and $DHGC$, shall be the two visible sides of the upright part of the cross; of which the length AE is here made equal to three times the breadth EH . Divide DH into three equal parts, HI , IK , and KD . Through these points of division, at I and K , draw MO and PR parallel to AD ; and make the parts MN , IO , PQ , KR , each equal HI ; then draw MP and OR parallel to DH . From M and O , draw MS and OS to the point of sight S ; and from the point of distance P draw PN cutting MS in T ; from T draw TU parallel to MO , and meeting OS in U ; and you will have the uppermost surface $MTUO$ of one of the cross pieces of the figure. From R draw RS to the point of sight S ; and from U , draw UV parallel to OR ; and $OUVR$ shall be the perspective square end next the eye of that cross part. Draw PMX (as long as you please) from the point of distance P , through the corner M ; lay a ruler to N and S , and draw XN from the line PM ; then lay the ruler to I and S , and draw YZS . Draw XY parallel to MO , and make XW and YB equal and perpendicular to XY ; then draw WB parallel to XY , and $WXYB$ shall be the square visible end of the other cross part of the figure. Draw BK toward the point of sight S ; and from U draw UP to the point of distance P , intersecting YS in Z ; then, from the intersection Z , draw Za parallel to MO , and Zb parallel to HD , and the whole delineation will be finished. This done, shade the whole, as in fig. 67, and you will have a true perspective representation of a double cross.

To exhibit the SCENOGRAPHY of walls, columns, &c. or to raise them on the pavement. 1. Suppose a pavement $AFHI$ (fig. 68) represented in a plan, together with the bases of the columns, &c. if there be any. 2. Upon the terrestrial line set off the thickness of the wall BA , and 1, 3. Upon A and B , as also upon 3 and 1, raise perpendiculars AD and BC , as also 3, 6, and 1, 7, 4. Connect the points D and 6 with the principal point V , by the right-lines DV , and 6 V . 5. Upon F and H raise perpendiculars FE , and HG . Thus will all the walls be delineated.

Now to raise the pillars, &c. there needs nothing but, from their several bases (whether square or circular) projected on the perspective plan, to raise indefinite perpendiculars; and on the fundamental line, where intersected by the radius FA passing through the base, raise the true altitude AD ; for DV being drawn as before, the scenographical altitudes will be determined.

To exhibit the SCENOGRAPHY of a door in building. Suppose a door required to be delineated in a wall $DEFA$. 1. Upon the fundamental line set off its distance AN from the angle A , together with the breadths of the posts NI and LM , and the breadth of the door itself LI . 2. To the point of distance K , from the several points N , I , L , M , draw right-lines KN , KI , KL , KM , which will determine the breadth of the door li , and the breadths of the posts in and ml . 3. From A to O set off the height of the door AO , and from A to P the height of the posts AP . 4. Join O and P with the principal point by the right-lines PO and OV . 5. Then from n , i , l , m , raise perpendiculars, the middle ones whereof are cut by the right-line OV in o , and the extremes by the right-line VP in p . Thus will the door be delineated with its posts.

If the door were to have been exhibited in the wall $EFGH$, the method would be nearly the same. For, 1. Upon the terrestrial line set off the distance of the door from the angle, and thence also the breadth of the door RT . 2. From R and T draw right-lines to the principal point V ; which give the breadth rt in the perspective plan. From r and t raise indefinite perpendiculars to FH . 4. From A to O set off the true height AO . Lastly, from O to the principal point V , draw the right-line OV , intersecting EF in z , and make rr and tt equal to Fz . Thus is the door $rrtt$, drawn; and the posts are easily added, as before.

To exhibit the SCENOGRAPHY of windows in a wall. When you know how to represent doors, you will find no difficulty in adding windows; all that is here farther required being to set off the height of the window from the bottom of the ground. The whole operation is as follows: 1. From 1 to 2 set off the thickness of the wall at the window; from 3 to 4 its distance from the angle 3; and from 4 to 5 its breadth: 2. From 4 and 5 to the point of distance L , draw the right-lines $L5$ and $L4$, which will give the perspective breadth, 10, 9, of the window. 3. From 10 and 9 raise lines perpendicular to the pavement, i. e. draw indefinite parallels to 6, 3. 4. From 3 to 11 set off the distance of the window from the pavement 3, 11; and from 11 to 12 its height 11, 12. Lastly, from 11 and 12, to the principal point V , draw lines $V11$, and $V12$: which, intersecting the perpendiculars 10, 13, and 9, 14, in 13 and 14, as also in 15 and 16, will exhibit the appearance of the window. From these examples, which are all

no more than applications of the first grand or general rule, it will be easily perceived what method to take to delineate any other thing, and at any height from the pavement. Those who wish to see the practice of perspective largely illustrated, and applied to a great variety of cases, may consult the second book of Kirby's Perspective, fol. 1768, and Kirby's Architecture, fol. 1761.

Fig. 69, shews the manner in which reflection is found in the looking-glass of the picture on the easel. A is the centre of the picture, and AB the vanishing line of the ground; the distance of the picture being equal to AB . AC is the vanishing line of the picture on the easel, and CD the vanishing line of the looking-glass. Through a , where the edge ba of the leg of the table cuts the surface of it, drawing ae , and through b drawing bd , both parallel to AB , bd cutting the intersection c of the surface of the picture on the easel with the ground in d , and then drawing de parallel to AC , and cutting ae in e , and then drawing Ae , is got the projection Ae of the common intersection of the surface of the table, and of the picture on the easel. For ae being parallel to AB , is the projection of a line in the surface of the table parallel to the picture, and for the same reason bd is the projection of a line on the ground, and de is the projection of a line in the plane of the picture on the easel, both of them parallel to the picture; ab is also the projection of a line parallel to the picture. Therefore $abde$ is the projection of a trapezium parallel to the picture, whose angle e is in the common intersection of the surface on the table, and of the picture on the easel. But A being the common intersection of the vanishing lines of those two planes, is the vanishing point of their common intersection, and therefore eA is the projection of that intersection. For the same reason a being the projection of the point where the surface of the glass touches the table, and E being the common intersection of the vanishing lines AB and CD , oe is the projection of the common intersection of the surface of the table and the surface of the glass. Therefore f where oe and eA meet, is the projection of the point where the three planes meet, of the surface of the table, the glass, and the picture on the easel. Therefore drawing fC , it is the projection of the common intersection of the picture on the easel and the looking-glass. Having found the vanishing point P of lines perpendicular to the plane of the looking-glass, whose vanishing line is CD , drawing PA through the vanishing point A of the line GH , and cutting CD in D , D is the vanishing point of the seat of GH on the plane of the glass. Therefore GH cutting Cf in i , Di is the projection of that seat. Then drawing GP cutting Di in k , k is the seat of the point G on the glass. Wherefore in GP making kg to represent a line equal to that represented by Gk , g is the projection of the reflection of G , and gi is the reflection of Gi , and drawing PH cutting gi in h , gh is the reflection of GH . And in the same manner may be found any other lines in the reflection. The reflection of the picture on the easel may also be described by its vanishing line, in the same manner as the projection of the picture itself was described; for in PAD making a D to represent a line equal to that represented by AD , a is the vanishing point of the reflected line gh , and C is the vanishing line of the reflected picture on the easel.

SECT. VII. SHADOWS.

The appearance of an opaque body, and a luminous one, whose rays diverge (e. gr. a candle, lamp, &c.) being given; to find the just appearance of the shadow, according to the laws of perspective: The method is this: from the luminous body, which is here considered as a point, let fall a perpendicular to the perspective plane or table; i. e. find the appearance of a point upon which a perpendicular, drawn from the middle of the luminary, falls on the perspective plane; and from the several angles, or raised points of the body, let fall perpendiculars to the plane. Those points whereon the perpendiculars fall, connect by right-lines, with the point upon which the perpendicular let fall from the luminary falls; and continue the lines to the side opposite to the luminary. Lastly, through the raised point, draw lines through the centre of the luminary, intersecting the former; the points of intersection are the terms or bounds of the shadow.

E. gr. Suppose it required to project the appearance of the shadow of a prism $ABCFED$ (Plate III. fig. 70) scenographically delineated: since AD , BE , and CF , are perpendicular to the plane, and LM is likewise perpendicular to the same (for the luminary is given, if its altitude LM be given) draw the right-lines GM and HM , through the points D and E . Through the raised points A and B , draw the right-lines GL and HL , intersecting the former in G and H . Since the shadow of the right-line AD terminates in G ; and the shadow of the right-line BE in H ; and the shadows of all other lines, conceived in the given prism, are comprehended within these terms; $GDEH$ will be the appearance of the shadow projected by the prism. If the shadows of objects be made by the light of the sun, the situation of that luminary, with respect to the picture, must be determined; and this is done by the help of the following considerations: By reason of the immense distance of the sun, it must always be supposed to be in or over some point in the horizontal line, in which the ground plane when extended to an infinite distance is conceived to vanish; and the particular point in the horizontal line must be determined from the number of degrees by which the sun is situated to the right or left hand of the perpendicular that goes through the point

PERSPECTIVE.

of sight; in the same manner as the vanishing point of a right-line upon the ground plane, that is oblique to the ground line, is found. *E. gr.* If the sun be thirty degrees to the left hand of it, let the angle DEH (*fig. 71*) be equal to 30° , and H will be that point in the horizontal line, over which the sun may be supposed to be perpendicular; and nothing is wanting to fix its precise place above the horizon, but to know its altitude, which is laid down in the same manner as the vanishing point of a line that is elevated above the ground plane. Thus, if the sun be 35° high, make $HI=HE$, and, raising the perpendicular HK , make the angle $HIK=35^\circ$, and K will be the sun's place. Let it be required to draw the shadow of any object made by the sun in this situation: and suppose K to be the place of the candle L , in (*fig. 71*) and H to be M , the point upon the ground plane that is perpendicularly under it; the process will be exactly the same as in that example. Thus, to draw the shadow of the solid, X (*fig. 72*) the place of the sun being at K ; draw Ha , and intersecting it by Kb in c , we have the place of the shadow of b ; and joining $a c$, we have the shadow of the perpendicular line ab . In like manner find d , the shadow of f , at the top of the line ef ; and also g , the shadow of the vertex of the line hi . Then joining these points, we have the shadow of the whole object X ; for it is evident, from the position of it, that the shadow of any other line in the figure must fall within that of these. When, as in this example, the place of the sun is fixed above the horizontal line, it is evident, that the shadow will be projected as falling towards the spectator, and that they will always be larger than the objects.

To draw the shadows which are made by the sun, having the same degree of elevation behind the spectator, which will make the shadows fall nearer the horizontal line, and less than the objects; the perpendicular from H (*fig. 71*) must be let fall to L , and the angle HIL must be the same as HIK , in the former case; and then, if the point L be made use of instead of K ; as these points are situated on the contrary side of the horizontal line, the shadow of objects will be represented as they would be made by the sun placed on the back of the spectator; and this position of shadows is generally thought more agreeable in a picture than the other. To find, in this manner, the shadow of the line ab , in the solid, X (*fig. 73*) draw Ha to the foot of it, and Lb to the top, intersecting each other in c , the place of the shadow. Find, in the same manner, where the shadow of the line ef , behind the body, would fall, and join that point and c , by a line which cuts the side of the figure in d , where only the shadow begins to be visible. Thus, joining a, c , and d , the shadow of the solid, X , is completed.

In both these cases the sun is supposed to be situated either before or behind the picture. If it be in the plane of the picture, it is evident that its place must be in the horizontal line, at an infinite distance from the point of sight; consequently all lines proceeding from it may be supposed parallel to one another. To draw the shadow of objects made by the sun in this situation, draw lines parallel to the horizontal line from the foot of the object, and intersect them by lines making angles with the horizontal line equal to the sun's altitude. This practice is very easy by means of the drawing board and square. Then, in order to draw the shadow of a solid, X , (*fig. 74*) with the ruler of the square parallel to the ground line, draw $a c$; and fixing the moveable transverse of the ruler in the angle of the sun's elevation, draw the line $b c$, which gives c for the place of the shadow of b . In the same manner also find d , the place of the shadow of e ; and joining the points d, c , we obtain the shadow of the whole figure; though it is so situated, that part of it is hid by the object. If there be ever so many lines, the shadows of which are to be found, once fixing the ruler serves for them all. It is merely necessary to slide the ruler along the drawing-board, till it comes to the points, from which the lines are to be drawn, both for the lines that are parallel to the horizon, and those that intersect them.

To draw the shadow of the solid, Y , (*fig. 75*) which lies oblique both to the horizon and to the ground plane, draw $a c$ from the foot of the line ab , parallel to the horizon; and fixing the moveable transverse of the ruler, so as to make an equal angle to the sun's altitude, draw $b c$. In the same manner find g , the shadow of f ; and drawing $g c$, and joining $c d$, the place where the nearest extremity of the solid touches the ground, we may complete the outline of the whole shadow; for the shadows of all the other lines must fall within these. We may observe, that it makes no difference in the shadow, whatever be the height or shape of objects, provided their tops, and every part of them, be in the same right-lines proceeding from the luminous body. See on the subject of this article, Priestley's Treatise on Perspective, part ii. p. 73, &c. and Taylor's Method of Perspective, by Kirby, book ii. chap. 4.

SECT. VIII.

INSTRUMENT FOR DRAWING IN PERSPECTIVE.

By the following Machine any person may delineate true perspective, without the help of the rules of this art. Mr. Ferguson has described a machine of this kind, the invention of which he ascribes to Dr. Bevis. The plan of this instrument is exhibited in plate IV. *fig. 76, 77*, which represents it when made use of in drawing distant objects in perspective. $abef$ (*fig. 76*) is an oblong square board, represented by $ABEF$ in *fig. 77*; x and y (X and Y) are two hinges on which the part $c d$ (CLD) is moveable.

This part consists of two arches or portions of circles $c m l$ (CLM) and $d n l$ (DNL) joined together at the top l (L) and at bottom to the cross bar $d c$ (DC) to which one part of each hinge is fixed, and the other part to a flat board, half the length of the board $abef$ ($ABEF$) and glued to its uppermost side. The centre of the arch $c m l$ is at d , and the centre of the arch $d n l$ is at c . On the outer side of the arch $d n l$ is a sliding piece n (much like the nut of the quadrant of altitude belonging to a common globe) which may be moved to any part of the arch between d and l ; and there is such another slider o on the arch $c m l$, which may be set to any part between c and l . A thread $c p n$ (CPN) is stretched tight from the centre c (C) to the slider n (N), and such another thread is stretched from the centre d (D) to the slider o (O): the ends of the threads being fastened to these centres and sliders. Now it is plain, that by moving these sliders on their respective arches, the intersection p (P) of the threads may be brought to any point of the open space within the arches. In the groove k (K) is a straight sliding bar i (I) which may be drawn farther out or pushed farther in at pleasure. To the outer end of this bar I (*fig. 77*) is fixed the upright piece $H Z$, in which is a groove for receiving the sliding piece Q . In this slider is a small hole r for the eye to look through in using the machine: and there is a long slit in $H Z$, to let the hole r be seen through when the eye is placed behind it at any height of the hole above the level of the bar I . In delineating a perspective representation, *e. gr.* of the house, $q s r p$, a great way off, place the machine on a steady table, with the end $E F$ of the horizontal board $ABEF$ toward the house, so that when the Gothic-like arch $D L C$ is set upright, the middle part of the open space (about P) within it may be even with the house when you place your eye on Z , and look at the house through the small hole r . Then fix the corners of a square piece of paper with four wafers on the surface of that half of the horizontal board which is nearest the house; and all is ready for drawing. Set the arch upright, as in the figure; which it will be when it comes to the perpendicular side t of the upright piece $s t$ fixed to the horizontal board behind D . Then place your eye at Z , and look through the hole r at any point of the house, as q , and move the sliders N and C till you bring the intersection of the threads at P directly between your eye and the point q ; then put down the arch flat upon the paper on the board, as at $S T$, and the intersection of the threads will be at W . Mark the point W on the paper with a dot of the black-lead pencil, and set the arch upright again, as before: then look through the hole r , and move the sliders N and O till the intersection of the threads comes between your eye and any other point of the house, as p ; then put down the arch again to the paper, and make a pencil mark thereon at the intersection of the threads, and draw a line from that mark to the former one at W ; which line will be a true perspective representation of the corner $p q$ of the house. Proceed in the same manner, by bringing the intersection of the threads successively between your eye and other points of the outlines of the house, as r, s , &c. and put down the arch to mark the like points on the paper at the intersection of the threads: then connect these points by straight lines, which will be the perspective outlines of the house. In like manner find points of the corners of the door and windows, top of the house, chimnies, &c. and draw the finishing lines from point to point: then shade the whole, making the lights and shades as you see them on the house itself, and you will have a true perspective figure of it. Great care must be taken, during the whole time, that the position of the machine be not shifted on the table; and to prevent such an inconvenience, the table should be very strong and steady, and the machine fixed to it, either by screws or clamps. In the same way, a landscape, or any number of objects within the field, of a view through the arch, may be delineated, by finding a sufficient number of perspective points on the paper, and connecting them by straight or curved lines, as they appear to the eye. The arch ought to be at least a foot wide at bottom, that the eye at Z may have a large field of view through it; and the eye should then be, at least, 10 $\frac{1}{2}$ inches from the intersection of the threads at P when the arch is set upright. For if it be nearer, the boundaries of view at the sides near the foot of the arch will subtend an angle at Z of more than sixty degrees, which will not only strain the eye, but will also cause the outermost parts of the drawing to have a disagreeable appearance. To avoid this, it will be proper to draw back the sliding bar I , till Z be 14 $\frac{1}{2}$ inches distant from P ; and then the whole field of view, through the foot-wide arch, will not subtend an angle to the eye at Z of more than forty-five degrees; which will give a more easy and pleasant view, not only of all the objects themselves, but also of their representations on the paper, wherein they are delineated. So that whatever the width of the arch be, the distance of the eye from it should be in this proportion: as 12 is to the width of the arch, so is 14 $\frac{1}{2}$ to the distance of the eye (at Z) from it. If a pane of glass laid over with gum-water, be fixed into the arch, and set upright when dry, a person who looks through the hole r may delineate the objects upon the glass which he sees at a distance through and beyond it, and then transfer the delineation to a paper cut upon the glass. Ferguson's Perspective, c. 3.

The above System was compiled from the Works of Brook Taylor, Ferguson, Priestley, and Kirby, by

T. MARQUOIS.

Parliament-street, Westminster.

P E R

PERSPICUITY, in oratory, is a principal excellence of style, to which all the ornaments and beauties of speech ought to give way; as it is necessary to render a discourse intelligible, and forms one of the constituent parts of **ELEGANCE**. See the *Syſtem*, Part III. Sect. I. Art. 1.

PERSPIRATION, *Perſpiratio*, in medicine, the action of evacuating the ſuperfluous juices of the body through the pores of the ſkin. When this evacuation is copious enough to be perceived by the ſenſes, as in ſweat, the perſpiration is ſaid to be *ſenſible*; where it eſcapes the notice of the ſenſes, as is the caſe in the ordinary ſtate of the body, the perſpiration is ſaid to be *inſenſible*. The word perſpiration, uſed ſimply, and without an adjective, is to be underſtood of inſenſible perſpiration. The veſſels through which the perſpiration is performed, lie obliquely open under the ſquamæ or ſcales of the cuticle or ſcarf-skin. They are inconceivably ſmall: from a calculation of Leewenhoeck it appears, that the mouths of one hundred and twenty-five thouſand of them may be covered with a common grain of ſand. The moſt conſiderable of theſe pores are the oriſces of the ducts ariſing from the miliary glands. Through theſe veſſels there is continually tranſfuding a ſubtle humour, from every point of the body, and throughout the whole expanſe of the cuticle. The matter evacuated this way is found by certain experience to be more than equal to that evacuated all the other ways, i. e. by ſtool, urine, &c. Sanctorius found in Italy, under the circumſtances of a moderate diet, middle age, and eaſy life, that the matter inſenſibly perſpired was $\frac{3}{4}$ of that taken in for food; ſo that there only remained $\frac{1}{4}$ for nutrition, and for the excrements of the noſe, ears, inteſtines, bladder, &c. M. Dodart, from a number of experiments, made for thirty-three years ſucceſſively, aſſures us, that we perſpire much more in youth than in age. In ſome perſons the perſpiration is ſo copious, that they void very little of the coarſer excrements, though they eat very heartily. The benefits of inſenſible perſpiration are ſo great, that without it, Borelli ſays, animal life could not be preſerved. The general cauſe of perſpiration is the circulation and heat of the blood. The great ſubtility, equability, and plenty of matter, thus perſpired, increaſe after ſleep, &c. conſtitute the grand ſymptoms of a perfect ſtate of health, and the chief means of preſerving the ſame. On the contrary, the departing from theſe is the firſt ſure ſign, and, perhaps, the original cauſe, of diſeaſe. Perſpiration is performed, preſerved, and increaſed, by the viſcera, veſſels, and fibres; by motion or exerciſe as far as the firſt appearance of ſweat; by moderate uſe of venery; by ſleep of ſeven or eight hours, the body well covered, yet not loaded with bed-clothes; cheerefulneſs; light, fermented, yet ſolid food, not fat; pure, not heavy air, &c. The contraries of theſe, as alſo the increaſe of the other excretions, diminiſh, prevent, and deprave it. Hence we ſee the cauſe, effect, &c. of this perſpirable matter, its uſe in preſerving the parts ſoft and flexible, and in ſupplying what is loſt, but chiefly in preſerving the nervous papillæ moiſt, freſh, lively, and fit to be affected by objects, and to tranſmit their impreſſions.

Perſpiration is alſo abſolutely neceſſary, in the animal economy, for purifying the maſs of blood, and diſcharging it of a number of uſeleſs heterogeneous particles, which might corrupt it. Hence it is, that upon a ſtoppage of the uſual perſpiration there ariſe ſo many indiſpoſitions, particularly fevers, agues, rheums, &c. Too much perſpiration occaſions weakneſs, ſwoonings, ſudden death; too little, or none at all, occaſions the capillary veſſels to dry, wither, and periſh. Hence alſo the larger emunctories come to be obſtructed; hence the circulation is diſturbed, ſharp humours retained; and hence putridity, crudity, fevers, inflammations, and impoſthumes.

Perſpiration is influenced by the paſſions of the mind. Thus anger and joy increaſe, and fear and ſadneſs leſſen, both perſpiration and urine. Anger cauſes a ſtrong motion in the membranes of the heart, and quickens its contraction and dilatation, and thereby quickens the contraction and dilatation of the blood-veſſels and ſecerning ducts, and of conſequence increaſes the diſcharges of perſpiration and urine; and that more or leſs, in proportion to the ſtrength or continuance of the paſſion. Joy affects and diſcharges in like manner as anger. In the paſſions of fear and ſorrow, perſpiration and urine are leſſened by the depreſſion of the activity of the ſoul under thoſe paſſions. Dr. Bryan Robinſon, of the *Food and Diſcharges of Hum. Bodies*, p. 77, ſeq.

Some have ſuppoſed that the perſpiration of animal bodies, in a healthy ſtate, has the ſame effect upon air that breathing it has, viz. phlogiſtifying and making it noxious; this is an opinion which Dr. Ingenhouſz has deduced from ſome experiments; and Dr. Macbride, *Eſſays*, p. 257, informs us, that having collected about two drachms of ſweat, and mixed it with ſix drams of lime-water, he found that the mixture immediately became turbid, and in a ſhort time depoſited a light ſediment, like that afforded in ſimilar circumſtances by urine, and which efferveſced as violently when ſpirit of vitriol was added. Whence he concludes that air is thrown off from the fluids by perſpiration as well as by urine. But Dr. Prieſtley obſerving, that there is nothing we know of in the human frame which would lead any perſon to ſuſpect that air ever iſſues from the ſkin, from various experiments, maintains, that perſpirable matter has no ſuch effect upon the air, leaving it as wholeſome or as fit for reſpiration as ever, as he concludes from the

P E T

teſt of nitrous air. Hence he infers that it is only **RESPIRATION**, and not the perſpiration of the body, that injures common air. *Exper. and Obſ.* Vol. V. Sect. X.

PERUVIAN BARK. See **CINCHONA**.

PETALA, *Petals*, in botany, the leaves of a flower; ſo called to diſtinguiſh them from the folia, or leaves of the plant. The word is formed from the Greek *πεταλον*, a leaf; which in that language ſerves indifferently for the leaves of the plant and thoſe of the flower. By flower is properly meant that aſſemblage of parts, called *petala*, *ſtamina*, *apices*, *piſtil*, which ſerve for the propagation of the kind. See the *Syſtem*, Sect. I. and Plate III.

PETER, or *Epistles of St. Peter*, two canonical books of the New Teſtament, written by the apoſtle St. Peter, and addreſſed to thoſe Jewiſh converts who were ſcattered throughout Pontus and Galatia, not only upon the perſecution raiſed at Jeruſalem, but upon former diſperſions of the Jews into thoſe places. The firſt of theſe epiſtles is principally deſigned to comfort and confirm them under thoſe fiery trials they were then ſubject to, and to direct them how to behave in the ſeveral ſtates and relations both in the civil and Chriſtian life. In the ſecond epiſtle, the apoſtle proſecutes the ſame ſubject, to prevent their apoſtacy from the faith, and guard them againſt the corrupt principles of the Gnoſtics, and thoſe who ſcoffed at the promiſe of Chriſt's coming.

PETER-pence, an ancient levy, or tax, of a penny on each houſe throughout England, paid to the pope. It was called *Peter-pence*, becauſe collected on the day of St. Peter ad vincula; by the Saxons it was called *Rome-feoh*, i. e. the fee of Rome, and alſo *Rome-ſcot*, and *Rome-pennyng*, becauſe collected and ſent to Rome; and laſtly, it was called *hearth-money*, becauſe every dwelling-houſe was liable to it, provided there were thirty pence *viva pecunie* belonging to it, nay, and every religious houſe; the abbey of St. Alban's alone excepted. This Peter-pence was at firſt given as a penſion or alms, by Ina king of the Weſt Saxons, in the year 727, being then on a pilgrimage at Rome; and the like was done by Offa, king of the Mercians, throughout his dominions, in 794; and afterwards by Ethelwulph, through the whole kingdom, in the year 855. It was not intended as a tribute to the pope, but chiefly for the ſupport of the Engliſh ſchool or college at Rome: the popes, however, ſhared it with the college; and at length found means to appropriate it to themſelves. At firſt it was only an occaſional contribution; but it became at laſt a ſtanding tax; being eſta bliſhed by three laws of king Canute, Edward the Confeſſor; the Conqueror, &c. The biſhops who were charged with the collecting it, employed the rural deans and archdeacons therein. Edward the Third firſt forbade the payment, but it ſoon after returned, and continued till the time of king Henry VIII. when Polydore Virgil reſided here as the pope's receiver-general. It was aboliſhed under that prince, and reſtored again under Philip and Mary; but it was finally prohibited under queen Elizabeth.

PETIOLE, in botany, the tender ſtalk that ſupports the leaves of a plant. See the *Syſtem*, Sect. II. and Plate I. with the explanation.

PETITION, *Petitio*, a ſupplication, in form, made by an inferior to his ſuperior; eſpecially to one having ſome ju riſdiction. It is uſed for that remedy which the ſubject hath to help a wrong done by the king, who hath a prerogative not to be ſued by writ: in which ſenſe it is either general, that the king do him right; whereupon follows a general indorſement upon the ſame, *Let right be done the party*: or it is ſpecial, when the concluſion and indorſement are ſpecial, for this or that to be done, &c.

By ſtatute, the ſoliciting, labouring, or procuring the putting the hands or conſent of above twenty perſons to any petition to the king or either houſe of parliament, for alterations in church or ſtate, unleſs by aſſent of three or more juſtices of the peace of the county, or a majority of the grand jury at the aſſizes or ſeſſions, &c. and repairing to the king or parliament to deliver ſuch petition with above the number of ten perſons, is ſubject to a fine of 100l. and three months' imprifonment, being proved by two witneſſes within ſix months, in the court of B. R. or at the aſſizes, &c. And if what is required by this ſtatute be obſerved, care muſt be taken that petitions to the king contain nothing which may be interpreted to reflect on the adminiſtration: for if they do, it may come under the denomination of a libel: and it is remarkable, that the petition of the city of London, for the ſitting of a parliament, was deemed libellous, becauſe it ſuggeſted that the king's diſſolving a late parliament was an obſtruction of juſtice; alſo the petition of the ſeven biſhops, ſent to the Tower by James II. was called a libel, &c. To ſubſcribe a petition to the king, *to frighten him into a change of his meaſures, intimating, that if it be denied, many thouſands of his ſubjects will be diſcontented*, &c. is included among the contempts againſt the king's perſon and government, tending to weaken the ſame, and is puniſhable by fine and imprifonment.

PETITION of Appeal to the houſe of lords, is the dernier reſort of any ſubject who thinks himſelf aggrieved by any interlocutory order or final determination in the court of chancery. This ju riſdiction of the houſe of peers is ſaid to have begun in 18 Jac. I. and the firſt petition, which appears in the records of parliament, was preſented in that year; and the firſt that was heard and determined was preſented in a few months after; both levelled againſt the lord keeper Bacon for corruption and other miſbehaviour. It

P E T

was afterwards warmly controverted by the house of commons, in the reign of Charles II. But the dispute has long since terminated.

PETREL, the English name of the genus *Procellaria*, in ornithology. For description of the genus, &c. see PROCELLARIA.

PETRIFICATION, in physiology, denotes the conversion of wood, bones, and other substances, principally animal and vegetable, into stone. The fossil bodies found petrified are principally either of vegetable or animal origin; and are more or less altered from their original state, according to the different substances they have lain buried among in the earth; some of them having suffered very little change, and others being so highly impregnated with crystalline, sparry, pyritical, or other extraneous matter, as to appear mere masses of stone, or lumps of the matter of the common pyrites; but they are generally of the external dimensions, and retain more or less of the internal figure of the bodies into the pores of which this matter has made its way. The animal substances thus found petrified are sea-shells; the teeth, bony palates, and bones of fish; the bones of land animals, &c. These are found variously altered, by the insinuation of stony and mineral matter into their pores; and the substance of some of them is now wholly gone, there being only stony, sparry, or other mineral matter, remaining in the shape and form.

As to the manner in which petrification is accomplished, we know very little. It has been thought, by many philosophers, that this was one of the rare processes of nature; and, accordingly, such places as afforded a view of it have been looked upon as great curiosities. However, it is now discovered, that petrification is exceedingly common; and that every kind of water carries in it some earthy particles, which, being precipitated from it, become stone, of a greater or lesser degree of hardness; and this quality is most remarkable in those waters which are much impregnated with selenetic matter. Of late, it has also been found, by some observations on a petrification in East Lothian, in Scotland, that iron contributes greatly to the process; and this it may do by its precipitation of any aluminous earth which happens to be dissolved in the water by means of an acid; for iron has the property of precipitating this earth, though it cannot precipitate the calcareous kind. The calcareous kinds of earth, however, by being soluble in water without any acid, must contribute very much to the process of petrification, as they are capable of a great degree of hardness by means only of being joined with fixed air, on which depends the solidity of our common cement, or mortar, used in building houses. See the articles CEMENT and MORTAR.

The name *petrification* belongs only, as we have seen, to bodies of vegetable or animal origin; and in order to determine their class and genus, or even species, it is necessary that their texture, their primitive form, and, in some measure, their organization, be still discernible. Thus we ought not to place the stony kernels, mouldered in the cavity of some shell, or other organized body, in the rank of petrifications properly so called.

Petrifications of the vegetable kingdom are almost all either gravelly or siliceous; and are found in gullies, trenches, &c. Those which strike fire with steel are principally found in sandy fissures; those which effervesce in acids are generally of animal origin, and are found in the horizontal beds of calcareous earth, and sometimes in beds of clay or gravel; in which case the nature of the petrification is different. As to the substances which are found in gypsum, they seldom undergo any alteration, either with respect to figure or composition, and they are very rare.

Organized bodies, in a state of petrification, generally acquire a degree of solidity, of which they were not possessed before they were buried in the earth, and some of them are often fully as hard as the stones or matrices in which they are enveloped. When the stones are broken, the fragments of petrifications are easily found, and easily distinguished. There are some organized bodies, however, so changed by petrification, as to render it impossible to discover their origin. That there is a matter more or less agitated, and adapted for penetrating bodies, which crumbles and separates their parts, draws them along with it, and disperses them here and there in the fluid which surrounds them, is a fact, of which nobody seems to entertain any doubt. Indeed, we see almost every substance, whether solid or liquid, insensibly consume, diminish in bulk, and, at last, in the lapse of time, vanish and disappear.

A petrified substance, strictly speaking, is nothing more than the skeleton, or, perhaps, image, of a body which has once had life, either animal or vegetable, combined with some mineral. Thus petrified wood is not, in that state, wood alone. One part of the compound or mass of wood having been destroyed by local causes, has been compensated by earthy and sandy substances, diluted, and extremely minute, which the waters surrounding them had deposited, while they themselves evaporated. These earthy substances, being then moulded in the skeleton, will be more or less indurated, and will appear to have its figure, its structure, its size, in a word, the same

P E T

general characters, the same specific attributes, and the same individual differences. Farther, in petrified wood, no vestige of ligneous matter appears to exist. We know that common wood is a body in which the volume of solid parts is greatly exceeded by that of pores. When the wood is buried in certain places, lapidific fluids, extremely divided, and sometimes coloured, insinuate themselves into its pores, and fill them up. These fluids are afterwards moulded and condensed. The solid part of the wood is decomposed and reduced into powder, which is expelled without the mass by aqueous filtrations. In this manner, the places which were formerly occupied by the wood are now left empty, in the form of pores. This operation of nature produces no apparent difference either of the size or of the shape; but it occasions, both at the surface and in the inside, a change of substance, and the ligneous texture is inverted; that is to say, that which was pore in the natural wood, becomes solid in that which was petrified; and that which was solid or full in the first state, becomes porous in the second. In this way, says M. Musard, petrified wood is much less extended in pores than solid parts, and at the same time forms a body much more dense and heavy than the first. As the pores communicate from the circumference to the centre, the petrification ought to begin at the centre, and end with the circumference of the organic body subjected to the action of the lapidific fluids. Such is the origin of petrifications. They are organized bodies, which have undergone changes at the bottom of the sea or the surface of the earth, and which have been buried, by various accidents, at different depths under the ground.

In order to understand properly the detail of the formation of petrified bodies, it is necessary to be well acquainted with all their constituent parts. Let us take wood for an example. Wood is partly solid and partly porous. The solid parts consist of a substance, hard, ligneous, and compact, which forms the support of the vegetable; the porous parts consist of vessels or interstices which run vertically and horizontally across the ligneous fibres, and which serve for conducting air, lymph, and other fluids. Among these vessels, the tracheæ, which rise in spiral forms, and which contain only air, are easily distinguished. The cylindric vessels, some of which contain lymph, and others the *succus proprius*, are full only during the life of the vegetable. After its death they become vacant by the evaporation and absence of the fluids with which they were formerly filled. All these vessels, whether ascending or descending, unite with one another, and form great cavities in the wood and in the bark. According to Malpighi and Duhamel, the ligneous fibres are themselves tubular, and afford a passage to certain liquors; in short, the wood and bark are interspersed with utriculi of different shapes and sizes. The augmentation of the trunk in thickness, according to Malpighi, is accomplished by the annual addition of a new exterior covering of fibres and of tracheæ. Others think that a concentric layer of sap-wood is every year hardened, whilst a new one is forming from the bark. But it is on all sides agreed, that the concentric layers of wood are distinct from one another, because at the point of contact betwixt any two of them, the new vessels, as well as new fibres, are more apparent and perceptible than they are in any other place.

We have, says M. Mongez, four distinct epochs in the process by which nature converts a piece of wood into stone, or, to speak more justly, by which she substitutes a stony deposit in its place: 1. Perfect vegetable wood, that is to say, wood composed of solid and of empty parts, of ligneous fibres, and of vessels. 2. Wood having its vessels obstructed and choaked up by an earthy deposit, while its solid parts remain unaltered. 3. The solid parts attacked and decomposed, forming new cavities betwixt the stony cylinders, which remain in the same state, and which support the whole mass. 4. These new cavities filled with new deposits, which incorporate with the cylinders, and compose nothing else but one general earthy mass, representing exactly the piece of wood.

Among the petrifications of vegetables called *dendrolites*, are found parts of shrubs, stems, roots, portions of the trunk, some fruits, &c. We must not, however, confound the impressions of mosses, ferns, and leaves, nor, incrustations, with petrifications.

The beauty and elegance of the *petrified ivy* of Derbyshire with us has been long famous. In the mountains near Matlock-baths, in that county, there are many grottos which afford great quantities of this petrified ivy, as it is called, and of other incrustations of the same kind. The beauty of these caverns is scarcely to be conceived; their roofs are hung with stalactites and stalagmites, in form of clusters of grapes, and the incruled plants are many of them so delicate and tender that they fall to pieces under the touch. It is very common in these places to see ivy creeping along the rock; in some parts the same branch will be found only incruled in the common way; in other parts the stony matter will so penetrate its pores, that the wood and leaves shall appear wholly petrified, and in others the same branch shall yet be fresh and vegetating.

Nothing

Nothing can give a more lively and beautiful idea of the whole business of petrification than this appearance of the several states or stages of it in the ivy, and other vegetables, in these places. It is evident that, in all these places, not only the water diffusing out of the rocks is able to deposit stony matter on the vegetables, &c. in form of incrustations, but even the steams and exhalations, being highly fated with these stony particles, are capable of working the same effect. This is evidently the case in regard to several pieces of the incrustated ivy, which have never been in the way of water, and yet are as completely covered with stone as the rest; and this is the only method in which the stony matter is conveyed into the internal parts of the plants that are really petrified in these places. For experience shews, in regard to these, that they are not petrified first, and afterwards incrustated, but it is plain that the incrustation is made first, and that, afterwards, when, in a long space of time, the vegetable matter within is perished and wasted away, the cavity that it leaves, by this means, is filled up with the same stony matter. It is evident that this inner part of the petrification was not formed while the vegetable yet existed, by the infiltration of stony matter into its pores, but that it is a mere mass of stone added afterwards, since it has never any the least trace of the inner structure of the vegetable: and this stony matter, though usually much more firm and solid than the outer crust, must, in many cases, have been formed merely by vapours, as it is in places where water is never found to come on any occasion.

Among the petrifications of animals, we find shells, crustaceous animals, polyparii, some worms, the bony part of fishes and of amphibious animals, few or no real insects, rarely birds and quadrupeds, together with the bony portions of the human body. The cornua ammonis are petrified serpents; and, with regard to figured and accidental bodies, these are *lusus naturæ*.

Scilla mentions a fossil lobster's claw, preserved in his Museum, and found in the hills near Messina, in which a piece of a scallop-shell was found, clenched just in the manner in which that animal seizes its prey. Those who suppose these fossils to be really produced in the earth, surely cannot suppose that there could be any seminal principle only for the claw of an animal. Mr. Boyle mentions a kind of sandy earth, found in England, which turns wood into stone, though there be no petrifying spring near the place: and this, he says, is done in a better manner than by any water he ever saw. See Works, Abr. vol. i. p. 161.

Animal petrifications are also found in the several parts of the bodies of living creatures. Of these the human body affords many, which are the occasion of very terrible, and generally incurable, diseases. The Philosophical Transactions affords us two very singular instances of this sort of petrifications; the one in a woman, whose whole left kidney was entirely petrified, not being filled up, in its cavity, with a stony concretion, as frequently happens in nephritic cases, but its whole substance converted into absolute stone, only covered with a thin skin. The other instance is the case of a consumptive person, whose lungs were found, on dissection, full of ulcers, and those having, almost all of them, more or less gravel in them; but this was not all, for several large pieces of the lungs were found, as the kidneys in the other instance, wholly converted into stone, only covered with a thin skin. Phil. Trans. No. 71.

In order, says M. Bertrand, in his *Dictionnaire des Fossiles*, that a body should become petrified, it is necessary that it be, 1. Capable of preservation under-ground: 2. That it be sheltered from the air and running water (the ruins of Herculaneum prove that bodies which have no connection with free air preserve themselves untouched and entire). 3. That it be secured from corrosive exhalations. 4. That it be in a place where there are vapours or liquids, loaded either with metallic or stony particles, in a state of dissolution, and which, without destroying the body, penetrate it, impregnate it, and unite with it, in proportion as its parts are dissipated by evaporation.

When the foundations of the city of Quebec, in Canada, were dug up, a petrified savage was found among the last beds to which they proceeded. Although there was no idea of the time at which this man had been buried under the ruins, it is, however, true, that his quiver and arrows were still well preserved. In digging a lead-mine in Derbyshire, in 1744, a human skeleton was found among flags' horns. It is impossible to say how many ages this carcase had lain there. In 1695, the entire skeleton of an elephant was dug up near Tonna, in Thuringia. Some time before this epoch the petrified skeleton of a crocodile was found in the mines of that country. We might cite another fact, equally curious, which happened at the beginning of the last century. John Munte, curate of Slægarp, in Scania, and several of his parishioners, wishing to procure turf from a drained marshy soil, found, some feet below ground, an entire cart, with the skeletons of the horses and carter. It is presumed that there had formerly been a lake in that place, and that the carter, attempting to pass over on the ice, had, by that means, probably perished.

A great many pieces of petrified wood are found in different counties of France and Savoy. In Coburg in Saxony, and in the mountains of Mefnia, trees of a considerable thickness have been taken from the earth, which were entirely changed into a very fine agate, as also their branches and their roots. In sawing them, the annual circles of their growth have been distinguished. Pieces have been taken up, on which it was distinctly seen that they had been gnawed by worms; others bear visible marks of the hatchet. In fine, pieces have been found which were petrified at one end, while the other still remained in the state of wood fit for being burned. It appears then that petrified wood is a great deal less rare in nature than is commonly imagined.

Cronstedt has excluded petrifications from any place in the body of his System of mineralogy, but takes notice of them in his appendix. He distinguishes them by the name of *Mineralia Lavata*, and defines them to "mineral bodies in the form of animals or vegetables." The most remarkable observations concerning them, according to Mr. Kirwan, who differs in some particulars from Mongez, are as follow. 1. Those of shells are found on or near the surface of the earth; those of fish deeper; and those of wood deeper still. Shells in substance are found in vast quantities, and at considerable depths. 2. The substances most susceptible of petrification are those which most resist the putrefactive process; of which kind are shells, the harder kinds of wood, &c.; while the softer parts of animals, which easily putrify, are seldom met with in a petrified state. 3. They are most commonly found in strata of marl, chalk, limestone, or clay; seldom in sand-stone, still more seldom in gypsum; and never in gneiss, granite, basalt, or schorl. Sometimes they are found in pyrites, and ores of iron, copper, and silver; consisting almost always of that kind of earth or other mineral which surrounds them; sometimes of flint, agate, or cornelian. 4. They are found in climates where the animals themselves could not have existed. 5. Those found in slate or clay are compressed and flattened.

On these petrifications Cronstedt observes, that shells and corals are composed of limy matter even when still inhabited by their animals, but they are classed among the petrifications as soon as the calcareous particles have obtained a new arrangement; for example, when they have become sparry; filled with calcareous earth, either hardened or loose, or when they lie in the strata of the earth. "These," says he, "form the greatest part of the fossil collections which are so industriously made, often without any regard to the principal and only use they can be of, viz. that of enriching zoology. Mineralogists are satisfied with seeing the possibility of the changes the limestone undergoes in regard to its particles; and also with receiving some insight into the alteration which the earth has been subject to from the state of the strata which are now found in it." The calcined shells, where the petrifications are of a limy or chalky nature, answer extremely well as a manure; but the indurated kind serve only for making grottos. Gypseous petrifications are extremely rare; however, Chardin informs us that he had seen a lizard inclosed in a stone of that kind in Persia.

PETROLEUM, or *Rock-oil*, a thick oily substance exuding out of the earth, and collected on the surface of wells in many parts of the world. It is found on some in Italy, and in a deserted mine in the province of Dalame in Sweden. In this last place it collects itself in small hollows of limestone, like resin in the wood of the pine-tree. It is found trickling from the rocks, or issuing from the earth; in many parts of the duchy of Modena, and in various parts of France, Switzerland, Germany, and Scotland, as well as in Asia. It is also found not only on the surface of wells, as already mentioned, but mixed with earth and sand, from whence it may be separated by infusion in water. It is of a pungent and acrid taste, and smells like the oil of amber, but more agreeable. It is very light and very pellucid; but, though equally bright and clear under all circumstances, it is liable to a very great variety in its colour. It is naturally almost colourless, and in its appearance greatly resembles the most pure oil of turpentine; this is called *white petroleum*, though it has no more colour than water. It is sometimes tinged of a brownish, reddish, yellowish, or faint greenish colour; but its most frequent colour is a mixture of the reddish and blackish, in such a degree that it looks black when viewed behind the light, but purple when placed between the eye and a candle or window. It is rendered thinner by distillation with water, and leaves a resinous residuum; when distilled with a volatile alkali, the latter acquires the properties of succinated ammoniac, and contains the acid of amber. It is the most frequent of all the liquid bitumens, and is perhaps the most valuable of them all in medicine. It is to be chosen the purest, lightest, and most pellucid that can be had, such as is of the most penetrating smell and is most inflammable. Monet informs us that some kinds of it are of the density of nut-oil. It is insoluble in spirit of wine; which, though it be the great dissolvent of sulphur, has no effect upon petroleum, not even with ever so long a digestion. It will not take fire with the dephlegmated

dephlegmated acid spirits; as oil of cloves and other of the vegetable essential oils do: and in distillation, either by balneum mariae or in sand, it will neither yield phlegm nor acid spirit; but the oil itself rises on its own form, leaving in the retort only a little matter, thick as honey, and of a brownish colour.

The finer kinds resemble naphtha. Kirwan is of opinion that naphtha is converted into petroleum by a process similar to what takes place in essential oils when exposed to the atmosphere; in which case the oil absorbs not only the pure but also the phlogisticated part of the atmosphere, in consequence of which several alterations take place in them.

Mr. Bouldoc made several experiments with the white petroleum of Modena; an account of which he gave to the Paris Academy. See the article MINERALOGY, Class III. and the System of CHYMISTRY, Part IV. Sect. 4.

It easily took fire on being brought near a candle, and that without immediately touching the flame; and when heated in any vessel, it will attract the flame of a candle, though placed at a great height above the vessel; and the vapour it sends up taking fire, the flame will be communicated to the vessel of heated liquor, and the whole will be consumed. It burns in the water; and when mixed with any liquor swims on the surface of it, even of the highest rectified spirit of wine, which is 1-7th heavier than pure petroleum. It readily mixes with all the essential oils of vegetables, as oil of lavender, turpentine, and the rest, and seems very much of their nature: nor is this very strange, since the alliance between these bodies is probably nearer than is imagined; as the essential oils of vegetables, may have been originally mineral ones, and drawn up out of the earth into the vessels of the plants.

The distinguishing characteristic of the petroleum is its thickness, resembling inspissated oil; when pure it is lighter than spirit of wine; but though ever so well rectified, it becomes in time thick and black as before. Petroleum, when shaken, yields a few bubbles, but they sooner subside than in almost any other liquor, and the liquor resumes its clear state again almost immediately. This seems owing to the air in this fluid being very equally distributed to all its parts, and the liquor being composed of particles very evenly and nicely arranged. The extensibility of this oil is also very amazing. A drop of it will spread over several feet of water, and in this condition it gives a great variety of colours; that is, the several parts of which this thin film is composed, act as so many prisms. The most severe frost never congeals petroleum into ice; and paper wetted with it becomes transparent, as when wetted with oil; but it does not continue so, the paper becoming opaque again in a few minutes, as the oil dries away. There are three varieties, according to Mengez; the yellow, the reddish, and the heavy black or brown kind.

PETROMYZON, the Lamprey, a genus of fishes belonging to the class *amphibia nantes*. It has seven spiracula at the side of the neck, no gills, a fistula on the top of the head, and no breast or belly fins. There are three species, distinguished by peculiarities in their back fins.

1. The marinus, or sea lamprey, is sometimes found so large as to weigh four or five pounds. It greatly resembles the eel in shape; but its body is larger, and its snout longer, narrower, and sharper at the termination. The opening of the throat is very wide; each jaw is furnished with a single row of very small teeth; in the middle of the palate are situated one or two other teeth, which are longer, stronger, and moveable towards the inside of the throat, the inferior part of the palate presents moreover a row of very small teeth, which reaches to the bottom of the throat, where we find four long notched bones; two short fistulous processes are observable at the extremity of the snout, and there are two others thicker but still shorter above the eyes. Willoughby supposes that the latter are the organ of hearing, and the former the organ of smell. His opinion with regard to the auditory faculty of this fish is founded on what we read in ancient authors, that the fishermen attracted the lampreys by whistling, and that Crassus had tamed one of them to such a degree that it knew his voice and obeyed his call.

The eyes of the lamprey are small, and covered with a transparent light blue membrane; the pupil is bordered with a circle of a colour resembling gold; near the gills, which are four in number, there is a round hole on both sides, through which it discharges water. The lamprey has no fins on his belly or breast; on the back we observe a fin, which begins pretty near the head, extends to the tail which it turns round, and is afterwards continued to the anus; this fin is covered by the skin of the body, to which it adheres but loosely; the skin is smooth, of a red blackish colour, and streaked with yellow; the lamprey advances in the water with winding motions like those of a serpent, which is common to it, with all the anguilliform fishes.

The lamprey lives on flesh. During the cold it lies concealed in the crevices of sea rocks, and consequently is fished for only at certain seasons. It lives in a state of hostility with the poulpe, a kind of sea polypus, which shuns the combat as long as it can; but when it finds the impossibility of escape, it endeavours

to surround the lamprey with its long arms. The latter slips away, and the poulpe becomes its prey. The lobster, we are told, avenges the poulpe, and destroys the lamprey in its turn.

Rondelet says, that the fishermen consider the bite of the lamprey as venomous and dangerous, and never touch it while alive but with pincers. They beat it on the jaws with a stick, and cut off its head.

Lampreys are very dexterous in saving themselves; when taken with a hook, they cut the line with their teeth; and when they perceive themselves caught in a net, they attempt to pass through the meshes. They fish for lampreys only on the pebbly edges of sea-rocks; some of these pebbles are drawn together to make a pit as far as the water-edge, or perhaps a little blood is thrown in, and the lamprey is immediately observed to put forth its head between two rocks. As soon as the hook, which is baited with crab or some other fish, is presented to it, it swallows it greedily, and drags it into its hole. There is then occasion for great dexterity to pull it out suddenly; for if it is allowed time to attach itself by the tail, the jaw would be torn away before the fish could be taken. This shews that its strength resides in the end of its tail; the reason of which is, that the great bone of this fish is reversed, so that the bones which in all other fishes are bent towards the tail, are here turned in a contrary direction, and ascend towards the head. After the lamprey is taken out of the water, it is not killed without a great deal of trouble; the best way is to cut the end of its tail, or perhaps to crush it with repeated blows on the spine, in order to prevent it from leaping. This shews that in the lamprey, animal life extends to the end of the spinal marrow.

M. de Querhoent removes our fears concerning the supposed poison of the lamprey. This species of fish, he tells us, abounds on the coast of Africa, and at the Antilles Isles; it is found likewise on the coast of Brazil, at Surinam, and in the East Indies. When taken with a hook, we must have the precaution to kill it before we take it off, otherwise it darts upon the fisher and wounds him severely. Its wounds, however, are not venomous; M. de Querhoent having seen several sailors, who were bitten by it, but experienced no disagreeable consequences. Lampreys are likewise found in great abundance at Ascension Island, but particularly in the seas of Italy; their flesh when dried is excellent; and boiling gives to the vertebrae the colour of gridelin.

The flesh of the lamprey is white, fat, soft, and tender; it is pretty agreeable to the taste, and almost as nourishing as that of the eel; those of a large size are greatly superior to the small ones. We know that the most wealthy of the Romans kept them in fish-ponds at a great expence. Vadius Pollio, the friend of Augustus, who is distinguished in history for his savage gluttony, on supposition that lampreys fed on human flesh were more delicate, ordered his slaves when accused of the slightest faults, to be thrown into his fish-ponds. We are no less surprised, in reading the ancient authors, to perceive the extraordinary attachment which the celebrated orators Hortensius and Crassus, men in other respects so grave and sensible, had to this animal. One of them shed tears at the loss of a lamprey; the other improved upon this puerility, and wore mourning at the death of his favourite. It is remarkable, that this fish, which is proper to the sea, and never comes into the rivers, can live and fatten in fresh-water. For the advancement of natural history, it were to be wished, that some person who lives near the sea-shore would make observations, in order to discover whether the lamprey is viviparous: its scales are so imperceptible, that they have been overlooked by most ichthyologists.

2. The fluviatilis, or lesser lamprey, sometimes grows to the length of ten inches. The mouth is formed like that of the preceding.—These are found in the Thames, Severn and Dee; are potted with the larger kind; and are by some preferred to it, as being milder tasted. Vast quantities are taken about Montlake, and sold to the Dutch for bait for their cod-fishery. Above 430,000 have been sold in a season at 40s. per 1000; and of late, about 100,000 have been sent to Harwich for the same purpose. It is said that the Dutch have the secret of preserving them till the turbot fishery.

PETROSA (ossa), in anatomy, a name given to the fourth and fifth bones of the cranium, called also *ossa temporum*, and *ossa squamosa*; the substance whereof, as their first and last names express, is squamose and very hard. See the System, Part I. Sect. 2.

PETROSELINUM (APIUM PETROSELINUM, Lin.) Parsley. This plant is commonly cultivated for culinary purposes. The seeds have an aromatic flavour, and are occasionally used as carminatives, &c. The root of parsley is one of the five aperient roots, and with this intention is sometimes made an ingredient in apozems and diet-drinks; if liberally used, it is apt to occasion flatulencies; and thus by distending the viscera, produces a contrary effect to that intended by it; the taste of this root is somewhat sweetish, with a light degree of warmth and aromatic flavour.

P H A

PEWIT, in ornithology, the English name of a species of the genus *Larus*. For description of the genus, &c. see **LARUS**.

PEWTER, a fictitious metal, used in domestic utensils: its basis is tin, and it consists of three different standards: viz. that which is called plate-metal, of which plates and dishes are made, which is formed of tin and regulus of antimony, in the proportion of one hundred and twelve pounds of the former to six or seven pounds of the latter: the next metal inferior to this is called trifling metal, and is lowered one half-penny per pound in worth, by alloying it with lead; of this metal ale-house pots are made. The lower sort of metal is still farther alloyed by lead; so as to reduce the value two-pence in a pound lower than plate-metal: of this, which is called lay-metal, wine-pots are made. See the system of **CHYMISTRY**, Part III. Chap. II. Sect. 2.

Pewter has occasionally served for money. In the Philosophical Transactions, M. Putland informs us that king James II. turned all the pewter vessels, &c. of the protestants in Ireland, he could seize, into money; half-crowns were somewhat bigger than half-pence, and other pieces in proportion. He ordered it to be current in all payments: whence, our author observes, people absconded for fear of being paid their debts. He also mentions crown-pieces of this metal, with this legend round the rim: *melioris tessere fidi*.

PHENOMENON, or **PHENOMENON**, *φαινόμενον*, formed from *φαίνωμαι*, I appear; strictly, an appearance in physics, an extraordinary appearance in the heavens, or on earth; either discovered by observation on the celestial bodies, or by physical experiments; and whose cause is not obvious. Such are meteors, comets, uncommon appearances of stars and planets, earthquakes, &c. Such also are the effects of the magnet, phosphorus, &c. The phenomena of comets are inconsistent not only with the solidity of the heavens, supposed in the Ptolemaic hypothesis, but equally with the plenitude of the heavens, asserted by the Cartesians. That hypothesis is best which solves most phenomena. Sir Isaac Newton shews, that all phenomena of the heavenly bodies follow from the attraction of gravity, which intercedes those bodies; and almost all the phenomena of the lesser bodies from the attraction and repulsion between their particles; so simple is nature.

PHAETON, in ornithology, a genus of birds belonging to the order *Anseres*; the characters of which are: the bill is sharp, straight, and pointed; the nostrils are oblong, and the hinder toe is turned forward. There are two species, viz.

1. The demersus, or red-footed penguin, has a thick, arched, red bill; the head, hind part of the neck, and the back, of a dusky purplish hue, and breast and belly white; brown wings, with the tip of the feathers white: instead of a tail, a few black bristles; and red legs. It is found on Penguin Isle, near the Cape of Good Hope, is common all over the South Seas, and is about the size of a goose. See Plate V. Genus 93.

2. The ethereus, or tropic bird, is about the size of a partridge, and has very long wings. The bill is red, with an angle under the lower mandible. The eyes are encompassed with black, which ends in a point towards the back of the head. Three or four of the larger quill-feathers, towards their ends, are black, tipped with white; all the rest of the bird is white, except the back, which is variegated with curved lines of black. The legs and feet are of vermilion red. The toes are webbed. The tail consists of two long straight narrow feathers, almost of equal breadth from their quills to their points. See Plate III. Genus 95.

"The name tropic bird (says Latham) given to this genus, arises from its being chiefly found within the tropic circles; but we are not to conclude that they never stray voluntarily, or are driven beyond them; for we have met with a few instances to prove the contrary. It is, however, so generally found within the tropic limits, that the sight of this bird alone is sufficient to inform the mariner of a very near approach to, if not his entrance therein. It has also been thought to portend the contiguity of land; but this has often proved fallacious, as it is not unfrequently found at very great distances therefrom. The sight of this bird is often to a prodigious height; but at other times it is seen, along with the frigate pelican, booby, and other birds, attending the flying-fishes at their rise from the water, driven from their native element into the air by their watery enemies, the shark, porpoise, albacore, bonito, and dolphin, which pursue them beneath, and prey upon them. These birds are sometimes observed to rest on the surface of the water, and have been now and then seen, in calm weather, upon the backs of the drowsy tortoises, supinely floating in the sea, so that they have been easily taken by the long-boat manned. On shore they will perch on trees; and are said to breed in the woods, on the ground beneath them. They have been met with in plenty on the islands of St. Helena, Ascension, Mauritius, New Holland, and various places in the South Seas; but in no place so numerous as at Palmerston Island, where these birds, as well as the frigates, were in such plenty, that the trees were absolutely loaded with them, and so tame, that they suffered themselves to be taken off the boughs with the hand. At Otaheite, and in the Friendly Isles, the natives give them the name of *haingoo* and *tolatae*.

No. 128.

P H A

PHAGEDÆNA, *Φαγέδαινα*, formed of *φαγέω*, to eat, in surgery, &c. a deep, bloated ulcer, which eats and corrodes the neighbouring parts.

PHAGEDÆNIC Medicines, such as are used to eat off fungus; or proud flesh: such are all caustics.

PHAGEDÆNIC Water, in chymistry, denotes a water made from quick-lime and sublimate; and is very efficacious in phagedænic ulcers. To prepare this water, put two pounds of fresh quick-lime in a large earthen pan, and pour upon it about ten pounds of rain-water: let them stand together for two days, stirring them frequently: at last leave the lime to settle well, then pour off the water by inclination, filtrate it, and put it up in a glass bottle, adding to it an ounce of corrosive sublimate in powder; which from white becomes yellow, and sinks to the bottom of the vessel. The water being settled, is fit for use in the cleansing of wounds and ulcers, and to eat off superfluous flesh, and especially in gangrenes; in which case, may be added to it a third or fourth part of spirit of wine.

PHALÆNA, the **MOTH**, in entomology, a genus of insects belonging to the order *Lepidoptera*. The feelers are cetaceous; and taper gradually towards the points; the wings are often bent backwards. Barbut divides this genus into eight families; and we are told there are no less than 460 species.

The chrysalida of phalænæ are generally oblong ovals, not angular; as those of butterflies, nor so soon transformed to perfect insects. They remain a much longer time within the cod, the greatest part not coming forth till the ensuing year. Some have been met with that remained in that state during two or three years successively. Heat or cold contributes greatly to forward or put back their final metamorphosis; a fact which may be ascertained by procuring them a certain degree of moderate heat, by which means one may see phalænæ brought forth upon one's mantelpiece in the depth of winter. For a copious account of the transformation of the caterpillar into the chrysalis, and the chrysalis into the caterpillar, see the article **CATERPILLAR**.

PHALAROPE, in ornithology, the English name of the genus *Tringa*. For description of the genus, see **TRINGA**: for representation, see the Plate, Genus 77.

PHANATIC, *Phanaticus*, commonly written *fanatic*; a visionary; one who fancies or thinks he sees spectres, spirits, apparitions, or other imaginary objects, even when awake; and takes them to be real. Such are phrenetics, necromancers, hypochondriac persons, lycanthropi, &c. Hence the word is also applied to enthusiasts, pretenders to revelation, new lights, prophecies, &c. See **FANATIC** and **ENTHUSIASM**.

PHANTASY, or *Fancy*, the imagination; the second of the powers or faculties of the sensitive or rational soul; by which the species of objects received by the common sense, are retained, recalled, farther examined, and either compounded or divided. Others define the *fantasy* to be that internal sense or power, whereby the ideas of absent things are formed, and presented to the mind, as if they were present. In melancholic and mad men this faculty is very strong, representing many extravagant and monstrous things, and framing its images as lively as those of sensation, whence naturally arise the visions and deceptions those persons are liable to. In poets and painters the same faculty ought to be the predominant one; to enable them to feign, and pursue, and execute, their fictions or fables with more strength, consistency, and beauty. In men it is supposed to be subject to reason, but in brutes it has no superior; this being the *ratio brutorum*, or what we call reason in brutes. The phantasy is free from the ligature; or suspension of sleep; witness our dreams, &c. Some philosophers use the word phantasy in a more general signification, viz. for what we usually call *sensus communis*, the common sense. See **IMAGINATION**.

PHALANGOSIS, in surgery, is a tumour and relaxation of the eyelids, often so great as to deform the eye, and considerably impede vision. Sometimes the eyelid, when in this state, subsides or sinks down, occasioned perhaps either by a palsy of the muscle which sustains and elevates the eyelid, or else from a relaxation of the cutis above, from various causes. Sometimes an œdematous or aqueous tumour is formed on the eyelids, so as almost entirely to exclude vision; but this last case should be distinguished from the other, and may be easily remedied by the use of internal and topical medicines, such as purges and diuretics given inwardly, and a compress dipped in warm spirit of wine and lime-water. But in the paralytic or relaxed state, the use of cordial and nervous medicines must be proposed internally; and outwardly, balsam of Peru and Hungary water are to be employed. If all these fail, the remaining method of cure is to extirpate a sufficient quantity of the relaxed cutis; and then, after healing up the wound, the remainder will be sufficiently shortened.

PHALLUS, the *Morel*, in botany, a genus of the order *Fungi*, belonging to the *Cryptogamia* class of plants. The fungus is reticulated above and smooth below.

The esculentus, or esculent morel, is a native of Britain, growing in woods, groves, meadows, pastures, &c. The substance, when recent, is wax-like and friable; the colour is a whitish yellow,

U u

PHA

yellow, turning brownish in decay; the height of the whole fungus, about four or five inches. The stalk is thick and clumsy, somewhat tuberous at the base, and hollow in the middle. The pileus is either round or conical; at a medium, about the size of an egg, often much larger; hollow within; its base united to the stalk; and its surface cellular, or latticed with irregular sinuses. The magnified seeds are oval. It is much esteemed at table, both recent and dried, being commonly used as an ingredient to heighten the flavour of ragouts.

PHARISEES, a famous sect of the Jews, who distinguished themselves by their zeal for the traditions of the elders, which they derived from the same fountain with the written word itself; pretending that both were delivered to Moses from Mount Sinai, and were therefore both of equal authority. From their rigorous observance of these traditions, they looked upon themselves as more holy than other men: and therefore separated themselves from those whom they thought sinners or profane, so as not to eat or drink with them; and hence, from the Hebrew word *pharis*, which signifies to separate, they had the name of *Pharisees*, or *Separatists*. Their pretences to extraordinary piety drew after them the common people, who held them in the highest esteem and veneration. They held a resurrection from the dead, and the existence of angels and spirits; but, according to Josephus, this was no more than a Pythagorean resurrection, that is, of the soul only, by its transmigration into another body, and being born anew with it. From this resurrection they excluded all who were notoriously wicked, being of opinion that the souls of such persons were transmitted into a state of everlasting punishment; but as to lesser crimes, they imagined that they were punished in the bodies which the souls of those who had committed them were sent into. According to this notion it was, that Christ's disciples asked him concerning the blind man, "Who did sin, the man, or his parents, that he was born blind?" With the Essenes, they held absolute predestination; and with the Sadducees, freewill; but how they reconciled these doctrines, we are no where informed.

PHARMACOPŒIA, formed from *φάρμακον*, remedy, and *ποιέω*, to make, a dispensatory, or a treatise describing the preparations of the several kinds of medicines, with their uses, manner of application, &c. We have various pharmacopœias, as those of Bauderon, Quercetan, Zwelfer, Charas, Bates, Salmon, Lemery, &c. The latest, and most in esteem, are the Edinburgh, and London Dispensatories; but the most universal is Quincy's Pharmacopœia.

PHARMACY, is the art of preparing, preserving, and compounding, substances, for the purposes of medicine. This art has been commonly divided into two branches, *Galenical* and *Chymical* pharmacy.

Galenical PHARMACY, called also simple pharmacy, is that derived to us from the ancients; consisting in the knowledge and management of the several parts of the materia medica, now in the hands of the apothecaries. See **GALENIC**.

Chymical PHARMACY, called also *spagirical* and *hermetical*, is that introduced by Paracelsus, who calls it *ars distillatoria*; consisting in the resolving of mixed bodies into their component parts, in order to separate the useless and ill, and collect and exalt the good. One of the chief obstacles in the way of the improvement of physic, is the physicians neglecting of pharmacy. Simples, vulgar, familiar, easily prepared, and readily procured, Pliny well observes, were the only remedies intended by nature: when fraud was got into the world, and men began to live by their wits, shops were soon set up; and life offered every man to sale. Soon after this, innumerable compositions, and endless inexplicable mixtures, were cried up; the product of Arabia and India were crowded into a draught; and a plaster for a little ulcer fetched from the Red Sea; whereas the proper remedies are those the poor every day meet with.

But for this division there is no foundation in nature; and accordingly processes in one pharmacopœia referred to the head of Chymical, are in another referred to the head of Galenical. There can be no doubt that even the most simple pharmaceutical preparations are, to a certain extent, chymical. Hence this division, founded on prejudice, and supported merely by a veneration for antiquity, is now banished from almost every modern pharmacopœia.

Pharmacy has also been divided into *Theoretical* and *Practical*; the first, consisting not merely of speculative opinions, but of a knowledge of facts and principles, tending to explain the rationale of processes; the latter, comprehending the mere manual labour employed in processes.

The former of these may therefore be justly styled *Scientific Pharmacy*. And there can be no doubt that an acquaintance with it is essentially necessary to the physician, as well as the apothecary: for, without it, he must often err in the forms of preparations and compositions which he employs; and must be often deceived in the effects resulting from compositions, when he infers their properties from the known powers of the ingredients in their separate state. The theory of pharmacy, therefore, is the same with that of chymistry; as are also the operations. The objects of pharmacy, however, are much more limited than those of chymistry; the latter comprehending, in the utmost latitude of

PHA

the word, almost every substance in nature; while pharmacy regards only such bodies in the vegetable, animal, and mineral kingdoms, as, by their effects on the human frame, tend to preserve health, or to restore it when lost.

PHARYNX, *Φάρυγξ*, in anatomy, the upper opening of the oesophagus or gullet, situated at the bottom of the mouth; called also the *fauces*. The pharynx is that part more particularly called the *gula*, or gullet; in which the action of deglutition commences, and where it is chiefly performed. See the System, Part III. Sect. IV.

PHASEOLUS, the **KIDNEY-BEAN**; a genus of the decandria order, belonging to the diadelphia class of plants. There is only one species; but of this there are many varieties. Those principally cultivated for the table are, 1. The common white, or Dutch kidney-bean. 2. The smaller kidney-bean, commonly called the *Battersea kidney-bean*. And, 3. The upright sort, called the *tree kidney-bean*.

1. The first sort was some time ago propagated in England, and is still in Holland; it grows very tall, and requires long stakes and poles to climb on, and its beans are considerably broad: this makes them less saleable in the markets, people supposing them to be old, because they are broad; and they are hence grown into disuse, though a much more valuable kind for eating than any other. 2. The second sort, or Battersea bean, is what is more universally cultivated: it never grows very tall, nor rambles far, and the air can easily pass between the rows, because of its moderate growth; and this makes it bear plentifully, and ripen well for the table. It is the best tasted bean, except the last. 3. The third, or tree kidney-bean, is also a plentiful bearer, and never rambles, but grows up in form of a shrub; but its beans are broader than the Battersea kind, and are not so well tasted. For the methods of cultivation, see the Treatise on GARDENING, Kitchen Garden, months April, May, and June.

A new species of phaseolus, apparently a very useful one, has been discovered by M. Morancy, "an inhabitant of Morne Rouge, dependent on the Cape;" we suppose Cape François, of the island of St. Domingo. In his search for plants, subservient to his collection of insects for the king's cabinet, he was overtaken by night, and he passed it in a cave, to which he had recourse for shelter. At its extremity he found beds of fossils, broken pieces of burnt earthenware, some tools, and other things, which shewed that this cave had formerly been the habitation of the natives. Near it he saw a climbing plant attached to some trees, with clusters of dry pods hanging from it. These he gathered, and on his return sowed the seed. Some months after, the plants grew tall and strong: they appeared to resemble a phaseolus, known, at Perpignan, by the name of *caraquella*, and, in the superb portfolios of the king, by that of *phaseolus Indicus cochleato flore*, which produced many roots, not unlike the manioc. On examining the root after the pods were ripe, he found from three to eight roots of this kind. The force of the vegetation was wonderful; but, dreading the deleterious effects of recent manioc, he did not taste them, but subjected them to a chymical analysis, which proved nothing. After boiling them in water a little salted, he ventured to taste them, and found them moist, unctuous, and saccharine, not unlike potatoes. He made, after some hours' trial, very good cassava with them, without being incommoded by the disagreeable fibres which are met with in the manioc during this operation. Since that time, biscuit and bread have been made from these roots by M. Lombart, counsellor at the Cape. The plant has been found to be very common in the woods. It requires no peculiar management: its roots are in season when the pods blacken, and its fibres run in every direction, searching for nourishment through the cleft of rocks, and receiving the impression of the strata without injury. If the principal root is left, the plant shoots again and flourishes as before; but it is not yet ascertained whether it puts forth any new roots. The seeds are not alimentary when dressed, as if nature designed them only for propagating other plants. Every use which a farinaceous plant can supply, this new phaseolus has successfully answered: and the seeds in the hands of Messrs. Heretier and Thouin will probably furnish a sufficient quantity for curiosity as well as use.

PHASES, *Φάσεις*, formed from *φαίνω*, I appear; in astronomy, the several appearances, or quantities of illumination of the moon, Venus, Mercury, and other planets; or the several manners wherein they appear illuminated by the sun. The variety of phases in the moon is very remarkable: sometimes she increases; sometimes wanes; sometimes is bent into horns, and again appears like a semicircle; at other times she is gibbous, and presently again resumes a full circular face. For the theory of the lunar phases, see the System, Sect. V. and Plate III. Fig. 4 and 5.

PHASIANUS, in ornithology, a genus belonging to the order *Gallina*. The cheeks are covered with a smooth naked skin. There are six species.

1. The gallus, or common dunghill cock and hen, with a compressed caruncle or fleshy comb on the top of the head, and a couple of caruncles or wattles under the chin. The ears are naked, and the tail is compressed and erected. Of all other birds, perhaps this species affords the greatest number of varieties; there being

being scarce two to be found that exactly resemble each other in plumage and form. The tail, which makes such a beautiful figure in the generality of these birds, is yet found entirely wanting in others; and not only the tail, but the rump also. The toes, which are usually four in all animals of the poultry kind, yet, in a species of the cock, are found to amount to five. The feathers, which lie so sleek, and in such beautiful order, in most of those we are acquainted with, are, in a peculiar breed, all inverted, and stand flaring the wrong way. Nay, there is a species that comes from Japan, which, instead of feathers, seems to be covered over with hair. See Plate III. Genus 51. Letter A.

No animal in the world has greater courage than the cock when exposed to one of his own species; and in every part of the world, where refinement and polished manners have not taken place, cock-fighting is a principal diversion. In China, India, the Philippine islands, and all over the East, cock-fighting is the sport and amusement even of kings and princes. With us it is declining every day; and it is to be hoped it will, in time, become only the pastime of the lowest vulgar.

His extraordinary courage is thought to proceed from his being the most falacious of all other birds whatsoever. A single cock suffices for ten or a dozen hens; and it is said of him, that he is the only animal whose spirits are not abated by indulgence. But then he soon grows old; the radical moisture is exhausted; and in three or four years he becomes utterly unfit for the purpose of impregnation. "Hens also (to use the words of Willoughby), as they, for the greatest part of the year, daily lay eggs, cannot suffice for so many births, but, for the most part, after three years, become effete and barren: for when they have exhausted all their seed-eggs, of which they had but a certain quantity from the beginning, they must necessarily cease to lay, there being no new ones generated within."

The hen seldom clutches a brood of chickens above once a season, though instances have been known in which they produced two. The number of eggs a domestic hen will lay in the year are above 200, provided she be well fed, and supplied with water and liberty. It matters not much whether she be trodden by the cock or no; she will continue to lay, although the eggs of this kind can never, by hatching, be brought to produce a living animal. Nature, almost exhausted by its own fecundity, seems to inform her of the proper time for hatching, which she herself testifies by a clucking note, and by discontinuing to lay. If left entirely to herself, the hen would seldom lay above 20 eggs in the same nest, without attempting to hatch them: but in proportion as she lays, her eggs are removed; and she continues to lay, vainly hoping to increase the number. In the wild state, the hen seldom lays above 15 eggs; but then her provision is more difficultly obtained, and she is perhaps sensible of the difficulty of maintaining too numerous a family. When the hen begins to sit, nothing can exceed her perseverance and patience: she continues for some days immovable; and when forced away by the importunities of hunger, she quickly returns. Sometimes, also, her eggs become too hot for her to bear, especially if she be furnished with too warm a nest within doors, for then she is obliged to leave them to cool a little: thus the warmth of the nest only retards incubation, and often puts the brood a day or two back in the shell. While the hen sits, she carefully turns her eggs, and even removes them to different situations; till at length, in about three weeks, the young brood begin to give signs of a desire to burst their confinement. When, by the repeated efforts of their bill, which serves like a pioneer on this occasion, they have broke themselves a passage through the shell, the hen still continues to sit till all are excluded. The strongest and best chickens generally are the first candidates for liberty; the weakest come behind, and some even die in the shell. When all are produced, she then leads them forth to provide for themselves. Her affection and her pride seem then to alter her very nature, and correct her imperfections. No longer voracious or cowardly, she abstains from all food that her young can swallow, and flies boldly at every creature that she thinks is likely to do them mischief. Whatever the invading animal be, she boldly attacks him; the horse, the hog, or the mastiff. When marching at the head of her little troop, she acts the commander; and has a variety of notes to call her numerous train to their food, or to warn them of approaching danger. Upon one of these occasions, the whole brood have been seen to run for security into the thickest part of a hedge, while the hen herself ventured boldly forth, and faced a fox that came for plunder.

Ten or twelve chickens are the greatest number that a good hen can rear and clutch at a time; but as this bears no proportion to the number of her eggs, schemes have been imagined to clutch all the eggs of a hen, and thus turn her produce to the greatest advantage. By these contrivances it has been obtained, that a hen that ordinarily produces but 12 chickens in the year, is found to produce as many chickens as eggs, and consequently often above 200. This contrivance is the artificial method of hatching chickens in stoves, as is practised at Grand Cairo; or in a chymical laboratory, properly graduated, as has been effected by Mr. Reaumur. At Grand Cairo, they thus produce 6000 or 7000 chickens at a time. For a very particular account of the

mode of hatching chickens in this part of the world, see the article HATCHING.

But it is otherwise in our colder and unequal climate; the little animal may, without much difficulty, be hatched from the shell, but they almost all perish when excluded. To remedy this, Reaumur has made use of a woollen hen, as he calls it; which was nothing more than putting the young ones in a warm basket, and clapping over them a thick woollen canopy.

Capons may very easily be taught to clutch a fresh brood of chickens throughout the year; so that when one little colony is thus reared, another may be brought to succeed it. Nothing is more common than to see capons thus employed; and the manner of teaching them is this: First the capon is made very tame, so as to feed from one's hand; then, about evening, they pluck the feathers off his breast, and rub the bare skin with nettles; they then put the chickens to him, which presently run under his breast and belly, and, probably rubbing his bare skin gently with their heads, allay the stinging pain which the nettles had just produced. This is repeated for two or three nights, till the animal takes an affection to the chickens that have thus given him relief, and continues to give them the protection they seek for: perhaps also the querulous voice of the chickens may be pleasant to him in misery, and invite him to succour the distressed. He, from that time, brings up a brood of chickens like a hen, clutching them, feeding them, clucking, and performing all the functions of the tenderest parent. A capon once accustomed to this service, will not give over; but when one brood is grown up, he may have another, nearly hatched, put under him, which he will treat with the same tenderness as he did the former.

Of this species Mr. Latham enumerates no less than 13 varieties, beginning with the wild cock, which is a third less in the body than the domestic cock. This variety he imagines to be the original stock from whence all our domestic varieties have sprung. They appear to be natives of the forests of India. There are but few places, however, as Mr. Latham goes on to observe, where the different voyagers have not met with cocks and hens, either wild or tame; and mention has been particularly made of finding them at St. Jago, Pulo Condore, Isle of Timor, Philippine and Molucca isles, Sumatra and Java, New Guinea, Tinian, and most of the isles of the South Seas. Those of Pulo Condore are very much like our own, but considerably less, being only of the size of a crow. The cocks crow like ours, but their voices are much more small and shrill.—*Damp. Voy.* vol. i. p. 329.—Two wild ones were shot there by our last voyagers.—*Elis's Narr.* ii. p. 340. Those of Sumatra and Java are remarkably large, and are called the *St. Jago breed*. The cock is so tall as to peck off a common dining-table. When fatigued, he sits down on the first joint of the leg; and is then taller than the common fowls. *Hist. Sumatr.* p. 98. They are found in New Guinea, but not in great plenty.—*Forr. Voy.* p. 105. The fowls which were met with, wild, at Timian, "were run down without much trouble, as they could scarce fly farther than 100 yards at a flight."—*Anson's Voy.* p. 416. Forster observes, that they are plenty at Easter, Society, and Friendly, Isles: at the two last they are of a prodigious size. They are not uncommon at the Marquesas, Hebrides, and New Caledonia; but the Low Isles are quite destitute of them.—*See Obs.* p. 193.—Ducks and poultry are numerous in the Sandwich isles.—*Cook's Journal*, p. 229. In respect to Europe, little need be said, as varieties without end are every where seen, and their manners fully known to every one. It is observed, however, that they breed most freely in the warmer situations. In the very cold regions, though they will live and thrive, they cease to multiply. They are not found to breed in the northern parts of Siberia; and in Greenland are only kept as rarities.—*Faun. Groen.* On the whole, it seems quite unnecessary to enlarge farther on a subject well known to every body. They are so common, that every one who wishes to become acquainted with their nature and manners, has the means of such knowledge in his power. Those who wish for minuter descriptions, we must refer to the authors who have professedly written on the subject; for the varieties which we have already mentioned, we refer to Mr. Latham.

2. The motmot, or Guinea pheasant, is brownish, somewhat red below, with a wedge-like tail, and wants spurs. See Plate III. Genus 51. Letter B. 3. The colchicus is red, with a blue head, a wedge-shaped tail, and a papillious cheek. It is a native of Africa and Asia. 4. The argus is yellowish; with black spots, a red face, and a blue crest on the back part of the head. It is found in Chinese Tartary. 5. The pecten has a yellow crest, a red breast, and a wedge-shaped tail. It is a native of China. 6. The nethemerus is white, with a black crest and belly, and a wedge-shaped tail. It is a native of China. Pheasants were originally brought into Europe from the banks of the Phasis, a river of Colchis, in Asia Minor; and from whence they still retain their name. Next to the peacock, they are the most beautiful of birds, as well for the vivid colour of their plumes, as for their happy mixture and variety. It is far beyond the power of the pencil to draw anything so glossy, so bright, or points so finely blending into each other. We are told, that when Croesus, king of Lydia, was seated on his throne, adorned with royal magnificence

P H E

magnificence and all the barbarous pomp of Eastern splendour, he asked Solon if he had ever beheld any thing so fine? The Greek philosopher, no way moved by the objects before him, or taking a pride in his native simplicity, replied, that after having seen the beautiful plumage of the pheasant, he could be astonished at no other finery.

These birds, though so beautiful to the eye, are not less delicate when served up at the table. Their flesh is considered as the greatest dainty; and when the old physicians spoke of the wholesomeness of any viands, they made their comparison with the flesh of the pheasant. However, notwithstanding all these perfections to tempt the curiosity or the palate, the pheasant has multiplied in its wild state.

A spirit of independence seems to attend the pheasant even in captivity. In the woods, the hen-pheasant lays from 18 to 20 eggs in a season; but in a domestic state she seldom lays above 10. In the same manner, when wild, she hatches and leads up her brood with patience, vigilance, and courage; but when kept tame, she never sits well, so that a hen is generally her substitute upon such occasions; and as for leading her young to their food, she is utterly ignorant of where it is to be found; and the young bird starves if left solely to her protection. The pheasant, therefore, on every account, seems better left at large in the woods than reclaimed to pristine captivity. Its fecundity, when wild, is sufficient to stock the forest; its beautiful plumage adorns it; and its flesh retains a higher flavour from its unlimited freedom. However, it has been the aim of late to take these birds once more from the woods, and to keep them in places fitted for their reception. Like all others of the poultry kind, they have no great sagacity, and suffer themselves to be easily taken. At night they roost upon the highest trees of the wood; and by day they come down into the lower brakes and bushes, where their food is chiefly found. They generally make a kind of flapping noise when they are with the females; and this often apprises the sportsman of their retreats. At other times he attacks them in the snow, and frequently takes them in springs. But of all birds they are shot most easily; as they always make a whirring noise when they rise, by which they alarm the gunner, and being a large mark, and flying very slow, there is scarcely any missing them.

When these birds are taken young into keeping, they become as familiar as chickens; and when they are designed for breeding, they are put together in a yard, five hens to a cock; for this bird, like all of the poultry kind, is very falacious. In her natural state the female makes her nest of dry grass and leaves; the same must be laid for her in the pheasantry, and she herself will sometimes properly dispose them. If she refuses to hatch her eggs, then a common hen must be got to supply her place, which task she will perform with perseverance and success. The young ones are very difficult to be reared; and they must be supplied with ants' eggs, which is the food the old one leads them to gather when wild in the woods. To make these go the farther, they are to be chopped up with curds, or other meat; and the young ones are to be fed with great exactness, both as to the quantity and the time of their supply. This food is sometimes also to be varied: and woodlice, earwigs, and other insects, are to make a variety. The place where they are reared must be kept extremely clean; their water must be changed twice or thrice a day; they must not be exposed till the dew is off the ground in the morning, and they should always be taken in before sun-set. When they become adult, they very well can shift for themselves, but they are particularly fond of oats and barley.

Mr. Latham observes, that the common pheasant is now found in a state of nature in almost the whole of the Old Continent. They sometimes (he says) come into farm-yards near the woods, and produce cross breeds with common hens. He then says, "M. Salerne remarks, that the hen-pheasant, when done laying and sitting, will get the plumage of the male, and after that become so little respected by him, as to be treated with the same incivility as he would show to one of his own sex. He mentions this as a new observation; but it is far more common than may be generally supposed, and had been long before mentioned by Edwards, who gave for example, one kept in the menagerie of the duke of Leeds; and remarks, that this change is most likely to happen when in a confined state. The circumstance of the hen acquiring the plumage of the cock, after a certain time, is not confined to the pheasant; the instance of the pea-hen, belonging to Lady Tynte, now in the Leverian Museum, evinces the contrary, which, after having many broods, got much of the fine plumage of the cock, with the addition even of the fine train feathers. The female also of the rock manakin is said to get the plumage of the opposite sex after a number of years; and perhaps, if observed hereafter, this may be found to be the case with many other species. A gentleman of my acquaintance (continues our author) dead long since, who used to keep these birds for his amusement, observed the same to me: and the ingenious Mr. J. Hunter has a well drawn-up paper in the Philosophical Transactions to the same purport; but, in addition to this, I am well informed, that it does not always require mature age to give the hen-pheasant the appearance of the male, as sometimes young birds will be adorned with his fine plumage. I

P H I

will not say how this happens, and whether it may be peculiar to this species to grow barren (if that be the reason) sooner than any other of the gallinaceous tribe; but I am assured that several of these spurless, cock-like hens, have proved on eating, to be young birds, from their juiciness and delicacy of flavour."

One of the varieties which our author remarks under this species, he calls the *Hybrid pheasant*, which is a mixed breed between the pheasant and cock; one of which is in the Leverian Museum.

In order to increase the breed, and make it still more valuable, Longolius teaches us a method that appears very peculiar. The pheasant is a very bold bird when first brought into the yard among other poultry, not sparing the peacock, nor even such young cocks and hens as it can master: but after a time it will live tamely among them, and will at last be brought to couple with a common hen. The breed thus produced take much stronger after the pheasant than the hen; and in a few successions, if they be let to breed with the cock pheasant (for the mixture is not barren), there will be produced a species more tame, stronger, and more prolific; so that he adds, that it is strange why most of our pheastries are not stocked with birds produced in this manner.

PHILANTHROPY, is compounded of two Greek words, which signify the *love of mankind*. It is therefore nearly of the same import with *benevolence*; and differs from *friendship*, as this latter affection subsists only between a few individuals, whilst *philanthropy* comprehends the whole species.

Whether man has an instinctive propensity to love his species, which makes him incapable of happiness but in the midst of society, and impels him to do all the good that he can to others, feeling their felicity an addition to his own; is a question that has been warmly debated among philosophers ever since metaphysics was studied as a science. With the opinions of the ancients we shall not, in this detached article, trouble our readers; but it would be unpardonable to pass without notice the different theories which on so interesting a subject have divided the moderns.

Hobbes, who believed, or pretended to believe, that right results from power, and that in society there is no other standard of justice than the law of the land, or the will of the supreme magistrate, built his opinions upon a theory of human nature, in which philanthropy has no place. According to him, mankind, in the original state of nature, were wholly *selfish*. Each endeavoured to seize, by fraud or force, whatever he thought would contribute to his comfort; and as all had nearly the same wants, the inevitable consequence of this selfishness was universal war. We are taught indeed by the same philosopher, that, in a series of ages, mankind discovered the miseries of this state of nature; and therefore, upon the same basis of universal selfishness, formed societies, over which they placed supreme governors for the purpose of protecting the weak against the violence of the strong. He does not, however, explain how men, whose angry and selfish passions were thus excited to the utmost against each other, could enter upon this friendly treaty; or, supposing it formed, how the ignorant multitude were induced to pay obedience to the more enlightened few. Clogged with this and other insurmountable difficulties, his philosophy of human nature soon fell into merited contempt; but about the *origin of philanthropy*, those who united in opposition to him, still thought very differently from one another.

The elegant *Shaftesbury*, who had imbibed much of the spirit of Plato, endeavoured, like his master, to deduce all the duties of man, and almost all his actions, from a number of internal feelings or instincts, which he supposed to be interwoven with his constitution by the immediate hand of God. This system appeared so honourable to human nature, and at the same time was so easily comprehended, that the noble lord had soon many followers, and may indeed be considered as the founder of a school which has produced philosophers whose works do honour to the age and country in which they flourished. Among these we must reckon *Bishop Butler*, *Hutchison*, *Lord Kaimes*, *Dr. Beattie*, and perhaps *Dr. Reid*.

According to the system of these writers, the whole duty of man results from an intuitive principle to which they have given the name of the moral sense; and with this sense they conceive philanthropy to be inseparably united, or rather perhaps to make an essential part of it. (See MORAL PHILOSOPHY.) If this theory be carried to its utmost extent, as it has been by some of its patrons, it seems to follow, that peace and harmony should reign among savages; and that a man who had from his infancy grown up in solitude, would be delighted with the first sight of a fellow-creature, and run to him with eagerness, as to a new source of enjoyment. This conclusion, however, is contrary to acknowledged facts. Savages are generally divided into small tribes or hordes; and though the attachment of individuals to their own tribe appears indeed to be abundantly strong, the tribes themselves are frequently at war, and entertain a constant jealousy of each other. Savages, too, are almost universally afraid of strangers; and the few solitary individuals, who have been caught in parts where they had run wild from their infancy, instead of being

being delighted with the appearance of fellow-men; have either fled from them with their utmost speed, or been fixed to the spot in terror and astonishment. There are no indications of that instinctive philanthropy for which some writers so strenuously plead. They have, indeed, induced others to deny, that in human nature there are any instinctive principles at all; and to endeavour to account for our several propensities by the influence of education producing early and deep-rooted habits.

PHILIPPICS, *Philippica*, *Φιλιππικοί λόγοι*, in literature, a name given to the orations of Demosthenes against Philip, king of Macedon. The Philippics are esteemed the master-pieces of that great orator: Longinus quotes abundance of instances of the sublime from them; and points out a thousand latent beauties therein. In effect, that pathetic wherein Demosthenes excelled, the frequent interrogations and apostrophes wherewith he attacked the indolence of the Athenians, where could they be better employed? How much delicacy soever there be in the oration against Lepidus, the Philippics have yet the advantage over it, were it only on account of the subject, which gives Demosthenes so fair a field to display his chief talent, we mean, with Longinus, that of moving and astonishing. **PHILIPPIC** is also applied to the fourteen orations of Cicero against Marc Anthony. It was Cicero himself that gave them this title in his epistle to Brutus; and posterity have found it so just, that it has been perpetuated to our times. Cicero's Philippics cost him his life; Marc Anthony having been so irritated with them, that when he arrived to the triumvirate, he procured Cicero's murder, cut off his head, and stuck it up on the very place whence the orator had delivered the Philippics.

PHILOLOGY. Under the term philology some comprehend universal literature; so that each one may therein include whatever he thinks proper; as grammar, rhetoric, poetry, antiquities, history, criticism, the interpretation of authors, &c. This seems to be not only making an abuse of words, but creating confusion in those matters where too much regularity and precision cannot be observed. The term philology is composed of the Greek words *φίλος* and *λόγος*, which imply "a love or study of languages." It appears, therefore, that philology, in its restricted sense, imports nothing more than a general knowledge of languages, of the natural and figurative signification of their words and phrases; and, in short, of all that relates to expression in the different dialects of nations, as well ancient as modern.

Philology makes what the French call the *belles-lettres*. In the universities it is also called *humanities*, or *humaniores literæ*. Languages in general may be divided into—1. *Ancient languages*, which are those that have become extinct with the people who spoke them, or have been so altered and disfigured that they no longer resemble the languages which were spoken by those people. 2. *Oriental languages*; the study of which is necessary in order to the understanding of the text of the holy scriptures, especially the Old Testament. 3. *Learned languages*; which are those that are indispensably necessary in the study of erudition, and particularly literature; which, while there were people in the world who made them their common language, were called *living*; but as no nation now makes use of them, they are called *dead languages*, and are therefore to be learned from books, or in schools. 4. *Modern languages*; in which are distinguished, first, the common languages of the European nations; and secondly, the languages of the people who inhabit the three other parts of the world. For the general rules which are applicable to all languages, see the System of GRAMMAR, Part I. See also the article LANGUAGE.

Though philology, in its original import, denoted only the study of words and language, it gradually acquired a much more extensive, and, at the same time, a much more useful, as well as more exalted, signification. It comprehended the study of grammar, criticism, etymology, the interpretation of ancient authors, antiquities; and, in a word, every thing relating to ancient manners, laws, religion, government, language, &c. In this enlarged sense of the word, philology becomes a science of the greatest utility; opens a wide field of intellectual investigation; and, indeed, calls for a more intense exertion of industry, and multifarious erudition, than most of those departments of literature which custom hath dignified with more high-sounding names.—It is, indeed, apparent, that, without the aid of philological studies, it is impossible, upon many occasions, to develop the origin of nations; to trace their primary frame and constitution; to discover their manners, customs, laws, religion, government, language, progress in arts and arms; or to learn by what men and what measures the most celebrated states of antiquity rose into grandeur and consideration. The study of history, so eminently useful to the legislator, the divine, the military man, the lawyer, the philosopher, and the private gentleman who wishes to employ his learned leisure in a manner honourable and improving to himself, and useful to his country, will contribute very little towards enlightening the mind without the aid of philological researches.

PHILOSOPHER, *Φιλοσοφός*, a person well versed in philosophy; or who makes profession of, or applies himself to, the study of nature and morality. The sects of philosophers are very numerous; No. 128.

and their dogmata, or tenets, very contradictory. Helmont, and some of the chymists, denominate themselves *philosophers by fire*. The alchymists, and adepts, are frequently denominated the *philosophers*, by way of eminence.

PHILOSOPHER'S Stone, the greatest object of alchymy, is a long-fought-for preparation, which, when found, is to convert all the true mercurial part of metal into pure gold, better than any that is dug out of mines, or perfected by the refiner's art.

Some Greek writers, in the fourth and fifth centuries, speak of this art as being then known; and towards the end of the thirteenth century, when the learning of the East had been brought hither by the Arabians, the same pretensions began to spread through Europe. It is supposed that this art, called *alchymy*, was of Egyptian origin; and that, when the ancient Greek philosophers travelled into Egypt, they brought back some of the allegoric language of this Egyptian art, ill understood, which afterwards passed into their mythology. Alchymy was the earliest branch of chymistry, considered as a philosophical science; in the other parts of chymical knowledge, facts preceded reasoning or speculation; but alchymy was originally speculative. See ALCHYMY.

PHILOSOPHIZING, the act of considering some object of our knowledge, examining its properties, and the phenomena it exhibits, and enquiring into their causes or effects, and the laws thereof; the whole conducted according to the nature and reason of things, and directed to the improvement of knowledge. See NEWTONIAN PHILOSOPHY.

PHILOSOPHY, is a word derived from the Greek, and literally signifies the love of wisdom. In its usual acceptance, however, it denotes a science, or collection of sciences, of which the universe is the object, and of the term thus employed, many definitions have been given, differing from one another, according to the different views of their several authors. By Pythagoras, philosophy is defined "the knowledge of things existing;" by Cicero, after Plato, "the knowledge of things divine and human, with their causes;" and by the illustrious Bacon, "the interpretation of nature." It may be proper here to observe, that the definition given by Cicero, is better than that of Pythagoras, because the chief object of the philosopher is to ascertain the causes of things, and in this consists the difference between his studies, and those of the natural historian, who merely enumerates phenomena, and arranges them in separate classes. The principal objects of philosophy are *God, Nature, and Man*. These are not separate and independent sciences, but, as Bacon expresses it, branches from the same trunk.

The philosophers, among the most ancient people of the world, were called *sages* or *wise men*, as appears from history both sacred and profane. Thales and Pythagoras, in Greece, were the first, among those that made an open profession of this science, who thought the title of *sage* too fastidious, and took the more modest name of *philosophers*, or *lovers*, or *studiers of wisdom*. Thales, who was a native of Miletus, in Ionia, and the first of the seven sages, was the founder of the Ionic sect; his most illustrious disciples were Anaximander, Anaximenes, Anaxagoras, and Archelaus. Anaxagoras employed himself entirely in the contemplation of the stars; and when he was asked if he had no concern for his country, replied, pointing to heaven with his finger, "I incessantly regard my country." Pythagoras founded the sect that was called *Italic*, because it was settled in that part of Italy which was called *Great Greece*, and which now makes part of the kingdom of Naples. He borrowed from the Egyptians a mysterious manner of teaching by numbers; and to that he added a certain harmony, by which he explained the perfection in all objects. He believed the world to be animated, intelligent, and round. Not knowing what to do with the soul after its separation or transmigration from the body, he invented the doctrine of the metempsychosis. His disciples of greatest note were Ocellus of Lucania, Archytas of Tarentum, Philolaus of Croton, Parmenides and Zeno, both of Elea, and Melissus of Samos. Zeno was the inventor of the dialectic; the others applied themselves closely to the study of natural philosophy, and to the investigation of its principles.

Socrates followed the career of these first philosophers, but turned almost all his studies towards morality. His master was Archelaus the Pythagorean. He was the first who began to reduce the confused ideas of those who had gone before him into method; for which reason he is called, by Cicero, *the father of philosophy*. His life was a model of frugality, moderation, and patience; and his doctrine abounds with wisdom.

Socrates, discovering a greater genius in Plato than in any of his other disciples, had a particular attachment to him, and his labours were not lost; for, among all the celebrated men who came out of the school of Socrates, Plato was, doubtless, the most renowned. He taught at Athens, and had, in a short time, many disciples. He established his school in the academy, which was a place without the town, and from thence they were called *Academics*. According to Plato, the soul of man is only a ray from the Divinity. He believed that this particle, united to its principle, knew all things; but when united to a body, it contracted ignorance and impurity by that union. He did not entirely

entirely neglect natural philosophy, like Socrates, but enquired into many questions which relate to that science. He believed that all things consisted of two principles, God and matter.—He likewise cultivated astronomy. His morality was the same in substance with that of Socrates. The disciples of Plato formed also many new sects. That of which Aristotle was the founder is doubtless the most illustrious. This philosopher was the first who formed, from the several parts of philosophy, a complete system. No one before him had treated separately, and from principles, the different parts of this science. He did not regard logic as a part of philosophy, but as a proper method whereby to dispose the understanding to discover the truths that it contains. The morality of Aristotle is the most perfect of all his works. His physics consist of notions and terms that are vague, and as trifling as obscure. His disciples and their followers were called the *Peripatetics* of Lyceum, where he had fixed his school.

Aristotle was not the only disciple of Plato who deviated from the sentiments of that great man: there were others who likewise placed themselves at the heads of different sects. Arcefilas was the author of a sect that was called the *Middle Academy*.—He declared that there was nothing either certain or true: and that the positive and negative might be maintained in all sorts of subjects. Lacydes, who taught in the same school as Plato, 56 years after Arcefilas, was the chief of another sect that was called the *New Academy*. He acknowledged that there was a degree of probability, but that we could not assuredly know, that any thing was absolutely true. Pyrrho, about the same time, placed himself also at the head of a sect. He improved on the dogma of the Academies; and maintained that it was impossible to comprehend any thing: but Pyrrho could not comprehend himself. He believed that there was nothing true, nothing but what might be said either this or that. His followers were called *Pyrrhonians*, or more commonly *Sceptics*, because they searched without ever being able to discover any thing. About the same time arose two sects, who, with principles diametrically opposite, rendered themselves highly celebrated, and divided at first the wits of Greece, and afterwards those of the rest of the world; and these were Zeno and Epicurus. Zeno was of Citium, a city in Cyprus. He taught in the porticos of Athens, from whence his disciples were called *Stoics*. The most famous dogma of Zeno and the Stoics consisted in the principle of morality, which was to live in conformity to nature, that is to say, according to the object of our desires; on this principle, and on divers others, they formed the idea of a philosophy altogether extravagant, and insensible to all external objects. The physics of Zeno had nothing new but the terms. The other sect, which flourished at the same time, was that of Epicurus; and they were called *Epicureans*. See EPICUREAN PHILOSOPHY.—This philosopher taught publicly at Athens, his native country, at the age of thirty-two years. He rejected all the chicaneries and subtleties of logic, and sought the truth by means of the senses. He attached himself greatly to morality, to which likewise tended all his other studies; and his morality was as consistent to the nature of man, as that of Zeno was contradictory; seeing that his first principle was, that pleasure is the pursuit of man, and that it consists in health of body, and tranquillity of mind; and that it is the source and end of a happy life, &c. Epicurus was also engaged, but with less success, in the labyrinth of metaphysics, and in physics: he adopted the system of atoms, of which Democritus was the first author. In short, maugre the evil interpretations and calumnies of his adversaries, he inculcated, by his doctrine, and by his example, frugality and sobriety; and, according to him, death is not an object of terror: "For," says he, "it is nothing so long as life subsists; and when it arrives, life is no more; no man has ever felt his death." It is evident, that these ancient systems of philosophy are at great variance with each other; and as truth is constantly uniform, it follows, that the greater part of these opinions cannot be true. This consideration engaged Patomus of Alexandria, under the emperor Augustus, to select all that he found most rational in the doctrines of all the other philosophers, whereof he composed a system, and founded a sect, and he for that reason, gave to his doctrine the name of the eclectic philosophy, from a Greek word, which signifies to *select*.

The doctrine of Plato was at first in greater estimation than any of the others; and there were many celebrated Platonists under the Roman emperors down to Julian the apostate, who was himself one of them. The first Christian doctors likewise declared for this philosophy, as Justin Martyr, Tatian, Athenagoras, Origen, &c. But at length the philosophy of Aristotle, perhaps of all others the most absurd, took the lead; and truth was no longer sought for but in the writings of that philosopher. This violent fondness for his reveries began about the 12th century; at which time a philosophy was formed, that is commonly called *scholastic*, and which is borrowed in great part from the writings of the Arabs, whom the scholastics, who were all attached to Aristotle, imitated in their subtle ambiguous, abstract, and capricious manner of reasoning, by which they never hit the truth, but constantly went on one side, or

beyond the mark. Towards the end of the 14th century, their spirits were extravagantly heated by logical distinctions, relative to that furious emulation, which was formed on the doctrine of Aristotle, between the nominalists and realists. The former had for their chief Ockham, an English cordelier, and a disciple of Scotus. They maintained, that the universal natures were nothing but words: and the others, who supported themselves by the authority of Scotus, maintained, that the same universal natures were beings strictly real. These disputes divided all the universities of Europe: philosophy was no longer employed but in operations of the intellect, conceptions, abstractions, and such like vain subtilties: and became a mere jargon, a confused heap of unintelligible ideas.

At length, in the 16th century, philosophy began to deliver itself from the chains of terminology; men accustomed themselves to philosophise by reason, and not by verbal contention; they began to throw off the yoke, and, without entirely despising Aristotle, they no longer believed him on his word. Nicholas Copernicus, who was born at Thorn, in 1473, and died in 1543, had already borne the torch of reason in the mathematics and astronomy: see COPERNICAN SYSTEM: he had rejected the system of the world that was invented by Ptolemy, and which the Greeks called *most wise, and most divine*; and had published his book *De motu octavae sphaerae*, and his treatise *De revolutionibus*; in which he established his system of the sun's being immovable, and of the motion of the earth. Galileo, who was born at Florence in 1564, adopted the system of Copernicus, confirmed it, and approved it by new observations. This discovery of the truth cost him five or six years' confinement in the prison of the inquisition. He introduced a new and excellent method of reasoning on philosophical subjects.

Peter Gassendus, professor of Mathematics in Paris, also practised, in the beginning of the 17th century, a new method of philosophizing, which contributed greatly to the progress of that science. Lastly, René Descartes appeared, almost at the same time: and, by a method that had been but very imperfectly understood before, discovered more truths in philosophy than all the preceding ages had produced; although, from the weakness which is natural to the human understanding, he has frequently mixed error with truth in his different systems. He treated on almost all the parts of philosophy, especially the mathematics, physics, and metaphysics. Every one is acquainted with his famous system of the *plenum* and *vortices*. Before Descartes, Francis Bacon, baron of Verulam, chancellor of England, had exposed the errors of the philosophy of the schools, and the wretched method that was there pursued. He was one of the greatest men that has ever appeared upon the earth. It was he who lighted that torch with which all his successors have illuminated philosophy; and in his writings are to be found the seeds of every new discovery, and of every new hypothesis. After this golden Aurora, the philosophic horizon was at once enlightened by two great luminaries, which dispersed many of those clouds that hid the truth from mortal eyes, and diffused great lights, at last, on many objects that lay buried in obscurity. See the article NEWTONIAN PHILOSOPHY.

From the slight draught here given of the history of philosophy, we may draw the following consequences: 1. That philosophers, in their researches concerning the causes of all things, have found themselves obliged to reduce ratiocination into a system; to confine it to certain rules, and form it into an art, which they have called Logic. 2. That by endeavouring to explain to mankind the nature, the causes, and effects of happiness, the investigation of these objects has produced a science that is called MORALITY, with which are connected the doctrines of *natural theology, the law of nature, ethics, politics, &c.* 3. That from their endeavours to investigate the nature of those sensible and palpable objects which surround us, has resulted a science that is called PHYSICS, or *Natural Philosophy*; which, in like manner, consists of several branches, that all concur to its perfection, such as OPTICS, CHYMISTRY, HYDRAULICS, MECHANICS, and their dependent arts; with many others. See the several Systems. 4. That by advancing still further, and by endeavouring to comprehend the nature and properties of subjects that are not discernable by the senses, but whose existence is the result of speculation and of a train of reasoning, a science has arisen that is called METAPHYSICS; which has also many branches, as *ontology, psychology, cosmology, pneumatology, &c.* 5. That from a desire to know the extension, the figures, the measures of all bodies, and their distances from each other, &c. they must necessarily have recourse to calculation; from whence result the *mathematical sciences*, whose principal branches are, ARITHMETIC, GEOMETRY, ALGEBRA, ASTRONOMY, &c. See the several Systems.

The essence of philosophy in general consists in the investigation of the causes of all things: and the grand principle of this enquiry consists in that fundamental maxim, that *no effect is produced without a cause*; that *nothing is done without a sufficient reason*. This system of the sufficient reason is, therefore, the basis of all philosophy, and without it nothing is philosophical. To consider the outside of things, is to know them historically;

to resolve them, in order to know their principles and their causes, is to learn to know them philosophically; and in this manner even history may be philosophically studied. This admirable system of the sufficient reason, by diffusing the spirit of philosophy in the world, has already purged it of numberless dangerous superstitions: the fables of magicians, sorcerers, spectres, ghouls, the absolute sympathy, and a thousand like reveries, have disappeared from among men of sense, to the very great advantage of the human race.

Philosophy may be again divided into *speculative*, which includes the subjects of metaphysics, morality, &c. and *demonstrative* or *experimental*, which principally regards physics; seeing that, by the improvement of the human mind by ingenious observations and the assistance of numberless admirable instruments, modern philosophers have discovered means of explaining the principal phenomena of nature by experiments, and of demonstrating their hypotheses to the sight and to the touch, which afford proofs much more evident than those of our ancestors, which were drawn merely from logical inferences.

The following Rules in Philosophy were established by Sir Isaac Newton.

1. That no more causes of a natural effect be admitted than are true, and suffice it to account for the phenomena thereof. This agrees with the sentiments of most philosophers, who hold that nature does nothing in vain; and that it were vain to do that by many things, which might be done by fewer.

2. Natural effects, therefore, of the same kind, proceed from the same causes. Thus, *e. gr.* the cause of respiration is one and the same in man and brute; the cause of a descent of a stone, the same in Europe as in America; the cause of light the same in culinary fire, and in the sun; and the cause of reflection the same in the planets as the earth.

3. Those qualities of bodies which are not capable of being heightened and remitted, and which are found in all bodies, where experiments can be made, must be looked on as universal qualities of all bodies. Thus the extension of a body is one perceived by our senses, nor is it perceivable in all bodies: but since it is found in all that we have perception of, it may be affirmed of all. So we find, that several bodies are hard; and argue that the hardness of the whole only arises from the hardness of the parts; whence we infer, that the particles, not only of those bodies which are sensible, but of all others, are likewise hard. Lastly, if all the bodies about the earth gravitate towards the earth, and this according to the quantity of matter in each; and if the moon gravitates towards the earth also, according to its quantity of matter; and the sea again gravitates towards the moon; and all the planets and comets gravitate towards each other; it may be affirmed, universally, that all bodies in the creation gravitate towards each other. This rule is the foundation of all natural philosophy.

Philosophy in general consists in the knowledge of the reason of things, in opposition to history, which is the bare knowledge of facts; or to mathematics, which is the knowledge of the quantity of things or their measures. These three kinds of knowledge ought to be joined as much as possible. History furnishes matter, principles, and practical examinations, and mathematics complete the evidence. Philosophy being the knowledge of the reasons of things, all arts must have their peculiar philosophy, which constitutes their theory: not only law and physic, but the lowest and most abject arts are not destitute of their reasons, which might usefully employ the time of the studious. It is true, those who call themselves philosophers and learned men have as yet done little towards forwarding the intelligence of arts: but we speak not of what is done, but of what ought to be done. One great obstacle to the progress of arts and sciences has been the neglect of practice in speculative men, and the ignorance and contempt of theory in mere practical men. What chimeras and absurdities the neglect of experience and practice has produced, need not be mentioned; the mischiefs arising from a neglect of theory are not so obvious: yet certainly it retards the progress of arts. All invention or improvement must be either casual or rational, including analogy, or inference from similar causes, under the term *rational*. Now although the foundations of arts have often been owing to some casual discovery, as gunpowder, or the loadstone, yet is this not to be trusted to alone. Improvements do not always flow from this source, but rather from the reflections of artists; and, if these reflections were rendered more distinct, more communicable, and easier to be retained, by the proper use of signs and other philosophical helps, great advantages might be expected: it being certain that philosophical knowledge is more extensive, and more sure in the application; and, besides, gives a pleasure to the mind not to be expected from that which is merely historical.

It is to be observed, that the bare intelligence and memory of philosophical propositions, without any ability to demonstrate them, is not philosophy, but history only. However, where such propositions are determinate and true, they may be usefully applied in practice, even by those who are ignorant of their demonstrations. Of this we see daily instances in the rules of arithmetic, practical geometry, and navigation; the reasons of which are often not understood by those who practise them with success. And this success in the application produces a conviction of mind,

which is a kind of a medium between philosophical, or scientific, and historical knowledge. The ingenious author of the *Analyst* has gone so far as to suggest, that mathematicians have no other conviction of the truth of the doctrine of fluxions. We have said that philosophy is the knowledge of the reasons of things. It may be asked, what are the reasons of things, or what is the explication of phenomena or facts? An ingenious author tells us, that the explication consists only in shewing the conformity any particular phenomenon hath to the general laws of nature; or, which is the same thing, in discovering the uniformity there is in the production of natural effects. This he thinks evident to any one whoever shall attend to the several instances wherein philosophers pretend to account for appearances. By a diligent observation of the phenomena within our view, we may discover the general laws of nature, and from thence deduce, though not demonstrate, other phenomena; all deductions of this kind depending on a superstition that the Author of Nature always operates uniformly, and in a constant observation of those rules we take for principles, which we cannot evidently know.

If we take a view of the several phenomena, and compare them together, we may observe some likenesses and conformity between them. For example, in the falling of a stone to the ground, in the rising of the sea towards the moon, in cohesion and crystallization, there is something alike, namely, an union or mutual approach of bodies: so that any one of these, or the like phenomena, may not seem strange or surprising to a man who has nicely observed and compared the effects of nature; for that only is thought so which is uncommon, or a thing by itself, and out of the ordinary course of our observation. That bodies should tend towards the centre of the earth is not thought strange, because it is what we perceive every moment of our lives; but that they should have a like gravitation towards the centre of the moon, may seem odd and unaccountable to most men, because it is discerned only in the tides; but a philosopher, whose thoughts take in a large compass of nature, having observed a certain similitude of appearances, as well in the heavens as the earth, that argue innumerable bodies to have a mutual tendency towards each other, which he denotes by the general name attraction, whatever can be reduced to that, he thinks justly accounted for. Thus he explains the tides by the attraction of the terraqueous globe towards the moon, which, to him, doth not appear odd or anomalous, but only a particular example of a general rule or law of nature. If, therefore, we consider the difference there is betwixt natural philosophers and other men, with regard to their knowledge of the phenomena, we shall find it consist not in an exact knowledge of the efficient cause that produces them, for that can be no other than the will of a spirit; but only in a greater extent of comprehension, whereby analogies, harmonies, and agreements are described in the works of nature, and the particular effects explained, that is, reduced to general rules, which rules, grounded on the analogy and uniformity observed in the production of natural effects, are more agreeable, and sought after by the mind; for that they extend our prospect beyond what is present, and near to us, and enable us to make very probable conjectures, touching things that may have happened at very great distances of time and place, as well as to predict things to come; which sort of endeavour towards omniscience is much affected by the mind. Berkeley, *Princ. of Hum. Knowledge*, Sect. 104, 105.

PHILOSOPHY is a term used in various significations among ancient and modern writers. In its laxer sense, it signifies the love of truth: thus Plato frequently calls it *philalethia*. In other places it signifies the knowledge of many things; thus Zeno calls philosophy, *καταληψις*, *comprehension*, because comprehending all truth. Agreeably to which is Cicero's definition of a philosopher, that he is one who studies to know the natures and causes of all things, human and divine, and to attend to every good rule and method of life. Cicero calls philosophy, *ars vita*, and Seneca, *lex vita*: and thus Plutarch. Constancy, fidelity, and a sound mind, are the real philosophy; and all the other parts of wisdom, tending any other way, are prettinesses and curiosities; and in this sense it was, that philosophy chiefly flourished in the school of Socrates, afterwards called the Academic School, and among the Stoics.

PHILOSOPHY, again, is frequently used by Pythagoras and Plato for metaphysics, or the knowledge of God: which Plato calls the true philosophy, others the *prima philosophia*; and in respect whereof, the Platonists call all other philosophy *nocturnal*, *νυκτερινή φιλοσοφία*. Some have given the following appellations to the ancient philosophy, under its several stages; philosophy, say they, became impious under Diagoras; vicious under Epicurus; hypocritical under Zeno; impudent under Diogenes; covetous under Democheres; voluptuous under Metrodorus; fantastical under Crates; scurrilous under Menippus; licentious under Pyrrho; and quarrelsome under Cleanthes. The several dogmata maintained by the several philosophers are infinite; Cicero makes no scruple to aver, that there is nothing in the world, how absurd soever, but has been maintained by one philosopher or other. From the first broachers of new opinions, and the first founders of schools, philosophy is become divided into innumerable

innumerable sects; some ancient, others modern; such are the Platonists, Peripatetics, Epicureans, Stoics, Pyrrhonians, and Academics; and such are the Cartesians, Newtonians, &c. See the rise, doctrines, &c. of each sect, under PERIPATETICS, EPICUREANS, STOICS, ACADEMICS, CARTESIAN, NEWTONIAN, &c. Philosophy may be divided into two branches, or it may be considered under two habitudes: theoretical and practical.

Philosophy may be divided into three parts: intellectual, moral, and physical; the intellectual part comprises logic and metaphysics; the moral part contains the laws of nature and nations, ethics and politics; and, lastly, the physical part comprehends the doctrine of bodies, animate or inanimate: these, with their various subdivisions, will take in the whole of philosophy.

Practical PHILOSOPHY, is that which lays down the rules of a virtuous and happy life; and excites us to the practice thereof. Practical philosophy is properly ethics alone, or the method of leading a virtuous and happy life. Yet most authors divide it into two kinds, answerable to the two sorts of human actions to be directed thereby; viz. 1. **LOGIC**, which governs the operations of the understanding. 2. **ETHICS**, properly so called, which direct those of the will.

PHIMOSIS, Φιμωσις, properly signifying a ligature with packthread; (Φιμωσις denoting packthread); in medicine, a disease of the penis, wherein the præputium is, by a violent inflammation, glued, or strongly constricted, upon the glands; so as not to be capable of being drawn back, to uncover the glans. Sometimes a phimosis conceals chancres on or about the glans; and sometimes it is so violent, as to prevent the flowing out of the matter; whence it causes an inflammation or mortification of the part. When the prepuce is detained behind the glans, the case is called a **PARAPHIMOSIS**. For a particular description, and the causes and cure, see the **System**, Genus 76.

PHLEGM, Φλεγμα, in chymistry, an aqueous and insipid fluid, supposed to be found in all natural bodies; coinciding with what the other philosophers call *water*. Phlegm makes the fourth of the chymical elements, or elementary principles. In the distillation of vinegar, as also of all minerals and inodorous vegetables, phlegm comes out first; in that of wine last. This phlegm is supposed to be the common vehicle and diluter of all solid bodies; and in proportion to its quantity in their mixture are the other parts more languid and disabled in their attraction: yet, on the chymist's system, phlegm should be a principle of action, as being necessary to the dissolution of the salt in bodies, and without which the salt must remain inactive. It is much to be questioned, whether this phlegm can ever be procured without some mixture of other matters; that, which has the least of them, must come nearest to the nature of a principle; and, on that account, rain-water should afford it most.

Phlegm, Boerhaave observes, drawn by distillation from vegetables, always carries with it somewhat of the smell of the vegetable, which it derives partly from the oil, and partly from the spirit residing therein. The same phlegm, by frequently reiterated distillations, lays aside most of its smell, and approaches nearer to pure water; but it never becomes perfectly such. Add, that the purest distilled water, if exposed a few days to the sun, is much changed, and rendered turbid. That phlegm is not an elementary body, Mr. Boyle argues from its different powers and properties: the phlegm of wine, and that of most liquors, have qualities that make them differ from mere water, and also from each other. In effect, the characters which serve to denominate a fluid, phlegm, or water, among the chymists, are insipidity, and volatility; yet quicksilver has both these, which nobody pretends to be phlegm. Add, that it appears, from several experiments, that water itself, by repeated distillations, may be converted into earth: yet water, the same author observes, has a much fairer pretence to an element than any other of the *tria prima*. Add, that as to the qualities which occasion that name to be given any visible substance, viz. its being fluid, insipid, and inodorous, we have never yet seen any of these separated substances, which the chymists call phlegm, which were perfectly destitute both of taste and smell. Common salt, and several other saline bodies, distilled ever so dry, will each yield a large quantity of phlegm; which can no other way be accounted for but from this, that among the various operations of the fire on the matter of a concrete, several particles of that matter are reduced to a shape and size, requisite to compose such a liquor as the chymists call phlegm or water.

PHLEGM, in the animal œconomy, is one of the four humours, whereof the ancients supposed the mass of blood to consist. Phlegm is the same that is otherwise called **PITUITA**. See that article.

PHLEGMATIC, among physicians, an appellation given to that habit or temperament of body wherein phlegm is predominant: which gives rise to catarrhs, coughs, &c. See **PITUITA**.

PHLEGMON, Φλεγμων, formed from *φλεγειν*, to burn, or inflame; in surgery, a general name for all hot or inflamed tumours, formed in the fleshy or bloody parts of the body. An inflammation, attended with a considerable swelling of the parts, constitutes a phlegmon. If the blood be good and laudable, and only peccant in quality, it is called a *true phlegmon*. When corrupted and adulterated with bile, or pituita, it is called a *bastard phlegmon*; in which case, it participates of the erysipelas, œdema, or scirrhus.

PHLOGISTON, formed of *φλογιστω*, I am inflamed, in chymistry, is defined to be the most pure and simple inflammable principle. That such a principle exists, in various degrees and modes of combination, in different bodies, is a fact which has been long and generally acknowledged. Some bodies have been observed to be capable, by exposure to fire, with the concurrence of air, of being kindled, of producing flame, of augmenting the fire, and of maintaining and supporting it; while other bodies, by exposure to fire did, indeed, become hot, red, and luminous, but were incapable of producing flame, and of maintaining fire. Hence chymists have been always led to distinguish these two kinds of bodies, calling the former combustible, and the latter incombustible; and they supposed that the inflammability of combustible bodies was the effect of a principle, which did not exist in those that were incombustible. However, some late writers have controverted this hypothesis, and the distinction founded upon it. Dr. Priestley conjectures, that the difference between the substances which are called inflammable, and others which also contain phlogiston, may be this, that in the former, heat, or the vibration occasioned by the emission of their own phlogiston, may be sufficient to occasion the emission of more till the whole be exhausted; that is, till the body be reduced to ashes. Whereas in bodies which are not inflammable, the heat occasioned by the emission of their own phlogiston may not be sufficient for this purpose, but an additional heat *ab extra* may be necessary. See the **System of AEROLOGY**, Sect. IV.

Some philosophers dislike the term phlogiston, and call the inflammable principle the elementary fire of bodies: but there seems to be no just objection against giving that or any other name to a real something, the presence or absence of which makes so remarkable a difference in bodies, as that of metallic calces and metals, oil of vitriol and brimstone, &c. and which may be transferred from one substance to another, according to certain known laws; or, as one and the same unknown cause of certain well known effects. Whereas the term fire, used to denote a constituent principle of natural bodies, is more ambiguous, because, in common acceptance, it includes heat, which has no more proper connection with phlogiston than it has with water or any other constituent part of bodies; and it will be necessary to recur perpetually to the distinction of fire in its state of action, and fire inactive or quiescent. It has been controverted among writers on this subject, whether phlogiston be pure elementary fire in its state of combination with the bodies in which it is found, if in this state it be susceptible of combining without any intermediate substance; or whether, in order to this combination, it be necessary that this element should be previously combined with some other substance, and consequently, that it is only a secondary principle? In favour of the former opinion, it is urged, that the inflammable principle of bodies cannot be separated and procured from bodies in any other state than that of free and active fire, and that it is deprived of its activity by the union it contracts with other substances. If this be the case, phlogiston has no other property than those which arise from the union of pure fire with the several substances to which it is united. But it is alleged that, on the contrary, when phlogiston is taken from one body by means of another applied to it, it unites with this as soon as it is disengaged from the former; and, therefore, the advocates of this opinion maintain, that it is not procured pure and alone, because it only quits one combination to enter at the same time into another. Senebier maintains that the phlogiston, which falls under our observation, seems to be always united to an acid: and that which appears to be the most generally combined with it is the vitriolic acid, which, at least, abounds in all combustible bodies. But he conjectures, that it is not always the same vitriolic acid that is united to phlogiston; and that the difference in the effect produced by phlogiston in the bodies, where it is found, proceeds from the different acids with which it is combined in them. Thus, when it is united with the vitriolic acid, it forms sulphur: when it is combined with sea-salt, it produces, as he says, phosphorus; and joined with nitre, it loses its qualities, and concentrates itself in bodies by means of that union.

However the question concerning the nature of phlogiston be determined, the power which chymists have of transferring the inflammable principle from one combination to another, by combustion and dissipation, has furnished them with the means of making many important observations on the effects which it produces in chymical operations, and of discovering the properties which it communicates to the several substances with which it unites. It is observed that phlogiston is not equally disposed to unite with all substances; that it combines very difficultly with fluid, volatile, and light matters, such as air and water; but it may be easily combined with solid, fixed, and heavy substances, as earths. And it serves as a kind of intermediate substance for uniting together bodies that are either incapable of uniting, or that unite with difficulty without it. The combination of phlogiston with different kinds of air, and also with water, has been illustrated and evinced by a variety of experiments by Dr. Priestley: all the kinds of air, he says, that appear to be essentially distinct from each other, are fixed air, acid, and alkaline; because these and another principle, called phlogiston, which he has not been

been able to exhibit in the form of air, and which has never yet been exhibited by itself in any form, seem to constitute all the kinds of air with which he is acquainted. See on this subject a *Traité* on the various Kinds of Cafes, by the ingenious author of the *Chymical Dictionary*, in the Appendix, c. 17.

Dr. Priestley has also shewn how common air is depraved and rendered unfit for the purposes of respiration, combustion, &c. by uniting with the phlogiston discharged from the lungs of animals, from burning bodies, from calcined metals, from putrifying substances, &c. and in some cases being saturated with it, so as thereby to become phlogisticated. And as a variety of causes contribute to the release and discharge of phlogiston from bodies in which it is combined, and from which, by certain processes, it is disengaged, which, by uniting with the air, diminishes it, precipitates its fixed air, and renders it noxious, he has discovered that vegetating plants purify the air by imbibing its phlogiston, and that the agitation of water is also conducive to the same beneficial purpose. The union of phlogiston with the vitriolic acid, in a dry state, is known to produce sulphur, the inflammability of which is caused by the phlogiston contained in it, and which is decomposed by the burning of its phlogiston. Some have even supposed, that the different combination of phlogiston with different acids may be one of the causes of the different affinities of bodies to each other. Phlogiston also unites itself with alkalis; and this union is manifest in putrid exhalations. Moreover, volatile alkalis produce the same effects that arise from the phlogiston; they render the blood more fluid, increase its circulation, and excite perspiration; and the odours of both are equally suffocating to those who breathe the air that is impregnated with them.

Moreover, phlogiston appears to be intimately combined with metals: without it they lose their metallic properties, and with it they recover them. This is a truth which has been long known and demonstrated. The difference of weight between a metal and its calx has been a phenomenon which has much puzzled the chymists and philosophers. Some, in order to account for this difference, have ascribed absolute levity to phlogiston, which, by being combined with the calx under the form of metal, diminishes its weight. The true cause of this difference was first suggested by Jean Rey, in the beginning of the last century, but for many years it was little known or regarded: however, it has been sufficiently ascertained by the experiments of Hales, Priestley, Lavoisier, &c. on *fixed AIR*.

Many facts have been lately urged to evince the identity of phlogiston and the electric matter: they resemble one another in the light and smell they afford, and in the effects they produce in animals and vegetables; they both accelerate the circulation of the blood, and of the sap; they augment the fluidity of both; they alike occasion cutaneous eruptions, remove obstructions in the vessels, irritate the muscles, and act upon them when all other stimulants are ineffectual. They concur in developing the parts of animals and vegetables; in promoting their growth; animals that are killed by lightning or by the electrical spark, seem to be effected in the same manner with those that are suffocated by mephitic or phlogistic vapours. The same causes which dissipate the electric fluid, seem also to dissipate the phlogiston, and to occasion a state of bodily inquietude in persons who are valetudinary, by depriving them of too large a quantity of phlogiston; thus, a moist and humid air affects both the one and the other in the same manner. The moments preceding thunder-storms are burthenome and oppressive, because they accumulate on the nerves too great a quantity of phlogiston, or electrical fluid.—This, like phlogiston, melts and calcines metals, and revivifies their calces.

Phlogiston and the electrical fluid are known to promote evaporation; the electrical spark infects the air, just as phlogiston does where it abounds; they both deposit fixed air, diminish common air, and form a precipitate in lime-water. From these and other similar effects, it is concluded, and not without reason, that the electric matter either is, or contains, phlogiston. For an account of several curious observations and experiments relating to phlogiston, in its connection with heat, see *HEAT, INFLAMMATION, FLAME, &c.*

Modern chymists and philosophers have ascribed a very extensive operation and use to phlogiston, in the whole economy of nature. See the Articles *BLOOD, NUTRITION, PLANT, PUTREFACTION, VEGETATION*, and the Systems of *BOTANY, CHYMISTRY*, and *AEROLOGY*.

A late author, however, in a discourse on phlogiston, has attacked the generally received doctrine concerning phlogiston; and he concludes with saying, that nothing true and certain is known concerning the nature of this principle. See on the subject of this article, *Chymical Dict.* Eng. edit. art. *PHLOGISTON*. Sennebier's *Mem. sur le Phlogistique*, &c. published in the *Abbé Rozier's Journal*; and Priestley's *Observations, &c. on Air*, in 5 vols. 8vo. passim. The ingenious and indefatigable Dr. Priestley informs the editor, that from some late experiments, not yet published, he has reason to conclude, that phlogiston is simply *inflammable AIR*, in a state of combination with any substance, just as fixed air is contained in chalk, &c. With a view of

ascertaining the nature and reality of phlogiston, he threw the focus of a burning lens on some chalk of lead, out of which all air had been expelled, when it was confined in inflammable air. The consequence was that the air was rapidly absorbed, lead was formed, and what remained of the air was just as inflammable as at first.

PHOCA, in mammalia, a genus of quadrupeds of the order *Fera*. There are six parallel fore-teeth in the upper jaw, the outermost being larger; and four blunt, parallel, distinct, equal fore-teeth in the under jaw. There is but one dog-tooth, and five or six three-pointed grinders; and the hind-feet are united so as to resemble a sheep's tail. These animals are amphibious, and described in the *System of AMPHIBIOLOGY*. There is a variety of species, the principal of which are,

1. The urfina, sea-bear, or urfine seal, has external ears. The male is greatly superior in size to the female. The bodies of each are of a conic form, very thick before, and taper to the tail. The length of a large one is eight feet; the greatest circumference five feet; near the tail, 20 inches; and the weight is about 800lb. The nose projects like that of a pug-dog, but the head rises suddenly: the teeth lock into one another when the mouth is shut; the tongue is large; the eyes are large and prominent, and may be covered at pleasure by a fleshy membrane. The length of the fore-legs is 24 inches; they are like those of other quadrupeds, not immersed in the body like those of seals; the feet are formed with toes like those of other animals, but are covered with a naked skin, so that externally they seem to be a shapeless mass; the hind-legs are fixed to the body quite behind, like those of common seals; but are capable of being brought forward, so that the animal makes use of them to scratch its head. See Plate II. Genus 11. Species 1.

These animals are found in the northern seas. They are found in amazing quantities between Kamtschatka and America, but are scarcely known to land on the Asiatic shore: nor are they ever taken except in the three Kurilean islands, and from thence in the Bobrowoie More, or Beaver Sea, as far as the Kronoski headland, off the river Kamtschatka, which comprehends only from 50 to 56 north latitude. It is observable that they never double the southern cape of the peninsula, or are found on the western side of the Penschinska sea; but their great resort has been observed to be to Bering's islands. They are as regularly migratory as birds of passage. They first appear off the three Kurile Islands and Kamtschatka in the earliest spring. There is not one female which does not come pregnant. Such as are then taken are opened, the young taken out and skinned. They are found in Bering's island only on the western shore, being the part opposite to Asia, where they first appear on their migration from the south. According to the Greenlanders, they are found in the southern parts of their country. They call it *Auvekajak*; and say that it is very fierce, and tears to pieces whatsoever it meets; that it lives on land as well as in water, and is greatly dreaded by the hunters.

During the three months of summer they lead a most indolent life: they arrive at the islands vastly fat; but during that time they are scarce ever in motion, confine themselves for whole weeks to one spot, sleep a great part of the time, eat nothing, and, except the employment the females have in suckling their young, are totally inactive. They live in families: each male has from eight to fifty females, whom he guards with the jealousy of an Eastern monarch; and though they lie by thousands on the shores, each family keeps itself separate from the rest, and sometimes, with the young and unmarried ones, amount to 120. The old animals which are destitute of females, or deserted by them, live apart, and are excessively splanetic, peevish, and quarrelsome: are exceeding fierce, and so attached to their old haunts, that they would die sooner than quit them. They are monstrously fat, and have a most hircine smell. If another approaches their station, they are roused from their indolence, and instantly snap at it, and a battle ensues; in the conflict, they perhaps intrude on the seat of another: this gives new cause of offence, so in the end the discord becomes universal, and is spread through the whole shore.

The other males are also very irascible; the causes of their disputes are generally these. The first and most terrible is, when an attempt is made by another to seduce one of their mistresses, or a young female of the family. This insult produces a combat, and the conqueror is immediately followed by the whole seraglio, who are sure of deserting the unhappy vanquished. The second reason of a quarrel is, when one invades the seat of another: the third arises from their interfering in the disputes of others.—These battles are very violent; the wounds they receive are very deep, and resemble the cuts of a sabre. At the end of a fight they fling themselves into the sea, to wash away the blood.

The males are very fond of their young, but very tyrannical towards the females; if any body attempts to take their cub, the male stands on the defensive, while the female makes off with the young in her mouth; should she drop it, the former instantly quits his enemy, falls on her, and beats her against the stones, till he leaves her for dead. As soon as she recovers, she comes in the most suppliant manner to the male, crawls to his feet,

Y y

and

and washes them with her tears: he, in the mean time, stalks about in the most insulting manner; but in case the young one is carried off, he melts into the deepest affliction, and shews all signs of extreme concern. It is probable that he feels his misfortunes the more sensibly, as the female generally brings but one at a time, and never more than two.

They swim very swiftly, at the rate of seven miles an hour. If wounded, they will seize on the boat, and carry it along with vast impetuosity, and oftentimes sink it. They can continue a long time under water. When they want to climb the rocks, they fasten with the fore-paws, and so draw themselves up. They are very tenacious of life, and will live for a fortnight after receiving such wounds as would immediately destroy any other animal.

The Kamtschatkans take them by harpooning, for they never land on their shore. To the harpoon is fastened a long line, by which they draw the animal to the boat after it is spent with fatigue; but in the chase the hunters are very fearful of too near an approach, lest the animal should fasten on, and sink their vessel.

The uses of them are not great. The flesh of the old males is rank and nauseous; that of the females is said to resemble lamb; of the young ones, roasted, a sucking-pig. The skins of the young, cut out of the bellies of the dams, are esteemed for clothing, and are sold for about three shillings and fourpence each; those of the old, for only four shillings.

2. The *leonina*, sea-lion, or bottlenose, is found near the south pole. One variety of this species is described at some length by the publisher of Anson's voyages. However, according to others who have written on this subject, the name of the sea-lion belongs not so properly to this as to another, which has a mane like a true lion. Of these we have the following account from Pernety's Historical Journal: "The hair that covers the back part of the head, neck, and shoulders, is, at least, as long as the hair of a goat. It gives this amphibious animal an air of resemblance to the common lion of the forest, excepting the difference of size. The sea-lions of the kind I speak of are 25 feet in length, and from 19 to 20 in their greatest circumference. In other respects they resemble the common sea-lions. Those of the small kind have a head resembling a mastiff's, with close-cropt ears.

"The teeth of the sea-lions which have manes, are much larger, and more solid, than those of the rest. In these, all the teeth which are inserted into the jaw-bone are hollow. They have only four large ones, two in the lower, and two in the upper, jaw. The rest are not even so large as those of a horse. I brought home one belonging to the true sea-lion, which is, at least, three inches in diameter, and seven in length, though not one of the largest. We counted 22 of the same sort in the jaw-bone of one of these lions, where five or six were wanting.

"These sea-lions that have manes are not more mischievous or formidable than the others. They are equally unwieldy and heavy in their motions; and are rather disposed to avoid, than to fall upon, those who attack them. Both kinds live upon fish and water-fowl, which they catch by surprise. They bring forth and suckle their young ones among the corn-flags, where they retire at night, and continue to give them suck till they are large enough to go to sea. In the evening you see them assembling in herds upon the shore, and calling their dams, in cries so much like lambs, calves, and goats, that, unless apprised of it, you would easily be deceived. The tongue of these animals is very good eating.

"It is said that their flesh is not absolutely disagreeable. I have not tasted it: but the oil which is extracted from their grease is of great use.

"The skins of the sea-lions are used chiefly in making port-manteaus, and in covering trunks. When they are tanned, they have a grain almost like Morocco. They are not so fine, but are less liable to tear, and keep fresh a longer time. They make good shoes and boots, which, when well seasoned, are waterproof.

"One day Mr. Guyot, and some others, brought on board five sea-lionesses. They were about seven feet long, and three and a half in circumference, though their intestines were drawn. These gentlemen had landed on a small island, where they found a prodigious number of these animals, and killed about one hundred of them with sticks. No other weapon is necessary on these occasions. A single blow with a bludgeon, three feet, or three feet and a half long, almost full at the nose of these animals, knocks them down, and kills them on the spot. This is not altogether the case with the males: their size is prodigious. Our gentlemen encountered two of them for a long time, with the same weapons, without being able to overcome them. They lodged three balls in the throat of one while he opened his mouth to defend himself, and three musket-shot in his body. The blood gushed from his wounds like wine from a tap. However, he crawled into the water and disappeared. A sailor attacked the other; and engaged him for a long time, striking him on the head with a bludgeon, without being able to knock him down: the sailor fell down very near his antagonist, but had the dexterity to reco-

ver himself at the instant the lion was going to gorge him. Had he once seized him, the man would infallibly have been lost: the animal would have carried him into the water, as they usually do their prey, and there feasted upon him. In his retreat to the sea, this animal seized a penguin, and devoured him instantaneously."

Mr. Pennant describes three seals of different species, which are called *sea-lions*, viz. the *phoca leonina*, or hooded seal; the *phoca leonina*, or bottlenose; and the *bestia marina*, or leonine seal. He differs in some particulars from the author just quoted; and such of our readers as desire to know these differences, we refer to his works.

3. The *vitulina*, sea-calf, or common seal, inhabits the European ocean. It has a smooth head, without external ears; and the common length is from five to six feet. The fore-legs are deeply immersed in the skin of the body: the hind-legs are placed in such a manner as to point directly backwards: every foot is divided into five toes; and each of these connected by a strong and broad web, covered on both sides with short hair. The toes are furnished with strong claws, well adapted to assist the animal in climbing the rocks it basks on: the claws on the hind-feet are slender and straight; except at the ends, which are a little incurved. The head and nose are broad and flat, like those of the otter; the neck short and thick; the eyes large and black; in lieu of external ears, it has two small orifices: the nostrils are oblong: on each side the nose are several long stiff hairs; and above each eye are a few of the same kind. The form of the tongue is so singular, that, were other notes wanting, that alone would distinguish it from all other quadrupeds; being forked, or slit at the end. The cutting-teeth are singular in respect to their number, being six in the upper jaw, and only four in the lower. It has two canine teeth above and below, and on each side of the jaw five grinders; the total 34. The whole animal is covered with short hair, very closely set together. The colour of that on the body is generally dusky, spotted irregularly with white; on the belly white: but seals vary greatly in their marks and colours, and some have been found entirely white. See Plate II. Genus XI. Species III.

The seal is common on most of the rocky shores of Great Britain and Ireland, especially on the northern coasts; in Wales, it frequents the coasts of Caernarvonshire and Anglesey. They inhabit all the European seas, even to the extreme north; are found far within the arctic circle, in the seas both of Europe and Asia, and are even continued to those of Kamtschatka. It preys entirely on fish, and never molests the sea-fowl: for numbers of each are often seen floating on the waves, as if in company. Seals eat their prey beneath the water; and, in case they are devouring any very oily fish, the place is known by a certain smoothness of the waves immediately above. The power of oil in stilling the waves excited by a storm is mentioned by Pliny; the moderns have made the experiment with success; and thereby made one advance towards eradicating the vulgar prejudices against that great and elegant writer.

Seals are excellent swimmers, and ready divers; and are very bold when in the sea, swimming carelessly enough about boats: their dens or lodgments are in hollow rocks or caverns near the sea, but out of the reach of the tide: in the summer they will come out of the water, to bask or sleep in the sun, on the top of large stones or shivers of rocks; and that is the opportunity our countrymen take of shooting them: if they chance to escape, they hasten towards their proper element, flinging stones and dirt behind them as they scramble along; at the same time expressing their fears by piteous moans: but if they happen to be overtaken, they will make a vigorous defence with their feet and teeth till they are killed. They are taken for the sake of their skins, and for the oil their fat yields: the former sell for 4s. or 4s. 6d. a-piece; which, when dressed, are very useful in covering trunks, making waistcoats, shot-pouches, and several other conveniences. We remember, some years ago, to have seen a young seal in some degree domesticated. It was taken at a little distance from the sea, and was generally kept in a vessel full of salt-water; but sometimes it was allowed to crawl about the house, and even to approach the fire. Its natural food was regularly procured for it, and it was taken to the sea every day, and thrown in from a boat. It used to swim after the boat, and always allowed itself to be taken back. It lived thus for several weeks; and, we doubt not, would have lived much longer, had it not been sometimes too roughly used by the boys who took it to and from the sea.

The flesh of these animals, and even of porpoises, formerly found a place at the tables of the great, as appears from the bill of fare of that vast feast that Archbishop Neville gave in the reign of Edward IV. in which is seen that several were provided on the occasion. They couple about April, on large rocks or small islands, not remote from the shore; and bring forth in those vast caverns that are frequent on our coasts: they commonly bring two at a time, which, in their infant state, are covered with a whitish down, or woolly substance. The seal-hunters in Caithness say, that their growth is so sudden, that in nine tides from their birth (108 hours) they will become as ac-

live as their parents. On the coast of that country are immense caverns opening into the sea, and running some hundreds of yards beneath the land. These are the resort of seals in the breeding time, where they continue till their young are old enough to go to sea, which is about six or seven weeks. The first of these caves is near the Ord, the last near Thrumster: their entrance is so narrow as only to admit a boat: their inside very spacious and lofty. In the month of October, or in the beginning of November, the seal-hunters enter the mouth of the caverns about midnight, and rowing up as far as they can, they land; each of them being provided with a bludgeon; and, properly stationed, they light their torches, and make a great noise, which brings down the seals from the farther end, in a confused body, with fearful shrieks and cries: at first the men are obliged to give way, for fear of being overborne; but when the first crowd is past, they kill as many as straggle behind, chiefly the young, by striking them on the nose; a very slight blow on that part dispatches them. The young seals of six weeks' age yield more oil than their emaciated dams: above eight gallons have been got from a single whelp, which sells from 6d. to 9d. per gallon; the skins from 6d. to 1s. each.

The natural history of this animal may be farther elucidated by the following extracts from a letter of the reverend Dr. William Borlase, dated October the 24th, 1763: "The seals are seen in the greatest plenty on the shores of Cornwall, in the months of May, June, and July. They are of different sizes; some as large as a cow, and from that downwards to a small calf. They feed on most sorts of fish which they can master; and are seen searching for their prey near shore, where the whistling-fish, wraws, and polacks resort. They are very swift in their proper depth of water, dive like a shot, and in a trice rise at fifty yards' distance; so that weaker fishes cannot avoid their tyranny except in shallow water. A person of the parish of Sennan saw a seal in pursuit of a mullet (that strong and swift fish); the seal turned it to and fro in deep water, as a greyhound does a hare; the mullet at last found it had no way to escape, but by running into shoal water: the seal pursued, and the former, to get more surely out of danger, threw itself on its side, by which means it darted into shoaler water than it could have swam in with the depth of its paunch and fins, and so escaped. The seal brings her young about the beginning of autumn: our fishermen have seen two sucking their dam at the same time, as she stood in the sea in a perpendicular position.— Their head in swimming is always above water, more so than that of a dog. They sleep on rocks surrounded by the sea, or on the less accessible parts of our cliffs left dry by the ebb of the tide; and if disturbed by any thing, take care to tumble over the rocks into the sea. They are extremely watchful, and never sleep long without moving; seldom longer than a minute; then raise their heads, and if they hear or see nothing more than ordinary, lie down again, and so on, raising their heads a little, and reclining them alternately in about a minute's time. Nature seems to have given them this precaution, as being unprovided with auricles or external ears; and consequently not hearing very quick, nor from any great distance.

These animals are so very useful to the inhabitants of Greenland and other arctic people, that they may be called their flocks. There are several other species of this genus, and a variety of curious particulars respecting them, which our limits permit us not to give. Such of our readers, however, as wish for further information on this subject, will find themselves amply gratified by a careful perusal of what Mr. Pennant has written on the subject, from whose labours we have extracted much of our article. See his *History of Quadrupeds*, Vol. II. p. 518, 536; his *Arctic Zoology*, Vol. I. p. 151—177; and his *British Zoology*, as also the several authors whose works he quotes.— See also Banks's *Geography*, p. 584.

PHENIX, *Phoenix*, in astronomy, a constellation of the southern hemisphere; unknown to the ancients, and invisible in our northern parts. See the *System*, Sect. VIII.

PHENICOPTERUS, or FLAMINGO, in ornithology, a genus of birds belonging to the order *Grallæ*. The beak is naked, toothed, and bent as if it was broken; the nostrils are linear; the feet are palmated, and four-toed. There is but one species; viz. the Bahamensis, a native of Africa and America. This bird resembles the heron in shape, excepting the bill, which is of a very singular form. It is two years old before it arrives at its perfect colour; and then it is entirely red, excepting the quill-feathers, which are black. A full-grown one is of equal weight with a wild-duck; and when it stands erect, it is five feet high. The feet are webbed. The flesh is delicate; and most resembles that of a partridge in taste. The tongue, above any other part, was in the highest esteem among the luxurious Romans. These birds make their nests on hillocks in shallow water: on which they sit with their legs extended down, like a man sitting on a stool. They breed on the coast of Cuba, and the Bahama islands in the West-Indies; and frequent salt-water only. By reason of the particular shape of its bill, this bird, in eating, twists its neck from side to side, and makes the upper mandible touch the ground. These birds are very stupid, and

will not rise at the report of a gun; nor is it any warning to those who survive, that they see others killed by their side: so that, by keeping himself out of sight, a fowler may kill as many as he pleases. See Plate V. Genus 82.

PHONICS, *Phonikē*, derived from *Phōnē*, voice or sound; the doctrine or science of sounds; otherwise called *acoustics*. For a copious explanation of the doctrine of Sounds, see the *System of ACOUSTICS*, throughout.

PHOSPHAT, a mineral found in Estramadura. It is of a whitish colour, and of great solidity, though not sufficiently hard to strike fire with steel. If triturated in an iron mortar in the dark, or even if two pieces be rubbed together, it becomes luminous; but when it has once lost this property, it does not, like some natural phosphori, receive it again by being exposed to the rays of the sun. If reduced to a very fine powder, and laid on coals, it does not decrepitate, but burns with a beautiful green light; though, if the coals be very hot, and the powder coarse, decrepitation will take place.

The phosphat of soda is obtained by combining the phosphoric acid with the mineral alkali. It has, we are told, been given with success as a purge; and M. Pelletier thinks it may be applied to the folding of metals instead of borax: and indeed it resembles this substance so much in many of its properties, that it has been supposed that phosphoric acid is one of the constituent principles of borax. See the *System of CHYMISTRY*, Part I. Chap. 4.

PHOSPHORUS, a name given to certain substances which shine in the dark without emitting heat. By this circumstance they are distinguished from the *pyrophori*, which though they take fire on being exposed to the air, are yet entirely destitute of light before this exposure. Phosphori are divided into several kinds, known by the names of *Bolognian Phosphorus*, *Mr. Canton's Phosphorus*, *Baldwin's Phosphorus*, *Phosphorus of Urine*, &c. of which the last is by far the most remarkable, both with respect to the quantity of light which it emits, and its property of taking fire and burning very fiercely, upon being slightly heated or rubbed. Besides these, however, it has been found that almost all terrestrial bodies, upon being exposed to the light, will appear luminous for a little time in the dark, metals only excepted. This points out a general division of the phosphori into two classes; namely, such as require to be exposed to the light either of the sun, or of some artificial fire, before they become luminous; and such as do not. Of the former kind are the Bolognian phosphorus, Mr. Canton's phosphorus, the phosphori from earthen, &c. Of the latter kind are rotten wood, skins of fishes, and the phosphorus of urine. To these we may add some other substances which become luminous in another way; viz. the mass which remains after the distillation of volatile sal-ammoniac with chalk, loaf-sugar, and the phosphorus of urine dissolved in spirit of wine. The first, which is a composition of the marine acid of the sal-ammoniac with the chalk, after being fused in a crucible, becomes luminous when struck with any hard body; white sugar is luminous, when grated or scraped in the dark; and the solution of phosphorus in spirit of wine is luminous only when dropped into water, and even then the light is only perceived where the drops fall into the liquid. One part of phosphorus communicates this property to 600,000 parts of spirit of wine. There is a remarkable difference between the light of rotten wood, fishes, and that of phosphorus of urine, even when it is not in an ignited state; for this last does not cease to be luminous even when included within an exhausted receiver, the contrary of which happens to rotten wood and fishes. If air is strongly blown upon this phosphorus from a pair of bellows, it will extinguish its light for some time, which is not the case with the other kinds. When kept in water, and placed in a warm air, the phosphorus of urine discharges such large and bright flashes into the air above it, as are apt to surprise and even frighten those who are unacquainted with it. These contractions are contracted in their passage through the water, but expand as soon as they get above it; however, the experiment can only be tried to advantage in warm weather, and in a cylindrical glass not above three-fourths filled with water.

The phenomena exhibited by the earthy phosphori are very curious; both on account of the singular circumstances in which they exhibit their light, and the varieties observed in the light itself. All these, as has been already mentioned, emit no light till they have been first exposed to the light of the sun, or some other luminous body. After that, they are luminous in the dark for a considerable time; but by degrees their light dies away, and they emit no more till after another exposure to the sun. But if this happens to be too long continued, they are then irrecoverably spoiled. The same thing will happen from being too much heated without any exposure to light. Indeed, if a phosphorus which has just ceased to be luminous, be heated, it will again emit light without any exposure to the sun; but by this its phosphoric quality is weakened, and will at last be destroyed. Indeed, these phosphori are so tender, and impatient either of light or heat, that the best method of rendering them luminous occasionally, is by discharging an electric bottle near them. The light of the flash immediately kindles the phosphorus,

P H R

phorous, and it continues luminous for a considerable time, after which it may again be revived by another flash, and so on.—However, with all the care that can be taken, these phosphori are very far from being perpetual; nor has any method been yet fallen upon to render them so.

The singularities in the light of the phosphori abovementioned are, that they emit light of many different and most beautiful colours. This difference of colours seems to be natural to them; for some will at first emit a green, others a red, others a violet, &c. at their formation. However, the best kinds agree in this strange property, that if they are exposed to a red light, they emit a red light in the dark; and the same of other colours.—But this must not be understood without limitation; nor is the phosphoreal light at any time so bright as the luminous body, whatever it was, by which it was kindled. Neither are we to imagine, that any particular phosphorus has a particular kind of light appropriated to it; for the same phosphorus which at one time emits a purple light, will at another perhaps emit a green, or a light of some other colour.

Many entertaining experiments may be made with the various kinds of phosphori, especially with that of urine. This last, however, is sometimes dangerous on account of the violence with which it burns. If dissolved in oil of cloves, it loses this property, but continues to be as luminous as before; so that this mixture, called *liquid phosphorus*, may be used with safety.—As on some occasions it may be wished to have it in powder, it is proper to observe that this may be done with safety by pouring some hot water upon the phosphorus in a glass mortar. The compound melts, and while in a soft state, is easily reducible to powder of any degree of fineness.

Acid of PHOSPHORUS. This acid, called also the *microcosmic acid*, has already been described, and the properties appertaining to it, in the System of CHYMISTRY. Since that article was written, however, it has been discovered by Mr. Schele, that an acid capable of making phosphorus is producible from calcined bones or hartshorn, and the vitriolic acid. The process for procuring this acid recommended by that gentleman was to dissolve the bones in nitrous acid; afterwards to precipitate the earth by means of the vitriolic acid; to filter and evaporate the liquor to dryness; and after drying off the nitrous acid, the phosphoric acid remains. This process, however, is expensive on account of the waste of nitrous acid; and is likewise very inconvenient, because a great deal of the earthy matter continues dissolved, even after the vitriolic acid is poured in, and therefore the phosphoric acid is never to be obtained pure; for which reason, the following process is preferable.

Take of calcined bones or hartshorn, one pound; oil of vitriol, 14 ounces. Let the bones be reduced to fine powder; then pour on the acid undiluted, and rub both together till they are as accurately mixed as possible. Having let them remain for some hours in this situation, pour on as much water, stirring and dissolving the lumps into which the mass will now be concentered, till it is all equally distributed through the liquid, and has the consistence of thick gruel. Let it remain 24 hours, and then pour it into a canvas cloth, in order to let the liquor drain from it. This is a very tedious operation, as fresh water must be continually pouring on till all the saline matter is washed off. When this is done, pour into the liquid a quantity of caustic volatile alkali, which will occasion a copious precipitation; for the earth of bones is much less strongly attracted by acids than even the caustic volatile alkali. The liquid being now filtered a second time, which will be done with sufficient ease, and afterwards evaporated, there remains a mass composed of phosphoric acid, and vitriolic sal-ammoniac. By increasing the fire, the latter is dissipated in vapour; and if the process has been successful, four ounces or more of pure phosphoric acid will remain.

With regard to the properties of this acid, it is not yet ascertained whether they are exactly the same with the microcosmic acid or not. Indeed, as far as yet appears, they seem to be different; and there are very strong reasons for supposing that the phosphoric acid, thus produced, is no other than the vitriolic altered by its combination with the earth of bones.

PHRASE, is used for a short sentence or small set or circuit of words, constructed together. In this sense, phrases are divided into complete and incomplete. Phrases are complete where are a noun and a verb, each in its proper function; i. e. where the noun expresses a subject, and the verb the thing affirmed of it. Incomplete phrases, are those where the noun and the verb together only do the office of a noun, as consisting of several words, without assuming any thing, and which might be expressed in a single word. Thus, *that which is true*, is an incomplete phrase, which might be expressed in one word, *truth*; as that which is true satisfies the mind; i. e. truth satisfies the mind. For an explanation of grammatical resolution of a sentence into its different parts of speech, see the close of the System of GRAMMAR, under the article PRAXIS.

PHRENITIS, or **PHRENZY**, in medicine, a constant and vehement delirium, or distraction; accompanied with an acute fever, raving, waking, &c. It differs from the *mania* and *melancholy*, as these are without fevers. Physicians generally make

P H Y

the phrenitis to consist in an inflammation in the meninges of the brain; and distinguish it from the *paraphrenitis*, which they suppose to be an inflammation of the diaphragm. For description, causes, prognosis, and cure, see the System, Genus 10.

PHTHIRIASIS, *Φθιριώσις*, formed from *Φθίρ*, louse, in medicine, the morbus pedicularis, or lousy disease, wherewith children, and even sometimes adults, are afflicted. Its cause is in the seeds or ova of that vermin laid in the cuticle, which here, happening to prove a proper nidus, cherishes and fosters the seed so as to hatch it. The linen cloths, used by goldsmiths to wipe their vessels with after gilding, are excellent against the phthiriasis on account of the mercury they contain; they are to be applied by rubbing the child's head.

PTHISIS, a pulmonary consumption, or a consumption arising from an ulcer, or other disorder of the lungs, accompanied with a slow hectic fever, which wastes, extenuates, and consumes the muscular flesh. For a copious description, causes, and methods of cure, in the different kinds and stages of this malady, see the System of MEDICINE, Genus 20, Article PTHISIS.

PHYSETER, or **SPERMACEI-FISH**, in the system of mammalia. There are four species; the most remarkable are,

1. The microps, or black-headed cachalot, with a long fin on the back, and the upper jaw considerably longer than the under one. A fish of this kind was cast ashore on Cramond isle, near Edinburgh, December 22d, 1769; its length was 54 feet; the penis seven feet and a half long. Linnaeus informs us, that this species pursues and terrifies the porpoises to such a degree as often to drive them on shore.

2. The catadon, or round-headed cachalot, with a fistula in the snout, and having no back fin. Of this species, a hundred and two, of different sizes, were cast on shore at one time, on one of the Orkney Isles, the largest 24 feet in length. For the method of extracting the spermaceti from the brain of these creatures, see the article SPERMACEI.

PHYSICS, or **NATURAL PHILOSOPHY**. By the word physics, in its most extensive sense, we understand *The science of the operations of nature, and of its productions*. This definition is alone sufficient to inform us, what are the particular parts of physics, and what are the means it employs to gain its ends.—Thus *NATURAL HISTORY*, or *ZOOLOGY*, *BOTANY*, and *MINERALOGY*, describe those bodies that nature produces, as far as they are discernible by our senses. So *CHYMISTRY* and *EXPERIMENTAL PHILOSOPHY* discover to us, at least in part, the composition of bodies, and the various alterations of which those compositions are susceptible. So *General and Speculative PHYSICS* draw from all these preliminary observations, from all these matters of fact, just consequences relative to the universal laws of nature, to the properties, forces, action, and essential qualities of bodies.

The object of physics being the examination of the whole frame of nature, so far as it is visible and palpable to man, it is easy to conceive, that it must form the most extensive branch of human knowledge, seeing that the operations of nature are varied almost to infinity. To reduce this immense subject into some order, philosophers have begun by dividing all the productions of this globe into three classes, which they call *kingdoms*, and distinguish into the *vegetable*, the *mineral*, and *animal kingdom*. Natural history, properly so called, teaches therefore all that is come to the knowledge of man in each of these kingdoms. Chymistry resolves all bodies, and consequently shews the manner in which they are compounded. Philosophers have likewise discovered that the universe is composed of elements, of which there are four, *EARTH*, *WATER*, *FIRE*, and *AIR*. Experimental philosophy, by numberless essays and observations, explains the manner in which these elements operate upon each other, and the effects that they produce. The knowledge of those heavenly bodies, whose various courses fill the vast expanse of the firmament, and of their properties and courses, either real or apparent, is comprised in the science of *ASTRONOMY*.

All the ancient Oriental nations, including the Hebrews and the Egyptians, were mere novices in physics; and their ignorance seems to prove the infancy of the world. The Greeks, men of a subtle and inquisitive genius, went farther, and sometimes guessed right enough, though, very rarely. Empedocles, for example, who is ranked by some among the Pythagoreans, professed the system of the four elements in nature; and added thereto two principles, which he called *principium amicitiae*, and *principium contentions*. The first, according to him, is the cause of the coalition of beings; and the second, that of their recession or separation. Was not this derived from the same origin as the celebrated system of the attraction and repulsion of bodies? Whatever was the cause, the progress of physics has ever been slow; and we are astonished when we see ancient writers of the greatest genius, as Plutarch and a hundred others, make use of such wretched reasoning when they mention those subjects that relate to physics.

Among the Romans, Lucretius and Cicero have indeed written on these subjects: but they have only related the opinions of the Greeks, which were not worthy of great regard. Seneca and Pliny went farther; and we are obliged to the latter for the useful observations

observations, which he has made on many parts of this science, although he is frequently too credulous. Pliny, moreover, does not belong to the class of dogmatic authors on physics, as he gives only an historical account of these matters.

The first ages of Christianity were the ages of darkness for all the sciences and the arts. It was not till very late, that Bacon, baron of Verulam, and some of his contemporaries, produced the first sparks of those fair lights that have since blazed forth by the happy labours of their successors. Gassendus, Descartes, Rudiger, Newton, Leibnitz, Wolff, and a multitude of other celebrated philosophers, have diffused these lights over philosophy; and all these great men have at last established that method of treating it which is alone able to discover the truth. This method is perfectly simple. They begin with establishing facts by means of experiments and observations, and draw from thence consequences relative to their causes and principles. For, as soon as experience or the senses have discovered what passes in nature, the mind endeavours to discover what cannot be distinguished by the senses; that is to say, what may be the cause or the end of each phenomenon or operation in nature; and by this means it constantly combines the accuracy of observation with the sagacity and rigour of argument.

It is certain, that a diligent observation of the subjects of mineralogy and zoology, united with the study of botany, affords every possible information relative to natural history in general; that is, we thereby acquire the historical knowledge of all the beings of this globe, that nature produces. Experimental philosophy, aided by chymistry, and several parts of the mathematics, disclose the composition of these beings, and the springs by which nature operates in their production, and in making them produce, in their turn, the mutual effect of the elements, &c. Astronomy, of which we have in like manner treated, explains the nature of the celestial bodies and their courses: and all these various sciences, united, conduct us at last, as far as the human mind is able to proceed, to the determination of the general laws of nature in the order of the universe; from whence result *universal* and *speculative physics*, of which it remains to give a cursory idea. This science, which for some thousand years has been justly called *speculative*, seeing that it has been founded altogether on vain speculations, and suppositions merely ideal, is at length supported by experiments and observations that bear the stamp of manifest demonstrations. It now forms no system, admits of no hypothesis, but such whose veracity and certainty have been previously demonstrated. For which purpose it calls to its assistance all the subordinate sciences, and makes use of their operations in the investigation and establishment of its principles.

As *mineralogy, botany, zoology, chymistry, anatomy, physiology*, and almost all the other parts of *physic, geography, experimental philosophy*, all the particular sciences which are comprised under the general denomination of *mathematics*; all those have relation to general physics, and each of them concurs, more or less, to furnish materials for its sublime operations. When, by the assistance of the labours of these, physics has established the veracity of facts, it then applies the most subtle, abstract, and profound ratiocination, to draw from thence just consequences, and to establish general principles, founded on these facts, relative to the universal laws of nature; to the celestial bodies, and the true order of the universe; to the elements, and their reciprocal action; to meteors; to bodies that are both visible and tangible; to the reciprocal action of palpable bodies; to the generation of beings in general, and of man in particular; to every production of nature in all the three kingdoms: in a word, it endeavours to account, as far as the weak lights of the human understanding are capable of accounting, for all the phenomena of heaven and earth. See all the above-mentioned sciences severally treated as they occur in the systems, and under the several articles in the order of the alphabet.

PHYSIOGNOMY, the art of knowing the humour, temperament, or disposition of a person, from observation of the lines of his face, and the characters of its members or features. The word is formed from the Greek *φύσις*, nature, and *γινωσκω*, I know. Baptista Porta and Robert Fludd are the principal modern authors of physiognomy. The ancient ones are the sophists Adamantius and Aristotle: the physiognomy of which last we have translated into Latin by De Lacuna.

This science, therefore, appears to have occupied much of the attention of ancient philosophers, and which, since the revival of learning, has in a great degree been disregarded. Till of late it has seldom in modern times been mentioned, except in conjunction with the exploded arts of alchemy, and judicial astrology. Within the two last centuries, no doubt, the bounds of human knowledge have been greatly extended by means of the patient pursuit of fact and experiment, instead of the hasty adoption of conjecture and hypothesis. We have certainly discovered many of the ancient systems to be merely creatures of imagination. Perhaps, however, in some instances, we have decided too rapidly, and rejected real knowledge, which we would have found it tedious and troublesome to acquire. Such has been the fate of the science of physiognomy; which certainly merits to be considered in a light very different from alchemy and those other fanciful studies with which it had accidentally been coupled.

It does not appear that the ancients extended the compass of physiognomy beyond man, or at least animated nature: But the study of that art was revived in the middle ages, when, misled probably by the comprehensiveness of the etymological meaning of the word, or incited by the prevalent taste for the marvellous, those who treated of the subject stretched the range of their speculation far beyond the ancient limits. The extension of the signification of the term was adopted universally by those naturalists who admitted the theory of signatures, and thus physiognomy implied the knowledge of internal properties by external appearances. Boyle admits the same signification. At present physiognomy seems to mean no more than "a knowledge of the moral character and extent of intellectual powers of human beings, from their external appearance and manners."

This, at least, we dare say; that of all the fanciful arts of the ancients, diffused among the moderns, there is none has so much foundation in nature as this. There is an apparent correspondence between the face and the mind. The features and lineaments of the one are directed by the motions and affections of the other: There is even a peculiar arrangement of the members of the face; a peculiar disposition of the countenance, to each particular affection, perhaps to each particular idea of the mind.

The foundation of physiognomy is this: the different objects that present themselves to the senses, nay, the different ideas that arise in the mind, do each make some impression on the spirits, and each an impression correspondent or adequate to its cause; therefore each a different impression. Now, if by repeated acts; or the frequent entertaining of a favourite passion, or vice, which natural temperament has hurried or custom dragged one to, the face is often put in that posture which attends such acts; the animal spirits will make such potent passages through the nerves (in which the essence of a habit consists) that the face, is sometimes unalterably set in that posture, or at least falls insensibly and mechanically into that posture, unless some present object distort it therefrom, or dissimulation hide it. This reasoning is confirmed by observation. Thus we see great drinkers with eyes generally set to the nose; the adduct muscles being often employed to put them in that posture, in order to view their loved liquor in the glass in the time of drinking; whence those muscles are also denominated *bibitory muscles*. Thus also lascivious persons are remarkable for the *oculorum mobilis petulantia*, as Petronius calls it. Hence we may account for the quakers' expecting face waiting the spirit; the melancholy face of most sectaries; the studious face of men of great application of mind, &c. In effect, does there need much penetration to distinguish the fierce look of the veteran foldier, the contentious look of the practised pleader, the solemn look of the minister of state, &c.?

Within these few years, M. Lavater, of Zurich, has attempted to revive the trade of physiognomy, and published a quarto volume on the certainty and utility of the art. His reasons for believing in it, besides those already given, are to the following purpose: "Every moment we are acting upon physiognomical principles, without being aware of it; and not men only, but the brutes also, even insects, both know their most convenient food, and their enemies, by the outside. What are we doing when we choose out some fruits as the best, or when we prefer one horse to another, but judging, from the outside, of the internal qualities? We then certainly act the physiognomist. That every man is undoubtedly a natural physiognomist, is still more apparent from considering the effects which result from the first sight of persons unknown. We are often inclined to tell our friends that we do not like the man before us, although we be in no degree acquainted with him. Whoever is an attentive observer of what passes in his own mind, knows that he no sooner sees any person, than certain attendant ideas succeed the first impression, which involve nothing less than a judgment over his dispositions of mind, so far that we pronounce him to be of a quite different cast from some others of our acquaintance. We cannot, in every case, tell exactly why we judge thus, whether it be from his figure, from his eyes, or from his nose. Nor can we always determine whether the impression be not from different ideas complicated. This is not to be learned by rule; we judge only from a feeling acquired by experience. As physiognomical practice is general, it cannot but be founded in nature; and one should think, therefore, that it possibly might be the subject of science. Does not practice always precede theoretical knowledge?"

This work gave occasion to M. Formey's attack upon the science in the Berlin Transactions for 1775. Formey strenuously controverts the extent assigned by Lavater to his favourite science.

PHYSIOLOGY, is a Greek word, which, in strict etymology, signifies that which discourses of nature: but in its common use, it is restricted to that branch of physical science which treats of the different functions and properties of living bodies; while by living bodies are meant those which are by a certain organized structure enabled to grow and propagate their kind. By this definition, physiology must necessarily have for its object the explanation of that internal organical economy in plants and animals, which nature has devised for the preservation of the individual, and for the continuance and propagation of the species. It is naturally divided into two kinds, particular and general. The former treats

P I K

of the properties and functions of the individual or species, as may be seen in the system of ANATOMY; the latter treats of those functions and properties which are general or common to all living bodies.

To the genuine naturalist no subject presents such a field of amusement and instruction. When as complete as the state of contemporary science will admit, it will exhibit a general result of all those experiments and observations that have purposely been made or occasionally contributed to illustrate the phenomena of animated matter; and when it shall reach that summit of perfection to which the efforts of genius may carry it, it may be enabled to diffuse a light, of which the naturalist of the present day can have no just or adequate conception: particularly in physic, anatomy, botany, and in natural history, its happy effects may be numerous and great. On many occasions it may there introduce order for confusion, certainty for doubt; and may be expected to enthrone science in various places which are now occupied by fancy and conjecture.

PIA Mater, in anatomy, called also *mater tenuis* and *meninx tenuis*, a fine coat, or membrane, immediately investing the brain, and lying under the *dura mater*. It is a fine thin membrane, adhering so closely, and insinuating itself in such a manner into all the folds and anfractuons parts of the brain, that it is scarce to be separated from it. See the System, Part VI. Sect. I.

PICA, in ornithology, a species of the genus *Corvus*. For description of the genus, see *CORVUS*.

PICÆ, the name of an order of birds, in the system of ornithology. For the characteristic and general description, see the System. For representation of the several genera, see Plate I.

PICUS, the **WOODPECKER**, in ornithology, a genus belonging to the order *Pica*. The beak is straight, and consists of many sides, and like a wedge at the point. There are 21 species, principally distinguished by their colour. These birds feed entirely on insects; and their principal action is that of climbing up and down the bodies or boughs of trees: for the first purpose they are provided with a long slender tongue, armed with a sharp bony end, barbed on each side, which, by the means of a curious apparatus of muscles, they can exert at pleasure, darting it to a great length into the clefts of the bark, transfixing and drawing out the insects that lurk there. They make their nests in the hollows of trees: in order therefore to force their way to those cavities, their bills are formed strong, very hard, and wedgelike at the end. Dr. Derham observes that a neat ridge runs along the top, as if an artist had designed it for strength and beauty; yet it has not power to penetrate a sound tree: their perforation of any tree is a warning to the owner to throw it down.

These birds make their nests in the hollows of trees, and lay five or six eggs, of a beautiful semi-transparent white. For representation, see Plate II. Genus 21.

Guinea PIG, the English name of a species of the genus *Mus*. For description of the genus, &c. see the article *MUS*. For representation of this species, see Plate VII. Genus 21. Species 1.

PIGEON, the English name of the genus *Columba*, in the Linnæan system of ornithology. The characters of which are, that the tongue is whole and even; the beak straight, and scurfy at the base; the nostrils long, and covered externally with a tumid membrane. Linnæus enumerates forty species. Varro observes, that they derive their Latin name *columba* from their voice or cooing. They were, and still are, in most parts of our island, in a state of nature; they breed in holes of rocks and hollows of trees. They are gregarious in their nature, lay only two eggs, and breed many times in the year, so that it is said fourteen thousand seven hundred and sixty may be produced in four years from a single pair: they bill in their courtship; the male and female sit by turns and feed their young; they cast their provision out of their craw into the young ones' mouths; they drink by continual draughts, like quadrupeds, and their notes are mournful or plaintive.

Many of them are observed to migrate into the south of England, not appearing with us till November, and retiring in the spring. Their summer haunts are probably in Sweden. The varieties produced from the domestic *pigeon* are very numerous and extremely elegant; they are distinguished by names expressive of their several properties, such as *tumblers*, *carriers*, *jacobines*, *croppers*, *powders*, *runts*, *turbits*, *owls*, *nuns*, &c. For representation, see Plate III. Genus 46. Letter B.

PIKE, in ichthyology, see *ESOX*.

The pike never swims in shoals as most other fish do, but always lies alone; and is remarkably bold and ravenous. Of the ravenous nature of this fish we shall give the following instances. At Rycott, in Oxfordshire, in the year 1749, in a moat surrounding the Earl of Abingdon's seat, there was a jack or pike of such a monstrous size, that it had destroyed young swans, feathers and all. An old cobb swan, having hatched five young, one after another was lost, till four were gone. At length an under gardener saw the fish seize the fifth. The old one fought him with her beak, and with the assistance of the gardener, released it, although he had got it under water. In the year 1765, a large pike was caught in the river Ouze, which weighed upwards of 28 pounds, and was sold for a guinea. On gutting the fish, a watch, with a

P I L

black ribbon and two steel seals were found in his stomach, which, by the maker's name, &c. was found to belong to a person who had been drowned six weeks before. For the most approved methods of catching this fish, the baits, seasons, &c. see the article **ANGLING**.

PILCHARD, in ichthyology, a fish which has a general likeness to the herring, but differs in some few particulars. The emoluments that accrue to the inhabitants of this country are great, and are best expressed in the words of Dr. W. Borlase, in his account of the Pilchard Fishery. "It employs a great number of men on the sea, training them thereby to naval affairs; employs men, women, and children, at land, in salting, pressing, washing, and cleaning; in making boats, nets, ropes, casks, and all the trades depending on their construction and sale. The poor is fed with the offals of the captures; the land with the refuse of the fish and salt; the merchant finds the gains of commission and honest commerce; the fisherman, the gains of the fish. Ships are often freighted hither with salt, and into foreign countries with the fish, carrying off at the same time part of our tin. The numbers that are taken at one shooting out of the nets is amazingly great." Mr. Pennant says, that Dr. Borlase assured him, that on the 5th of October 1767, there were at one time inclosed in St. Ives' Bay 7000 hogheads, each hoghead containing 35,000 fish, in all 245,000,000.

PILE, in medicine, a disease by physicians called *hemorrhoids*. For description, causes, prognosis, and cure, see the System, Genus 31.

PILGRIM, one who travels through foreign countries to visit holy places, and to pay his devotion to the relics of dead saints. The humour of going on pilgrimage anciently prevailed exceedingly; particularly about the time of the croisades. See the article **CROISADES**. Pilgrimages were most in vogue after the end of the eleventh century, when every one was for visiting places of devotion, not excepting kings and princes themselves; and even bishops made no difficulty of being absent from their churches on the same account. The places most visited were Jerusalem, Rome, Compostella, and Tours; but the greatest number now resort to Loretto, in order to visit the chamber of the Blessed Virgin, in which she was born, and brought up her Son Jesus, till he was twelve years of age. This chamber, it is pretended, was carried by angels into Dalmatia, about the year 1291, and afterwards, in the same manner, transported to Loretto, where a magnificent cathedral is built over it. In this chamber is the image of the Blessed Virgin, almost covered with pearls and diamonds, and round the statue there is a kind of rainbow, formed of precious stones of various colours. Five hundred thousand pilgrims have sometimes resorted to this house in one year, in order to pay their devotions before this glorious image. Several of the principal orders of knighthood were established in favour of pilgrims going to the Holy Land, to secure them from the violence and insults of the Saracens and Arabs, &c. Such were the orders of the knights Templars, the knights Hospitallers, knights of Malta, &c. The Mahometans are commanded in the Koran to perform a pilgrimage to Mecca. This is one of the capital points of their religion, and therefore a prodigious cavalcade of pilgrims annually go thither, in the company of those who are sent with the grand signior's presents to the tomb of Mahomet.

In every country where Popery was established, pilgrimages were common; and in those countries which are still popish, they continue. In England, the shrine of St. Thomas à Becket was the chief resort of the pious; and in Scotland, St. Andrew's, where, as tradition informs us, was deposited a leg of the holy apostle. In Ireland they still continue; for, from the beginning of May till the middle of August, every year, crowds of popish penitents from all parts of that country resort to an island near the centre of *Lough-jin*, or *White Lakes*, in the county of Donegal, to the amount of 3000 or 4000. These are mostly of the poorer sort, and many of them are proxies for those who are richer; some of which, however, together with some of their priests and bishops, on occasion, make their appearance there. When the pilgrim comes within sight of the holy lake, he must uncover his hands and feet, and thus walk to the water side, and is taken to the island for six pence. Here there are two chapels and 15 other houses; to which are added confessionals, so contrived, that the priest cannot see the person confessing. The penance varies according to the circumstances of the penitent; during the continuance of which (which is sometimes three, six, or nine days) he subsists on oatmeal, sometimes made into bread. He traverses sharp stones on his bare knees or feet, and goes through a variety of other forms, paying sixpence at every different confession. When all is over, the priest bores a gimblet-hole through the pilgrim's staff, near the top, in which he fastens a cross peg; gives him as many holy pebbles out of the lake as he cares to carry away, for amulets to be presented to his friends, and so dismisses him, an object of veneration to all other papists not thus initiated; who no sooner see the pilgrim cross in his hands, than they kneel down to get his blessing.

There are, however, other parts of Ireland sacred to extraordinary worship and pilgrimage; and the number of holy wells, and miraculous cures, &c. produced by them, is very great. That such things should exist in this enlightened age, and in a Protestant country, is indeed strange; but our wonder ceases, when we

PIP

that it is among the lowest, and perhaps the worst, of the people. They who carry external religion to an extreme, and place that confidence in ceremony which belongs only to the spirit of it, are seldom distinguished either for their wisdom or their virtue. We do not deny, however, that they who carry matters to the other extreme, may be equally destitute of real knowledge and genuine morality.

PIMPLE, a small pustule arising on the face. By mixing equal quantities of the juice of houseleek, *sedum minus*, passed through paper, and of spirit of wine rectified by itself, a white coagulum of a very volatile nature is formed, which Dr. Bughart commends for curing pimples of the face; and says that the thin liquor separated from it with sugarcandy is an excellent remedy for thick viscid phlegm in the breast.

PINDARIC, in poetry, an ode formed in the manner of Pindar. The Pindaric manner is distinguished by the boldness and height of the flights, the suddenness and surprise of the transitions, and the seeming irregularities, wildness, and enthusiasm of the whole.

PINE-TREE, the English name of the genus *Pinus*. For description of the genus, see **PINUS**.

PINE-APPLE, a delicious fruit; the characters of which are these: The flower consists of three oval petals, produced from the protuberance of the pyramidal fruit, which have six oval-shaped stamina, crowned with spear-shaped summits: the germen is situated below the flower, which becomes a cell, in which are lodged several angular seeds. The fruit is produced from an herbaceous plant, which has leaves resembling those of an aloe, and for the most part sawed in their edges, but much thinner. The fruit resembles the cones of the pine-tree, whence it is supposed to have its name. For a full account of the culture of pines, see the close of the System of GARDENING.

PINK, in botany, the English name of the genus *Dianthus*. See **DIANTHUS**. For the season and manner of propagating pinks, see the System of GARDENING, months of March, April, and May.

PINNATED Leaf, among botanists, see the System of BOTANY, Sect. I. and Plate I. with the explanation.

PINUS, the *Pine-tree*; a genus of the monadelphia order, belonging to the monœcia class of plants. There are 14 species; of which the most remarkable are, 1. The pinea, pinealder, or wild pine, grows naturally on the mountains in Italy and the south of France. 2. The rubra commonly called the *Scots fir* or *pine*. It is common throughout Scotland, whence its name; though it is also found in most of the other countries of Europe.

Uses. From the first species is extracted the common turpentine, much used by farriers, and from which is drawn the oil of that name. A decoction of nuts or seeds of this species in milk, or of the extremities of the branches pulled in spring, is said, with a proper regimen, to cure the most inveterate scurvy. The wood of this species is not valued; but that of the Scots pine is superior to any of the rest. It is observable of the Scots pine, that when planted in bogs, or in a moist soil, though the plants make great progress, yet the wood is white, soft, and little esteemed; but when planted in a dry soil, though the growth of the tree is there very slow, yet the wood is proportionably better. Few trees have been applied to more uses than this. The tallest and straightest are formed by nature for masts to our navy. The timber is resinous, durable, and applicable to numberless domestic purposes, such as flooring and wainscoting of rooms, making of bedsteads, chests, tables, boxes, &c. From the trunk and branches of this, as well as most others of the pine-tribe, tar and pitch is obtained. By incision, barras, Burgundy pitch, and turpentine, are acquired and prepared. The resinous roots are dug out of the ground in many parts of the Highlands, and, being divided into small splinters, are used by the inhabitants to burn instead of candles. At Loch-Broom, in Ross-shire, the fishermen make ropes of the inner bark; but hard necessity has taught the inhabitants of Sweden, Lapland, and Kamtschatka, to convert the same into bread. To effect this, they, in the spring season, make choice of the tallest and fairest trees; then stripping off carefully the outer bark, they collect the soft, white, succulent interior bark, and dry it in the shade. When they have occasion to use it, they first toast it at the fire, then grind, and, after steeping the flour in warm water to take off the resinous taste, they make it into thin cakes, which are baked for use. On this strange food the poor inhabitants are constrained to live for a whole year: and, we are told, through custom, become at last even fond of it. Linnæus remarks, that this same bark-bread will fatten swine; and humanity obliges us to wish that men might never be reduced to the necessity of robbing them of such a food. The interior bark, of which the abovementioned bread is made, the Swedish boys frequently peel off the trees in the spring, and eat raw, with greedy appetite. From the cones of this tree is prepared a diuretic oil, like the oil of turpentine, and a resinous extract, which has similar virtues with the balsam of Peru. An infusion or tea of the buds is highly commended as an antiscorbutic. The farina, or yellow powder, of the male-flowers, is sometimes in the spring carried away by the winds, in such quantities, where the trees abound, as to alarm the ignorant with the notion of its raining brimstone. The tree lives to a great age; Linnæus affirms, to 400 years.

PIP, or *Peep*, a disease among poultry, consisting of a white

PIS

thin skin, or film, that grows under the tip of the tongue, and hinders their feeding. It usually arises from want of water, or from the drinking puddle water, or eating filthy meat. It is cured by pulling off the film with the finger, and rubbing the tongue with salt. Hawks are particularly liable to this disease, especially from feeding on stinking flesh.

PIPER, *Pepper*; a genus of the trigynia order, belonging to the diandria class of plants. There are 20 species, of which the most remarkable is the siriboa, with oval, heart-shaped, nerved leaves, and reflexed spikes. This is the plant which produces the pepper so much used in food. See **PEPPER**.

The pepper exported from Malabar, which was formerly entirely in the hands of the Portuguese, and is at present divided between the Dutch, British, and French, amounts to about 10,000,000 weight. Betel, or betle, is species of this genus. See **BETEL**.

At all times of the day, and even in the night, the Indians chew the leaves of the betel, the bitterness of which is corrected by the areca that is wrapped up in them. There is constantly mixed with it the chinam, a kind of burnt lime made of shells. The rich frequently add perfumes, either to gratify their vanity or their sensuality.

It would be thought a breach of politeness among the Indians to take leave for any long time, without presenting each other with a purse of betel. It is a pledge of friendship that relieves the pain of absence. No one dares to speak to a superior unless his mouth is perfumed with betel; it would even be rude to neglect this precaution with an equal. The women of gallantry are most lavish in the use of betel, as being a powerful incentive to love. Betel is taken after meals, it is chewed during a visit, it is offered when you meet, and when you separate; in short nothing is to be done without betel. If it be prejudicial to the teeth, it assists and strengthens the stomach. At least, it is a general fashion, that prevails throughout India.

PIPIRA, in ornithology, a genus of birds of the order *Passeres*. Latham gives it the name of *manakin*, and so does Buffon, who informs us that it was bestowed upon them by the Dutch settlers in Surinam. Latham describes 25 different species, and five varieties. This genus has a considerable resemblance to the genus *Parus* or titmouse.

The most remarkable species is the *tuneful manakin*. Its length is four inches, the bill dusky, the forehead yellow, and the crown and nape blue; the chin, sides of the head below the eyes, and the throat are black; the upper part of the back, the wings, and the tail, are dusky black; the tail is very short: the lower part of the back and rump, the breast, belly, vent, and thighs, are orange-coloured; the legs are dusky. For representation, see Plate III. Genus 42. It is a native of St. Domingo, where it has gained the name of *organiste* from its note, forming the complete octave in the most agreeable manner, one note successively after another.

PIRATE, *Pyrate*, *Pirata*, *Rover*; a person, or vessel, that robs on the high seas, or makes descents on the coasts, &c. without the permission or authority of any prince or state. Alexander reproaching a pirate with his condition, was answered, "If I am a pirate, it is because I have only a single vessel; had I a fleet, I should be a mighty conqueror."

PISCES, in astronomy, the twelfth sign, or constellation, of the zodiac. See the System, Sect. IX.

PISMIRE, are a kind of insects, very common in Africa; of which there is so great a variety, and such innumerable swarms, that they destroy not only the fruits of the ground, but even men and beasts in so little time as one single night; and would, without all doubt, prove more fatally destructive to the inhabitants, were they not so happily destroyed by a proportionable number of monkeys, who greedily ferret and devour them.

PISTIL, among botanists, the female organ of generation in flowers. It is composed of three parts, the germen, the style, and the stigma: the germen supplies the place of the uterus in plants; its shape is various, but it is always situated at the bottom of the pistil, and contains the embryo seeds: the style is a part of various figures also, but is placed on the germen; in some it is extremely short, in others it seems entirely wanting: the stigma is also of various figures; its place, however, is certain, as it always stands on the top of the style, and if there is no style, on the top of the germen. The pistil is an essential part of a flower; and the principal female organ of generation; it being in this that the seeds or young plants are formed. It arises from the pedicle of the flower, or the centre of the calyx; and at length becomes the young fruit, which is sometimes hid in the calyx, and sometimes stands quite out. See the System, Sect. II. No. I. and Plate III.

PISTON, a part or member in several machines, particularly pumps, air-pumps, syringes, &c. called the *jack*. See the System of HYDRAULICS, Article V. and Plate I. Fig. 18.

PISUM, *Peas*; a genus of the decandria order, belonging to the diadelphia class of plants. There is a great variety of garden peas now cultivated in Britain, which are distinguished by the gardeners and seedsmen, and have their different titles: but as great part of these have been seminal variations, so if they are not very carefully managed, by taking away all those plants which have a tendency to alter before the seeds are formed, they will degenerate into

PIT

into their original state: therefore all those persons who are curious in the choice of their seeds, look carefully over those which they design for seeds at the time when they begin to flower, and draw out all the plants which they dislike from the other. This is what they call *roguing their peas*; meaning hereby, the taking out all the bad plants from the good, that the farina of the former may not impregnate the latter; to prevent which, they always do it before the flowers open. By thus diligently drawing out the bad, reserving those which come earliest to flower, they have greatly improved their peas of late years, and are constantly endeavouring to get forwarder varieties; so that it would be to little purpose in this place, to attempt giving a particular account of all the varieties now cultivated; therefore we shall only mention their titles by which they are commonly known; placing them according to their time of coming to the table, or gathering for use.

The golden hotspur.	Nonpareil
The Charlton.	Sugar dwarf.
The Reading hotspur.	Sickle pea.
Master's hotspur.	Marrowfat.
Essex hotspur.	Rose or crown pea.
The dwarf pea.	Rouncival pea.
The fugar pea.	Grey pea.
Spanish Morotto.	Pig pea; with some others.

The English sea-pea is found wild upon the shore in Suffex and several other counties in England, and is undoubtedly a different species from the common pea. For the cultivation of this most useful article, see the *System of GARDENING*, Article Kitchen Garden, Months January, July, October.

PIT-COAL, or *Stone-Coal*, in mineralogy, see that article.

The coal-trade is of infinite importance to Great Britain, which never could have arrived at its present commercial eminence without it; and this eminence it will be impossible to retain if coal should ever become scarce. This we trust, is not likely to be the case, though Mr. Williams expresses great fears for it, and informs us, that at Newcastle, and in many parts of Scotland, the mines near the sea, are already wasted, the first consequence of which must be an enormous rise in the price. See his observations on this subject in his *Natural History of the Mineral Kingdom* p. 156, &c. This author says, that coal was not discovered till between the middle of the 12th and beginning of the 13th centuries; it is therefore, according to him, 400 years since it was first discovered in Britain, but they have not been in common use for more than 200 years. The same author gives us many pertinent observations on the appearances and indications of coal, instructions about searching for it, remarks on false and doubtful symptoms of coal; for all which, together with his observation on the different kinds of Scots coal, we shall refer our readers to the work itself; the first part of which, occupying the largest proportion of the first volume, is upon the *strata* of coal, and on the *concomitant strata*. See also the article **COAL**.

PITS (*Brine*), the name given by the people of Worcestershire and Cheshire, to the wells or pits affording the salt water, out of which they extract the salt. In the country near where these brine pits are, the instruments used in boring, often bring up fine and hard salt; so that they give proof of there being rocks of salt in many places. The pit at Droitwich, in Worcestershire, affords no sand in boiling, nor any the least sediment of the stony matter at the bottom of the pan, and the salt is the purest of all the others: and by the people of the country, it is esteemed the most wholesome, because of its being without the sand. This and the other pits hereabouts, all have the smell of rotten eggs, especially after a little rest, as on the Monday morning after the Sunday's rest. If meat be put to pickle in the brine of these pits, instead of being preserved, it will stink in twenty four hours, sometimes in twelve, yet they yield the best salt of any inland pits in the world. For particular account, see *Brine Springs*.

PITCH, a tenacious sort of juice, or gum, drawn from fatty woods, chiefly from pines and firs; and used in shipping, in medicine, and in various other arts. Pitch is properly a juice of the wild *PINE*, or pitch-tree; and is conceived to be no other than the oil thereof inspissated, and turned black, farther than in the balsam. The best is that brought from Sweden and Norway. Its goodness consists in its being of a glossy black colour, dry, and brittle.

Burgundy PITCH, is brought to us from Saxony, and is supposed to be a preparation of the same kind with the common *ROSIN* of the shops, only divested of the oil, made by boiling the common *TURPENTINE* till it acquires a due consistence. See the *System of CHYMISTRY*, Part IV. Sect. IV.

PITH, in vegetation, the soft spongy substance contained in the central part of plants and trees. As the substance of the trunk in trees becomes more woody, the pith is compressed and straitened to such a degree, that it wholly disappears. It is plain from this, that the office of the pith in vegetation cannot be very great, since it is not of perpetual duration. By its spongy structure, it seems fitted to receive any superfluous moisture that might transude through the pores of the woody fibres. If by the recess of such moisture, or from any other cause, it happens to rot and perish, as frequently happens in elms, the tree is found to grow full as well without it; a proof it is of no essential life in vegetation.

The pith of trees is continued farther into their minute parts

PLA

than is generally conceived; the smallest branches and pendicles of the leaves and flowers have their share of it, according to the nature of the tree they belong to; and even the middle ribs of the leaves, when examined by the microscope, are not without it; a transverse section of one of these ribs of the leaf of a pithy tree shews a very beautiful arrangement of vessels, or little bladders, containing a quantity of clear liquor, and resembling in all respects those of which the pith in the branches is composed. The pith of plants, in fine, seems what the marrow is in animals, a congeries of an infinite number of vesicles, which seem destined to separate a finer juice than is necessary for the nourishment of the coarser part of the tree. It is observed of plants which have a larger than ordinary share of pith, that they produce larger quantities of flowers than others; instances of this are seen in the rose, the lilac, and the common elder: and in the ferulaceous plants, the quantity of flowers is not only profusely large, according to the great quantity of pith in their stalks, but the pith seems carried up the stalks all the way to the seeds themselves; the long seeds of the sweet myrrhis, and other the like plants, while not ripe, being only pith. *Mem. Acad. Scienc.* 1709. See also the *System of BOTANY*, Sect. II. and the article **MICROSCOPIC OBJECTS**. Of the same sort is the pith in the large growing feathers of birds; being composed of vesicles that can be distended lengthways, but have sphincters at the ends, to prevent too large a lateral dilatation. *Vid. Hales's Veget. Statics*, vol. i. p. 337.

PITUITA, one of the four humours found in the bodies of animals, on which their temperament is commonly supposed to depend. The pituita, called phlegm, is properly the most viscid and glutinous part of the blood separated in the largest glands, where the contortions of the arteries are greatest, and give the greatest retardation to the blood's velocity; as in the glands about the mouth and head. Pituita is supposed to be the prevailing humour in cold, heavy, slow people, inclined to feriousness and sludy. The pituita, discharged at the nostrils, is separated in the membrane that lines the cavity of the nose, cheeks, &c. Its use is, to keep that membrane soft, and defend it from injuries of extraneous bodies, especially those of the air, which passes this way, in respiration, when the mouth is shut.

PITUITARY Gland, is a gland in the brain somewhat difficult to be seen without removing it out of its place; and of a singular kind of substance, which seems to be neither medullary nor glandular. In figure it is transversely oval or oblong, and in the lower part in some subjects it is divided by a small notch with two lobes, like a kidney bean.

PITUITARY Membrane, is that which lines the whole internal nares, the cellular convolutions, the couchæ, the fides of the septum narium, and, by an uninterrupted continuation, the inner surface of the sinus frontales and maxillares, and of the ductus lachrymales, palatini, und sphenoidales. It is likewise continued down from the nares to the pharynx, septum palati, &c. It is so called because it separates from the arterial blood a mucilaginous lymph, called **PETUITA**. See the *System*, Part VII. Sect. III.

PLACENTA, in anatomy, a softish roundish mass, found in the womb of a pregnant woman; wherein the ancients supposed the blood was purified, and prepared for the nourishment of the fœtus. Hence they also call it *hepar uterinum*, the liver of the womb, as it did the office of a liver in preparing the blood. It is called by the moderns *placenta*, q. d. womb-cake, because in form of a cake. See the *System of MIDWIFERY*, Sect. VI.

PLAGIARY, in philology, *author-theft*; or the practice of purloining other people's works, and putting them off for a man's own. Among the Romans, *plagiarius* was properly a person who bought, sold, or retained a freeman for a slave; so called, because the Flavian law condemned such a person *ad plagus*, to be whipped. Thomasius has an express treatise *de plagio literario*; wherein he lays down the laws and measures of the right which authors have to one another's writings. Dictionary writers, at least such as meddle with arts and sciences, seem in this case to be exempted from the common laws of *meum and tuum*; they do not pretend to set up on their own bottom, nor treat the reader at their own cost. Their works are supposed, in great measure, compositions of other people; and whatever they take from others, they do it avowedly. In effect, their quality gives them a title to appropriate every thing that may be for their purpose, wherever they find it, and they do no otherwise than as the bee does for the public service. Their occupation is not pillaging, but collecting contributions; and if you ask them their authority, they will produce you the practice of their predecessors of all ages and nations.

PLAGUE, *Pestilence*, or *Pestilential Fever*, is a very acute, malignant, and contagious disease; being a putrid fever of the worst kind, and seldom failing to prove mortal. Though it is generally defined a malignant fever, Diemerbroek thinks they ought to be distinguished, since the fever is not the essence of the disease, but merely a symptom or effect of it. See the *System of MEDICINE*, Genus 6.

The plague, as is generally agreed, is never bred or propagated in Britain, but always imported from abroad, especially from the Levant, Lesser Asia, Egypt, &c. where it is very common. Sydenham has remarked that it rarely infects this country oftener than

since in 40 years, and happily we have been free of it for a much longer period.

Authors are not as yet agreed concerning the nature of this dreadful distemper. Some think that insects are the cause of it, in the same way that they are the cause of blights; being brought in swarms from other climates by the wind, when they are taken into the lungs in respiration; the consequence of which is, that they mix with the blood and juices, and attack and corrode the viscera. Mr. Boyle, on the other hand, thinks it originates from the effluvia or exhalations breathed into the atmosphere from noxious minerals, to which may be added stagnant waters and putrid bodies of every kind.

Mr. Gibbon thinks that the plague is derived from damp, hot, and stagnating air, and the putrefaction of animal substances, especially locusts. See *Gibbon's Roman History*, 4to edit. vol. iv. p. 327—332, where there is also a very particular account of the plague which depopulated the earth in the time of the Emperor Julian.

The Mahometans believe that the plague proceeds from certain spirits, or goblins, armed with bows and arrows, sent by God to punish men for their sins: and that when the wounds are given by spectres of a black colour, they certainly prove fatal, but not so when the arrows are shot by those that appear white. They therefore take no precaution to guard themselves against it. The wiser professors of this religion, however, at present act otherwise; for we find a receipt recommended by Sidy Mohammed Zerroke, one of the most celebrated Marabouts, prefaced with these remarkable words: "The lives of us all are in the hands of God, when it is we must die. However, it hath pleased him to save many persons from the plague, by taking every morning while the infection rages, one pill or two of the following composition; viz. of myrrh two parts, saffron one part, of aloes two parts, of syrup of myrtleberries, *q. s.*" But this remedy is confined to the more enlightened; for the bigotry of the lower sort is so extreme as to make them despise all precautions which people of other nations use. Of this extreme and foolish prejudice Dr. Chandler gives an interesting account when speaking of the plague at Smyrna. This learned author is of opinion that the disease arises from animalcules, which he supposes to be invisible. See *Chandler's Travels in Asia Minor*, p. 279, &c.

It is a remarkable fact, that plagues are sometimes partial, and that they only attack particular animals, or a particular description of persons, avoiding others altogether, or attacking them but slightly. Thus Furnelius informs us of a plague, or murrain, in 1514, which invaded only cats. Dionysius Halicarnassensis mentions a plague which attacked none but maids; and that which raged in the time of Gentilis, killed scarce any women, and very few but lusty men. Boterus mentions another plague, which assaulted none but the younger sort; and we have instances of the same kind of a later standing. Cardan speaks of a plague at Basil, with which the Switzers were infected, and the Italians, Germans, or French exempted; and John Utenhovius takes notice of a dreadful one at Copenhagen, which, though it raged among the Danes, spared the Germans, Dutch, and English, who went with all freedom, and without the least danger, to the houses of the infected. During the plague which ravaged Syria in 1760, it was observed that people of the soundest constitutions were the most liable to it, and that the weak and delicate were either spared or easily cured. It was most fatal to the Moors; and when it attacked them it was generally incurable.

Many methods have been adopted in different countries to prevent the importation of this dreadful scourge of the human race, and to stop the progress of infection after it has been imported. In England, mayors, bailiffs, head officers of corporations, and justices of peace, have power to tax inhabitants, houses, and lands, &c. within their precincts, for the relief of persons infected with the plague; and justices of the county may tax persons within five miles round, on a parish's inability; the tax to be levied by distress and sale of goods, or in default thereof by imprisonment. Infected persons going abroad, after being commanded to keep house for avoiding further infection, may be resisted by watchmen, &c. and punished as vagrants, if they have no fores upon them; and if they have infectious sores on them it is felony. Justices of peace, &c. are to appoint searchers, examiners, and buriers of the dead, in places infected, and administer oaths to them for the performance of their duties, &c. *Stat. 1. Jac. 1. cap. 31.* See QUARANTINE.

The commission of Moscow having, in the year 1770, invented a fumigation-powder, which, from several lesser experiments, had proved efficacious in preventing the infection of the plague; in order more fully to ascertain its virtue in that respect, it was determined, towards the end of the year, that ten malefactors, under sentence of death, should, without undergoing any other precautions than the fumigations, be confined three weeks in a lazaretto, be laid upon the beds, and dressed in the clothes which had been used by persons sick, dying, and even dead, of the plague in the hospital. The experiment was accordingly tried, and none of the ten malefactors were then infected, or have been since ill. The fumigation-powder is prepared as follows.

Powder of the first strength. Take leaves of juniper, juniper-berries pounded, ears of wheat, guaiacum-wood pounded, of each six pounds; common saltpetre pounded, eight pounds; sulphur pounded, six pounds; Smyrna tar, or myrrh, two pounds; mix all the above ingredients together, which will produce a pood of the powder of fumigation of the first strength. [N. B. A pood is 40 pounds Russian, which are equal to 35 pounds and a half or 36 pounds English avoirdupoise.]

Powder of the second strength. Take southernwood cut into small pieces, four pounds; juniper-berries pounded, three pounds; common saltpetre pounded, four pounds; sulphur pounded, two pounds and a half; Smyrna tar, or myrrh, one pound and a half; mix the above together, which will produce half a pood of the powder of fumigation of the second strength.

Odoriferous Powder. Take the root called kalmus cut into small pieces, three pounds; leaves of juniper cut into small pieces, four pounds; frankincense pounded grossly, one pound; storax pounded, and rose-flowers, half a pound; yellow amber pounded, one pound; common saltpetre pounded, one pound and a half; sulphur, a quarter of a pound: mix all the above together, which will produce nine pounds and three quarters of the odoriferous powder.

If guaiacum cannot be had, the cones of pines or firs may be used in its stead; likewise the common tar of pines and firs may be used instead of the Smyrna tar, or myrrh, and mugwort may supply the place of southernwood.

A dreadful plague raged at London in the year 1665, attended with the most destructive effects. In 1720 the city of Marseilles was visited with this destructive disease, brought in a ship from the Levant; and in seven months, during which time it continued, it carried off not less than 60,000 people. This desolation is not yet obliterated from the minds of the inhabitants; some survivors remained alive but a few years ago to transmit a traditional account of it to after ages. There are two fine pictures painted by Puget representing some of the horrid scenes of that time. "They are (says lady Craven) only too well executed. I saw several dying figures taking leave of their friends, and looking their last anxious, kind, and wishful prayers on their sick infants, that made the tears flow down my cheeks. I was told the physicians and noblemen who were assisting the sick and dying, were all portraits: I can easily conceive it; for in some faces there is a look of reflection and concern which could only be drawn from the life." *Letters*, p. 34, 35. This fatal event has caused the laws of quarantine to be very strictly enforced in the Lazaretto here, which is an extensive insulated building.

The ravages of this disease have been dreadful wherever it has made its appearance. On the first arrival of the Europeans at the island of Grand Canaria, it contained 14,000 fighting men, soon after which, two-thirds of the whole inhabitants fell a sacrifice to the plague, which had doubtless been introduced by their new visitors. The destruction it has made in Turkey in Europe, and particularly in Constantinople, must be known to every reader, and its fatal effects have been particularly heightened there by that firm belief, which prevails among the people, of predestination, &c. as has been already mentioned. It is generally brought into European Turkey from Egypt; where it is very frequent, especially at Grand Cairo. To give even a list of all the plagues which have desolated many flourishing countries, would extend this article beyond all bounds, and minutely to describe them all would be impossible. For the plague at Smyrna, we refer to Chandler's *Travels* as above. Respecting that which raged in Syria in 1760, we refer to the Abbé Mariti's *Travels* through Cyprus, Syria, and Palestine, vol. 1st, p. 278—296. This plague was one of the most malignant and fatal that Syria ever experienced; for it scarcely made its appearance in any part of the body when it carried off the patient.

PLANE, *Planum*, in geometry, denotes a plain figure, or a surface lying evenly between its bounding lines.

PLANES are frequently used in Astronomy, &c. for imaginary surfaces, supposed to cut, and pass through, solid bodies, and on this foundation it is that the whole doctrine of conic sections, and of the sphere, turns. When a plane cuts a cone parallel to one of its sides, it makes a parabola; when it cuts the cone parallel to its base, it makes a circle. The sphere is wholly explained by planes, imagined to cut the celestial luminaries, and to fill the areas or circumferences of the orbits; and they are differently inclined to each other; and by us the inhabitants of the earth; the plane of whose orbit is the plane of the ecliptic, their inclination is estimated with regard to this plane. See the *System*, Sect. IX.

PLANE, in mechanics. A *horizontal PLANE*, is a plane level or parallel to the horizon. The determining how far any given plane, &c. deviates from a horizontal one makes the whole business of LEVELLING. See the *Treatise on SURVEYING*.

PLANET, *Planeta*, $\omega\lambda\alpha\ \eta\eta\eta$, *wanderer*, in opposition to a star which remains fixed; in astronomy, a celestial body revolving round the sun as a centre, and continually changing its position with respect to the other stars. The planets are usually distinguished into *primary* and *secondary*. For a copious explanation of the doctrine of the planets, see the *System*, Section V. VI. VII. VIII. throughout.

PLANETARIUM, an astronomical machine, made to represent

sent the motions of the planets as they really are in nature, or at least agreeably to the Copernican system, and commonly called an ORRERY. For a particular description of the planetarium made by Mr. Adams, together with its uses, see the System of ASTRONOMY, Section XVI. For representation, see Plate II. Fig. I.

PLANIMETRY, *Planimetria*, that part of geometry which considers lines and plain figures; without any consideration of heights and depths. *Planimetry* is particularly restrained to the mensuration of planes and surfaces; in opposition to *Stereometry*, or the mensuration of solids. See TREATISE ON MENSURATION, Sect. I.

PLANISPHERE, a projection of a sphere, and the several circles thereof, on a plane; as upon paper or the like. In this sense, maps of the heavens and the earth, wherein are exhibited the meridians, and other circles of the sphere, are called planispheres. See the article MAP.

PLANT, *Planta*, an organical body consisting of a root, and other parts; and producing usually leaves, a stem, branches, and flowers. A plant may be defined, in Boerhaave's manner, to be an organical body composed of vessels and juices; to which body belong a root, or a part whereby it adheres to some other body, and particularly the earth, from which it derives the matter of its life and growth. A plant is distinguished from a fossil by its being organical, and consisting of vessels and juices; and from an animal, by its adhering to another body, and deriving its nourishment therefrom. That plants are organized bodies, and endued with life, is evident from many considerations; every body that has spontaneous motion must also have life; for proper and internal motion in every body depends on the spontaneous propulsion of fluids, and where this manifests itself there is life. This kind of motion in plants appears in a variety of circumstances: thus herbs in green-houses or stoves incline or turn towards the light. When shut up, if they find a hole in the wall, shutters, or frames, there they endeavour to penetrate. Several plants, in the day-time, turn their flowers towards the sun; most plants, in a serene sky, expand their flowers; but before rain shut them up, or contract them at the approach of night. The flowers of many plants hang down in the night, as if the plants were asleep, lest rain or the moist air should injure the fertilizing dust. The trefoils, &c. shut up or double their leaves before storms and tempests, but unfold them in a clear sky. The tamarind-tree is said, by Alpinus and Acolta, to enfold within its leaves the flowers or fruit every night, in order to guard them from cold or rain. Some of the sensitive plants, and the wood-forrel with pinnated leaves, upon being touched, roll up their leaves, and turn downwards or shrink, and after a little time expand them again, as if they had both life and sensation. And it farther appears, that motion is no less necessary to the vigour of plants, than exercise to the health and strength of animals. Thus plants in stoves and green-houses, though they have sufficient heat and nourishment, are slender, weak, and lose the colour of their leaves, and seem to languish for want of motion; and trees, surrounded with high walls or buildings, and confined within narrow bounds, are slender, and grow tall, but not strong.

Plant is a general name, under which are comprised all vegetable bodies, as trees, shrubs, and herbs. Trees are defined to be perennial plants, which rise to a very great height, with a simple, woody, and durable stem or trunk: and by these characters they are accurately distinguished from herbs, whose stems are frequently compound, herbaceous, or succulent, and die down to the root every year. These differences suggested the very ancient division of vegetables into herbs and trees; so that from the time of Aristotle and Theophrastus, this division has obtained a principal place in almost every system, except that of Linnæus, which mixes herbs, shrubs, and trees promiscuously together: and thus is preserved the harmony of his system, which is solely founded on the fructification of every individual genus and species. The distinction into trees and shrubs, though of equal antiquity, is neither so obvious, nor are its limits so accurately ascertained. The learned Dr. Alston, in his *Tyrocinium Botanicum*, wishes to consider the distinction into trees and shrubs as a true natural distinction, and endeavours to trace its foundation in the internal structure of the plants themselves. All trees, says he, whether they bear buds or not, are covered with two barks, the outer and inner, called by the botanists *cortex* and *liber*. Shrubs differ from herbaceous vegetables in the duration of their stems; from trees, in the nature of their covering, which is not a bark but a cuticle or simple skin: but this fact is not sufficiently ascertained. The farther distinction into shrubs and under-shrubs, which is exceedingly arbitrary and indeterminate, was first suggested by Clusius, in a work intitled *Rariores & Exoticæ Plantæ*, published in 1576; and adopted by Cæsalpinus and others. See Dr. Hunter's edition of Evelyn's *Sylva*, p. 2, note *. From the observations of Malpighi, Dr. Grew, M. Reneaume, Bradley, and others, there appears a great similitude between the mechanism of plants, and that of animals; the parts of the former bear a constant analogy to those of the latter; and the vegetable and animal economy appear both formed on the same model. For a copious description of the several parts, properties, &c. of a plant, see the System of BOTANY, Sect. II. throughout, and Plate III. For the organization or construction of timber, as viewed by the microscope, see explanation of the Plates on Microscopic Objects. For representation, see Plate III.

PLANTATION, in the islands and continent of America, a spot of ground which some planter, or person, arrived in a new colony, cultivates and tills for his own use. Plantations, or colonies in distant countries, are either such where the lands are claimed by right of occupancy only, by finding them desert and uncultivated, and peopling them from the mother-country; or where, when already cultivated, they have been either gained by conquest, or ceded to us by treaties. See COLONY. But there is a difference between these two species of colonies, with respect to the laws by which they are bound. For it hath been held (Salk. 411, 666) that if the uninhabited country be discovered and planted by English subjects, all the English laws then in being, which are the birthright of every subject, are immediately there in force. But this must be understood with very many and very great restrictions. Such colonists carry with them only so much of the English law as is applicable to their own situation and the condition of an infant colony; such, for instance, as the general rules of inheritance, and of protection, from personal injuries. But in conquered or ceded countries, that have already laws of their own, the king may indeed alter and change those laws; but, if he actually does change them, the ancient laws of the country remain, unless such as are against the law of God, as in the case of an infidel country. 7 Rep. 17. Calvin's Case. Show. Parl. cap. 31. The American plantations are principally of this latter sort, being obtained in the last century either by right of conquest and driving out the natives, or by treaties. And therefore, the common law of England, as such, has no allowance or authority there; they being no part of the mother-country, but distinct, though, till the late unhappy contest, dependent dominions. Judge Blackstone observes, they were subject, however, to the control of the parliament: whilst, on the other hand, it is as strenuously contended, that they neither are nor could be subject to the legislative authority of the parliament of Great Britain. But the litigation and decision of this question was unfortunately referred to the issue of a war, the wished-for termination of which produces alterations in the state of our American plantations, and their connection with this country. Previous to our late contest, our colonies, with respect to their interior policy, were of three sorts: viz. Provincial establishments, proprietary governments, and charter governments.

PLANTING, in gardening. For the methods of cultivating plants in general, see the respective articles, under their different heads, in the Systems of AGRICULTURE and GARDENING.

PLASTER of Paris, is a fissile stone, serving many purposes in building; and used likewise in sculpture, to mould and make statues, basso-relievos, and other decorations in architecture. It is dug out of quarries, in several parts of the neighbourhood of Paris; whence its name. See GYPSUM, and the System of CHYMISTRY, Part II. Chap. I.

PLATALEA, the spoonbill, in ornithology. For description of the genus, &c. For representation, see Plate IV. Genus LX.

PLATINA, a metallic substance, analogous to the perfect metals, and especially to gold, many of the properties of which it possesses; and, in consequence of modern experiments, is supposed to be itself a perfect metal. The name platina seems to be a diminution of *plata*, silver, and expresses the most obvious appearance of this body, which is that of silver-coloured metal in small grains. See the System of CHYMISTRY, Part III. Chap. 2. Sect. 8.

Soon after the importation of this substance into England, it was found, that the Spaniards, having discovered that it sustained all the ordinary trials of gold, possessed nearly the same specific gravity, and rendered gold much less pale than silver; had a method of adulterating gold with it, which was so brittle that it could not be refined nor applied to any use. And it is said, that in order to prevent frauds of this kind, the king of Spain ordered the mines that afforded it to be stopped up: but there is now no danger of such fraud, since modern experiments have discovered easy means for distinguishing with certainty gold debased by platina, and for completely parting the two metals, however they may be blended together by accident or by design.

It has sufficiently appeared, from many experiments, that platina is not only of itself refractory in the fire, but obstinately resists the additions and managements, by which every other known metallic body is corroded, dissolved, or changed into a vitreous state. Neither borax, nor alkali, nor nitre, which calcines all the known metallic bodies, except gold, silver, and mercury, nor common salt, nor vitriolic salts, nor the essential salts of urine, nor the phosphoric acid, nor the black flux, nor sulphur, nor earthy bodies, nor vitreous bodies, produce any material alteration in platina. However, Dr. Lewis discovered that the liver of sulphur is capable of dissolving platina, as it also does gold, by fusion. Copper seems to be most improved by being alloyed with platina. When, indeed, a large proportion of platina is added to copper, as equal parts or two-thirds, the alloy is hard, brittle, and coarse; but when a less quantity of platina is added, as from $\frac{1}{4}$ to 1-25, or even a less, a golden-coloured copper is produced, very malleable, harder, susceptible of a finer polish, smoother grained, and much less subject to calcination and rust than pure copper. The cupellation of platina was one of the most desirable discoveries with regard to this substance; because on the success of this operation depended our obtaining compact and

PLA

and malleable masses of pure platina, in the same state, with a metal which has been well fused, and of which all sorts of utensils might be made, either by casting or by forging. M. Macquer seems to make no doubt that platina may be rendered manageable by the workmen in large quantities, so as to furnish us with burning concaves, specula for telescopes, innumerable vessels and utensils for chymical and culinary uses, and almost all the works of the locksmith. He observes, that platina would for these purposes be an excellent material, as its vivid and brilliant polish is never tarnished by any kind of rust, and as it not only resists the action of air, water, fire, acids, and the voracious metals, as well as the purest gold does, but joins to these admirable qualities a property still more precious, which gold wants, viz. the force and hardness of iron. From many circumstances enumerated by Dr. Lewis, Scheffer, Margraaf, Macquer, Beaumé, &c. we may infer that platina is a mineral substance, whose metallic aspect, great weight, malleability, and perfect miscibility with all the common metallic bodies, are sufficient characters of its being a true metal, which abides fixed and unaltered in the strongest fires, is no wise scorified by nature, or by lead or bismuth, nor dissolved by vitreous bodies, and which is, therefore, a perfect metal, of the same class with gold and silver, and, perhaps, more perfect or less alterable than they; which, with the colour of silver, possesses the specific weight, and several other of the most discriminating properties, of gold: resisting, equally with gold, many agents, which discolour, corrode, dissolve, or scoriify silver, and the base metals, as air and sulphureous exhalations, the nitrous, marine, and vitriolic acids; both in their liquid state, and when resolved by fire into fume, and sulphur and antimony in fusion. With these valuable properties, it adds some to gold itself, making it both less soft and less fusible, which no other alloy does; so that hence a due proportion of it bids fair to remove those inconveniencies which the enamellers complain of, when they work upon plates either of fine gold or of alloyed gold. But, though platina undoubtedly belongs to the same genus of bodies with gold and silver, of which genus no more than these three species have been hitherto discovered; and though it agrees with gold in many of its distinctive properties, yet there are other important characters in which it remarkably differs from gold.

The sciences, commerce, and arts, must receive great advantages from the application of a new perfect metal to useful purposes, which to the fixity and indestructibility of gold, unites a hardness and solidity almost equal to those of iron, which is unalterable by the action of water and air; is not subject to rust; and resists, as well as glass or earthen vessels, all salts, even aqua-fortis and other pure acids. It is to be regretted that, although large quantities of it are found in America, it is so exceedingly rare here. But since the best chymists of Europe have examined platina, they have published certain and easy methods by which the smallest quantity of platina mixed with gold may be discovered, and by which these metals may be separated, in whatever proportion they may happen to be united. As a particular detail of these methods would exceed our bounds, we shall here relate only one of the most convenient and least troublesome. It is founded on a property which gold has, and not platina, of being capable of precipitation from aqua-regia by martial vitriol: and upon a property which platina has, and not gold, of being capable of precipitation from aqua-regia by sal-ammoniac. When therefore we would discover if gold be alloyed with platina, let it be dissolved in aqua-regia; and to this solution, which will contain both metals, let some sal-ammoniac, dissolved in water, be added; upon which the platina will be precipitated in form of a brick-coloured sediment. If, on the other side, we would know if platina contain any gold, let this platina be dissolved in aqua-regia, and to the solution add a solution of martial vitriol in water; upon which the liquor will become turbid, and the gold will form a precipitate, which may be easily separated by decanting and filtrating the liquor. We may then affirm that the reasons which induced the Spanish ministry to interdict the use of platina no longer subsist: and we hope, that, when they are once convinced of this, society will no longer be deprived of a substance which may be so advantageous to them, and which may be a new source of wealth to the crown of Spain, the sole proprietor of this precious treasure.

PLATONIC, something that relates to Plato, his school, philosophy, opinions, or the like. *Platonic Love* denotes a pure spiritual affection, subsisting between the different sexes, abstracted from all carnal appetites, and regarding no other object but the mind, and its beauties; or it is even a sincere disinterested friendship subsisting between persons of the same sex, abstracted from any selfish views, and regarding no other object but the person. The term took its rise from the philosopher Plato, a strenuous advocate for each kind. The world has a long time laughed at Plato's notions of love and friendship. In effect, they appear arrant chimeras, contrary to the intentions of nature, and inconsistent with the great law of self-preservation; which love and friendship are both ultimately resolvable into.

PLAY-HOUSE. See THEATRE, AMPHITHEATRE, &c. The most ancient English play-houses were the Curtain in Shoreditch. In the time of Shakspeare, who commenced a dramatic writer about the year 1592, there were no less than ten theatres open, four private houses, and six that were called public theatres. Most, if

PLE

not all, of Shakspeare's plays were performed either at the Globe, which was an hexagonal building, partly open to the weather, and partly covered with reeds, on the southern side of the river Thames, called the Bankside, and a public theatre, where they always acted by day-light; or at the theatre in Blackfriars, which was a private play-house, and where plays were usually represented by candle-light. Both these belonged to the same company of comedians, viz. his majesty's servants, which title they assumed after a licence had been granted them by king James, in 1603; having before this time been called the servants of the lord-chamberlain. The exhibitions at the Globe seem to have been calculated chiefly for the lower class of people, and those at Blackfriars for a more select and judicious audience. The former was a summer, and the latter a winter, theatre. Many of our ancient dramatic pieces were performed in the yards of carrier's inns, in which, in the beginning of queen Elizabeth's reign, the comedians, who then first united themselves in companies, erected an occasional stage. The form of these temporary play-houses seems to be preserved in our modern theatre. Many circumstances concur to render it probable that our ancient theatres, in general, were only furnished with curtains, which opened in the middle, and a single scene, composed of tapestry, sometimes ornamented with pictures. In the year 1605 Inigo Jones exhibited an entertainment at Oxford, in which moveable scenes were used; but they were not then used in the public theatres. When Sir William Davenant first opened, by virtue of his patent, the duke of York's theatre in Lincoln's-inn-fields, in the spring of the year 1662, with one of his own plays, the Siege of Rhodes, then scenes made their first appearance upon the English stage; and about that time actresses were also introduced, probably by him, in imitation of the foreign theatres; and Mrs. Betterton is said to have been the first woman that appeared on the English stage. Before this time, female characters were represented by boys or young men. In the time of Shakspeare, plays began at one o'clock in the afternoon, and the exhibition was usually finished in two hours; and so late as 1667, they commenced at three o'clock. See Malone's Supplemental Observations to Steevens's edition of Shakspeare.

PLEA, *Placitum*, in law, that which either party alledgeth for himself in court, in a cause then depending to be tried. Pleas are either of the crown, or common pleas.

PLEAS of the Crown comprehend all crimes and misdemeanors in which the king, on behalf of the public, is the plaintiff. Such are treasons, felonies, misprisions of either, and mayhem.

Common PLEAS, include all civil actions depending between subject and subject. The former of these were the proper object of the jurisdiction of the court of king's-bench; the latter of the court of common pleas.

Court of Common PLEAS, called also *Common-bench*. See COURT of Common Pleas.

PLEADING, *Placitatio*, a discourse spoken at the bar, in defence of the cause of a party. From the time of the conquest, all pleading was performed in French, till the time of Edward III. when it was appointed that the pleas should be pleaded in English, but that they should be entered, or recorded, in Latin. But now by 4 Geo. II. cap. 26, it is enacted, that all proceedings in courts of justice shall be in English. It is but of late years that eloquence was admitted to the bar, where it has been much practised and encouraged.

PLEASURE, the effect of a sensation, or perception, agreeable to the mind, or of the gratification of some appetite. Pleasures may be distinguished into two kinds: The first, those which anticipate, or go before the reason; such are all agreeable sensations. These are properly called pleasures of sense, or of the body. The second are those which do not precede, or anticipate, either the senses or reason. These we call pleasures of the mind. Such is the joy arising from a clear perception of some future good, or the confused sensation of the present one. For an instance of each: A man frequently finds pleasure in eating a fruit he was before unacquainted with; this is anticipating pleasure, which he feels before he knows the fruit to be good. On the other hand, a hungry hunter expects, or perhaps actually finds, victuals; where the joy he conceives is a pleasure that follows from the knowledge of his present or future good.

Pleasure and pain seem to be no other than engines in nature's hands, whereby we are directed to consult our own preservation, and avoid our ruin. To things that may contribute to the one, as food, venery, &c. she has annexed pleasure; and to those that may conduce to the other, as hunger, diseases, &c. pain. She durst not leave it to our discretion whether we would preserve and propagate the species, or not; but, as it were, constrains us to both. Were there no pleasure in eating, nor pain in hunger, what numbers would be starved, through negligence, forgetfulness, or slothfulness? What is it induces people to the office of generation, but pleasure? Without this, the world had scarce subsisted to this time. Among the multiplicity of things to be done, and to be avoided, for the preservation of animal life, &c. how should we have distinguished between the one and the other, but for the sensation of pleasure and pain? These are not only spurs to urge us on, but also guides, to direct us whither we are to go. Wherever nature has fixed a pleasure, we may take it for granted, she there enjoins her duty; and something

something is to be there done, either for the individual, or for the species. Hence it is, that our pleasures vary at different stages of life; the pleasures, e. gr. of a child, a youth, a grown man, an old man, &c. all tending to those particular things required by nature in that particular state of life, either for the preservation, simply, or jointly, for that and propagation, &c. From the different constitutions of the body, at different ages, it were very easy to account for all the particular tastes and pleasures thereof: not by deducing the pleasures mechanically from the disposition of the organs in that state, but by considering what is necessary for the perfection and well-being of the individual in that state, and what is to contribute to that of the species. In a child, e. gr. mere preservation in the present state is not enough, it must likewise grow: to bring this to pass, nature has made the returns of hunger, &c. more frequent, as well as more acute, and the pleasures of feeding more exquisite. And that the success of aliment, in proportion to the bulk of the body, may be dispensed with, she has made one of the great pleasures of the state to consist in a series of sportive exercises; by means whereof the parts of the body come to be opened and expanded, and arrive at maturity. This done, the pleasures that conduced thereto disappear; and others, suited to the new state, succeed.

PLEIADES, Πλειάδες, in astronomy, an assemblage of seven stars in the neck of the constellation Taurus. They are thus called from the Greek πλεῖν, *navigare*, a sail; as being terrible to mariners, on account of the rains and storms that frequently rise with them.

PLENITUDE, *Plenitudo*, the quality of a thing that is full, or that fills another. In physic, it is chiefly used for a redundancy of blood and humours. Physicians reckon two kinds of plenitude. The one called *ad vires*, when the abundance of the blood oppresses the patient's strength. The other *ad vasa*, when it fills the vessels too much; swelling them to a degree of bursting.

PLENUM, in physics, a term used to signify that state of things, wherein every part of space, or extension, is supposed to be full of matter. It is used in opposition to a *vacuum*, which is a space supposed devoid of all matter. The Cartesians adhere firmly to the doctrine of an absolute *plenum*. This they do on this principle, that the essence of matter consists in extension; from whence, indeed, the consequence is very easy, that wherever there is space or extension, there is also matter. But this principle we have shewn to be false; and, therefore, the consequence drawn from it falls to the ground.

PLEONASM, *Pleonasmus*, formed from πλεονασμος, q. d. superabundance, in rhetoric, a figure of speech, whereby we make use of words seemingly needless or superfluous, in order to express a thought with the greatest force and energy. Such is, I saw it with my own eyes; or, he heard it with his own ears, &c. The pleonasm is called by the Latins *redundantia*. Pleonasm, by grammarians, is usually defined a fault in discourse, wherein we say more than is necessary. M. Vaugelas will not allow the phrase, I saw it with my own eyes, to be a pleonasm; inasmuch as there are no superfluous words in it; none but what are necessary to give a stronger assurance of the thing affirmed. It is sufficient that one of the phrases say somewhat more than the other, to avoid the imputation of a pleonasm.

PLETHORA, πλεθώρα, in medicine, such an abundance of any good and laudable humour, as proves hurtful to the animal functions. Plethora is chiefly understood of the blood, though sometimes of the other humours. The *Plethora* is the consequence of a good chylification, sanguification, &c. attended with a too sparing discharge by perspiration, &c. It is usually described either as *ad vires*, or *ad vasa*. The plethora is chiefly produced in a body whose organs of digestion are strong, blood-vessels lax, diet full of good juice, temperament sanguine, mind at ease and indolent, of a middle age, and in a moist air. It renders heat and motion uneasy; it stretches the great vessels, and compresses the smaller. And hence stiffness and heaviness, and on the least occasion ruptures in the vessels, suffocations, &c. Dr. Friend makes the catamenia, or MENSES, the mere result of a plethora. Medical writers now usually distinguish four kinds of a plethora. 1. The simple plethora, which is that state of the body to which the blood is too abundant in quantity, but is as yet of no bad quality. 2. The cacochymious plethora, which is that where the blood is abundant in quantity, and at the same time is subject to a too great thickness, or some other discracy. 3. The plethora *ad vasa*, whereby the blood, from its over great quantity, renders the vessels turgid, without any farther ill effect. And 4. The plethora *ad vires*, in which there is joined to too great a plenitude of the vessels, a lassitude and torpor or numbness of the limbs.

The signs of a plethora are, 1. A florid constitution of the body. 2. A tolerable use of the nonnaturals, a good appetite to food, and a sound sleep; this is the case while the plethora is simple and unmixed; but when any commotion happens from without, the signs are inquietude at night, dreams of bleeding, and of wounds from swords or other weapons, rubicund looks in the face, and a general turgescence of the vessels; a heaviness of the limbs, an inaptitude to motion, and difficulty of breathing; a vertiginous disorder of the head, a sense of a pricking or tingling in the flesh from the slightest heat, an easy heating of the body from the weather, a moisture of the eyes, and in hysterical women a sensation as if a piece of cold ice were suddenly laid on some part of the head.

Persons most subject to a PLETHORA, are, 1. People of sedentary lives, who live high. 2. The younger rather than persons more advanced in years. 3. The female sex rather than the men. 4. All persons who have been accustomed to large evacuations, and have hastily suppressed them. And, 5. Those persons who have suddenly changed a life of labour or exercise to a sedentary one, without making the necessary changes in the non-naturals.

PLEURA, πλῆρα, derived from πλῆρες, which, primarily, signifies *side*, in anatomy, a membrane which lines the inside of the cavity of the breast, and incloses all the parts contained therein, being of the same figure and extent as the thorax itself, and of the same substance with the PERITONEUM.

The use of the pleura is to defend the inside of the thorax, and to render it smooth, that the lungs may not be hurt in their motion. See the *System of ANATOMY*, Part IV. Sect. II.

PLEURISY, *Pleurēsis*, *Pleuritis*, πλῆρις, in medicine, a violent pain in the side, attended with an acute fever, a cough, and a difficulty of breathing. The pleurisy arises from an inflammation of some part of the pleura, to which is frequently joined that of the exterior and superficial part of the lungs. This inflammation seizes any part of the integuments of the thorax, viz. either of the pleura or mediastinum; and, therefore, the pricking pain may be felt in any part of the thorax; but the place it most ordinarily infests is the side; sometimes the right, sometimes the left; sometimes higher, sometimes lower. The pleurisy sometimes succeeds another fever, occasioned by a precipitation of the febrile matter upon the pleura. When it rises to an imposthume, it is called an EMPYEMA. When it happens in the mediastinum, or diaphragma, it is called PARAPHRENITIS.

PLEURONECTES, in ichthyology, a genus belonging to the order *Thoracici*.

1. The hippoglossus, or holibut. This is the largest of the genus: some have been taken in our seas weighing from 100 to 300 pounds; but much larger are found in those of Newfoundland, Greenland, and Iceland, where they are taken with a hook and line in very deep water. They are part of the food of the Greenlanders, who cut them into large slips, and dry them in the sun. They are common in the London markets, where they are exposed to sale, cut into large pieces. They are very coarse eating, excepting the part which adheres to the side-fins, which is extremely fat and delicious, but surfeiting. They are the most voracious of all flat-fish. There have been instances of their swallowing the lead weight at the end of a line, with which the seamen were founding the bottom from on board a ship. These flat-fish swim sideways; for which reason Linnæus hath styled them *pleuronectes*.

2. The platessa, or plaice, is very common on most of our coasts, and sometimes taken of the weight of 15 pounds: but they seldom reach that size, one of eight or nine pounds being reckoned a large fish. The best and largest are taken off Rye on the coast of Sussex, and also off the Dutch coasts. They spawn in the beginning of February.

3. The flesus, or flounder, inhabits every part of the British sea, and even frequents our rivers at a great distance from the salt waters; and for this reason some writers call it the *passer fluviatilis*. It never grows large in our rivers, but is reckoned sweeter than those that live in the sea. It is inferior in size to the plaice, seldom or never weighing more than five pounds. It may very easily be distinguished from the plaice, or any other fish of this genus, by a row of sharp small spines that surround its upper sides, and are placed just at the junction of the fins with the body. Another row marks the side-line, and runs half way down the back.

4. The limanda, or dab, is found with the other species: it is in best season during February, March, and April; they spawn in May and June, and become slabby and watery the rest of summer.

5. The solea, or sole, is found on all our coasts; but those on the western shores are much superior in size to those of the north. On the former they are sometimes taken of the weight of six or seven pounds. The chief fishery for them is at Brixham in Torbay.

6. The maximus, or turbot, grows to a very large size; Mr. Pennant has seen them of 23 pounds weight, but has heard of some that weighed 30. They are taken chiefly off the north coast of England, and others off the Dutch coast. The large turbot, and several other kinds of flat-fish, are taken by the hook and line, for they lie in deep water: the method of taking them in wares, or flaked nets, is too precarious to be depended on for the supply of our great markets, because it is by mere accident that the great fish stray into them. For the classification, see the *System*, Genus 35.

PLEXUS, in anatomy, a name common to several parts in the body, consisting of bundles of little vessels, interwoven in form of net-work. The nerves, in their progress, form several *plexuses*; especially the par vagum, or eighth pair, the intercostals, and the fifth. The par vagum, at its intersection with the intercostal nerve, forms the *plexus gangliiformis superior* and inferior. A branch of this nerve joining near the heart, with others from the intercostals, forms the *plexus cardiacus superior*.

PLOVER, golden or green, *Pluvialis*, in ornithology, a species of the genus *Charadrius*. For description of the genus, see CHARADRIUS.

entary
s more
n. 4:
is, and
to have
y one;

narilly;
of the
nerein,
of the

x, and
otion.

avio
a dif-
ion of
he ex-
seizes
pleura
felt in
cells in
high-
nother
upon
n EM-
ma, it

to the

e ge-
o 300
land,
k and
reen-
fun-
e ex-
ating,
mely
ous of
the
were
swim

uro-
casts,
ldom
larger
llex,
f Fe-

sea,
aters;
It
hose
m or
dif-
row
aced
arks

it is
m in
mer.
the
On
even

Mr.
ome
Eng-
le-
for
e, or
y of
fith
35-
the
m of
les;
t the
arve,
h of
tals,

reiciv
see

CS.

*A View with Sections of Prince's American Air Pump, which is superior to Simult
 & every other modern Construction, See commencement of Section 2 System of Pneumatics*

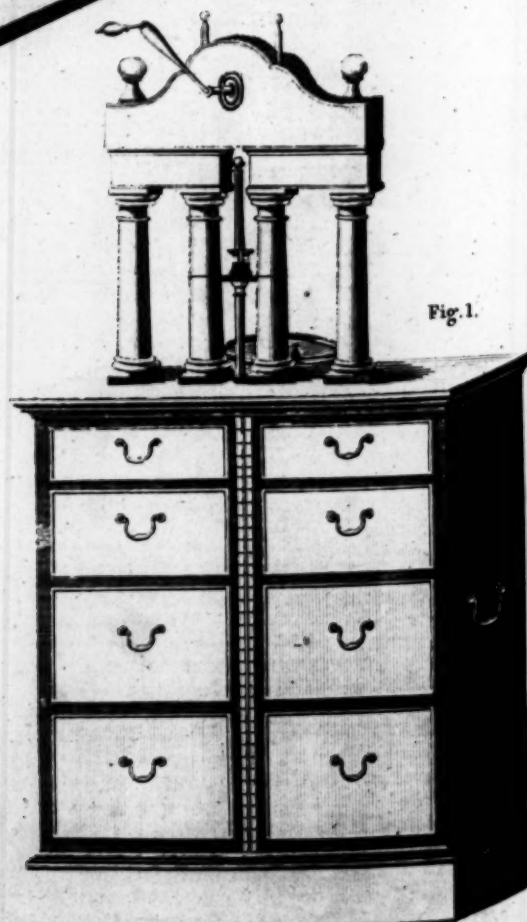
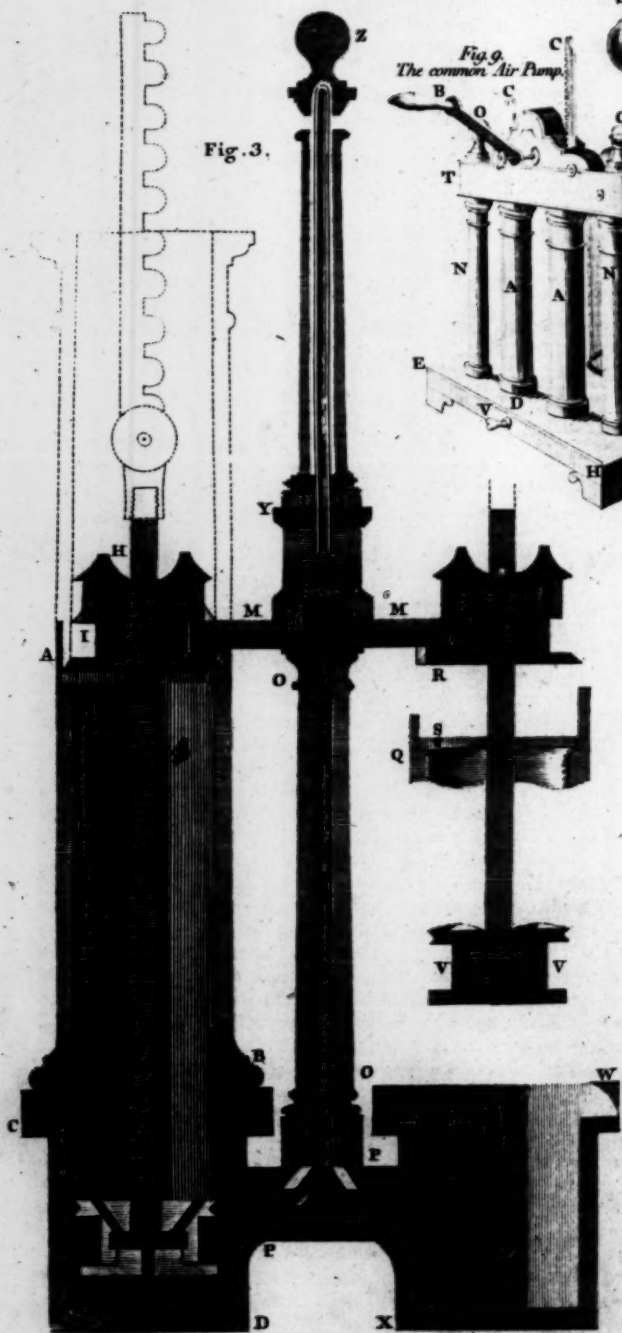
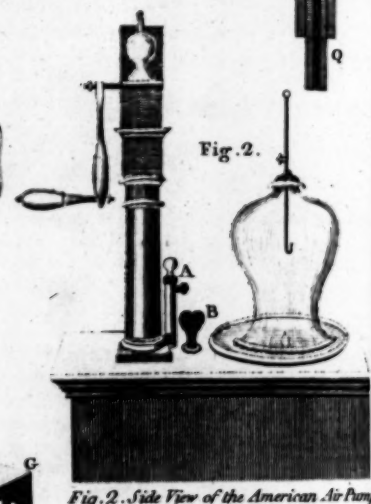
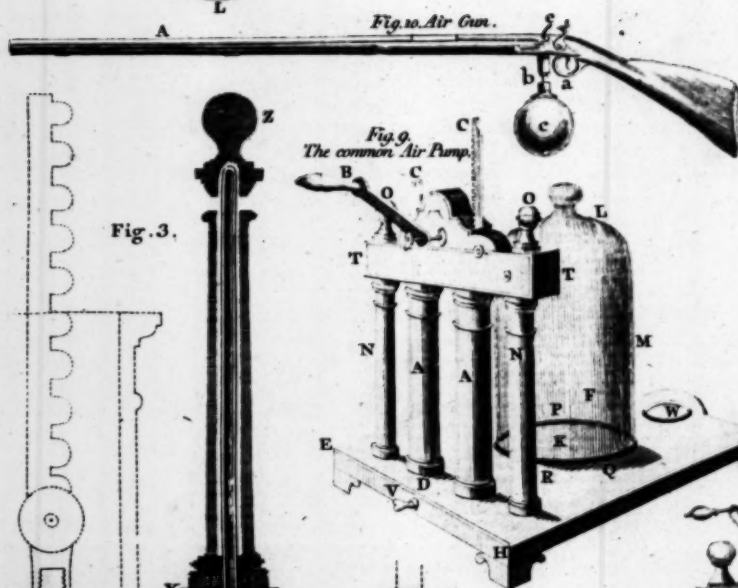
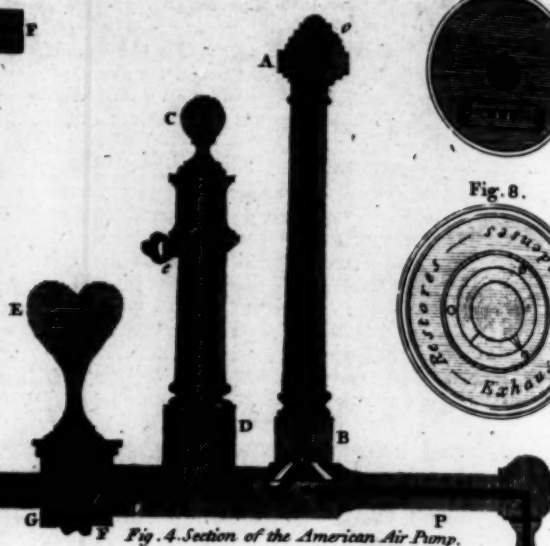
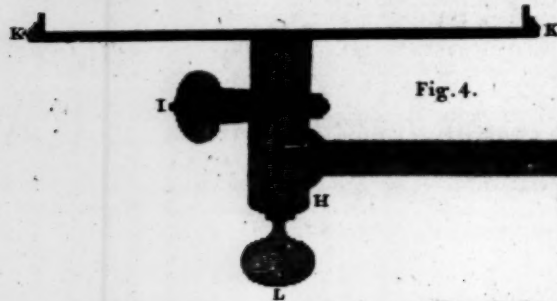
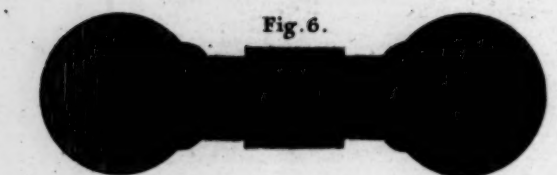
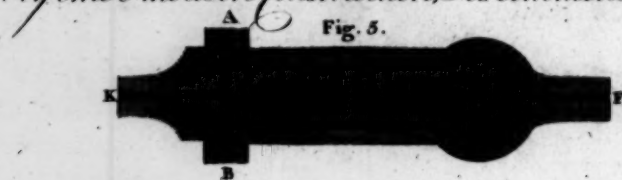


Fig. 3. Section of the American Air Pump.

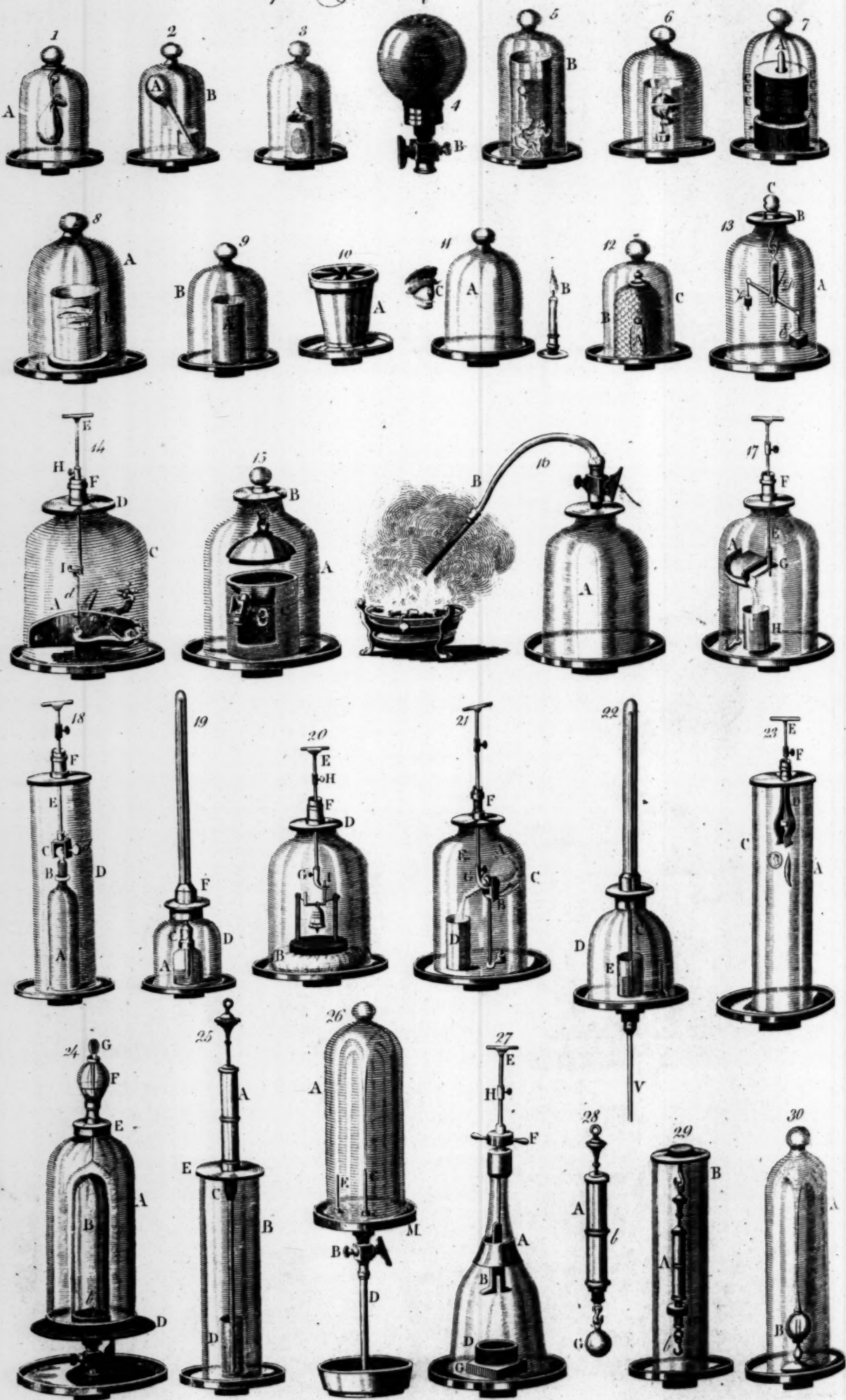
Fig. 1. Front View of the American Air Pump.

the
the

sp.

End

Experiments on the Air Pump See System of Pneumatics. Section 2. Experiment 1 to 30



SYSTEM OF PNEUMATICS.

PNEUMATICS, called also **PNEUMATOLOGY** and *Pneumatology*, among schoolmen; the doctrine and contemplation of spirits and spiritual substances, as God, angels, and the human soul; in which sense pneumatics is the same with what we otherwise call metaphysics. **PNEUMATICS** is more commonly used among us for that branch of natural philosophy which treats of the weight, pressure, and elasticity of the **AIR**, and the effects arising from it.

S E C T. I.

OF THE PROPERTIES OF AIR:

The air is that thin transparent fluid body in which we live and breathe. It encompasses the whole earth to a considerable height ; and, together with the clouds and vapours that float in it, is called the *atmosphere*. The air is justly reckoned among the number of fluids, because it has all the properties by which a fluid is distinguished. For, it yields to the least force impressed, its parts are easily moved among one another; it presses according to its perpendicular height, and its pressure is every way equal. That the air is a fluid, consisting of such particles as have no cohesion betwixt them, but easily glide over one another, and yield to the slightest impression, appears from that ease and freedom with which animals breathe in it, and move through it without any difficulty or sensible resistance. But it differs from all other fluids in the four following particulars. 1. It can be compressed into a much less space than that which it naturally possesseth. 2. It cannot be congealed or fixed, as other fluids may. 3. It is of a different density in every part, upward from the earth's surface ; decreasing in its weight, bulk for bulk, the higher it rises ; and therefore must also decrease in density. 4. It is of an elastic or spongy nature, and the force of its spring is equal to its weight. That air is a body, is evident from its excluding all other bodies out of the space it possesses : for if a glass jar be plunged, with its mouth downwards, into a vessel of water, there will be but very little water get into the jar, because the air of which it is full keeps the water out. As air is a body, it must needs have gravity or weight : and that it is weighty, is demonstrated by experiment. For, let the air be taken out of a vessel by means of the air-pump, then having weighed the vessel, let in the air again, and upon weighing it, when refilled with air, it will be found considerably heavier. Thus, a bottle that holds a wine quart, being emptied of air and weighed, is found to be about 17 grains lighter than when the air is let into it again ; which shews that a quart of air weighs 17 grains. But a quart of water weighs 1462½ grains ; thus divided by 17, quotes 860 in round numbers ; which shews, that water is 860 times as heavy as air near the surface of the earth. As the air rises above the earth's surface, it grows rarer, and consequently lighter, bulk for bulk. For since it is of an elastic or springy nature, and its lowermost parts are pressed with the weight of all that is above them, it is plain that the air must be more dense or compact at the earth's surface, than at any height above it ; and gradually rarer the higher up. For the density of the air is always as the force that compresseth it ; and therefore the air towards the upper parts of the atmosphere being less pressed than that which is near the earth, it will expand itself, and thereby become thinner than at the earth's surface. Dr. Cotes has demonstrated, that if altitudes in the air be taken in arithmetical proportion, the rarity of the air will be in geometrical proportion. For instance,

At the altitude of	7	miles above the surface of the earth, the air is	-	-	-	-	-	-	4	times thinner and lighter than at the earth's surface.
	14		-	-	-	-	-	-	16	
	21		-	-	-	-	-	-	64	
	28		-	-	-	-	-	-	256	
	35		-	-	-	-	-	-	1024	
	42		-	-	-	-	-	-	4096	
	49		-	-	-	-	-	-	16384	
	56		-	-	-	-	-	-	65536	
	63		-	-	-	-	-	-	262144	
	70		-	-	-	-	-	-	1048576	
	77		-	-	-	-	-	-	4194304	
	84		-	-	-	-	-	-	16777216	
	91		-	-	-	-	-	-	67108864	
	98		-	-	-	-	-	-	268435456	
	105		-	-	-	-	-	-	1073741824	
112	-	-	-	-	-	-	4294967206			
119	-	-	-	-	-	-	17179869184			
126	-	-	-	-	-	-	68719476736			
133	-	-	-	-	-	-	274877906944			
140	-	-	-	-	-	-	1099511627776			

And hence it is easy to prove by calculation, that a cubic inch of such air as we breathe would be so much rarefied at the altitude of 500 miles, that it would fill a sphere equal in diameter to the orbit of Saturn. The weight or pressure of the air is exactly determined by the following experiment. Take a glass tube, about three feet long, and open at one end; fill it with quicksilver, and, putting your finger upon the open end, turn that end downward, and immerse it into a small vessel of quicksilver, without letting in any air: then take away your finger, and the quicksilver will remain suspended in the tube 29½ inches above its surface in the vessel; sometimes more, and at other times less, as the weight of the air is

No. 129. VOL. III.

varied by winds and other causes: That the quicksilver is kept up in the tube by the pressure of the atmosphere upon that in the bason, is evident; for, if the bason and tube be put under a glass, and the air be then taken out of the glass, all the quicksilver in the tube will fall down into the bason; and if the air be let in again, the quicksilver will rise to the same height as before. Therefore the air's pressure on the surface of the earth is equal to the weight of $29\frac{1}{2}$ inches depth of quicksilver all over the earth's surface, at a mean rate. A square column of quicksilver, $29\frac{1}{2}$ inches high, and one inch thick, weighs just 15 pounds, which is equal to the pressure of air upon every square inch of the earth's surface; and 144 times as much, or 2160 pounds, upon every square foot; because a square foot contains 144 square inches. At this rate a middle sized man, whose surface may be about 14 square feet, sustains a pressure of 30240 pounds, when the air is of a mean gravity: a pressure which would be insupportable, and even fatal to us, were it not equal on every part, and counterbalanced by the spring of the air within us, which is diffused through the whole body, and reacts with an equal force against the outward pressure. Now since the earth's surface contains (in round numbers) 200,000,000 square miles, and every square mile 27,878,400 square feet, there must be 5,575,680,000,000,000 square feet on the earth's surface: which multiplied by 2160 pounds (the pressure on each square foot) gives 12,043,468,800,000,000,000 pounds for the pressure or weight of the whole atmosphere. When the end of a pipe is immersed in water, and the air is taken out of the pipe, the water will rise in it to the height of 33 feet above the surface of the water in which it is immersed; but it will go no higher: for it is found, that a common pump will draw water no higher than 33 feet above the surface of the well; and unless the bucket goes within that distance from the well, the water will never get above it. Now, as it is the pressure of the atmosphere on the surface of the water in the well that causes the water to ascend in the pump, and follow the piston or bucket, when the air above it is lifted up; it is evident, that a column of water 33 feet high, is equal in weight to a column of quicksilver of the same diameter, $29\frac{1}{2}$ inches high; and to as thick a column of air, reaching from the earth's surface to the top of the atmosphere. In serene calm weather, the air has weight enough to support a column of quicksilver 31 inches high; but in tempestuous stormy weather, not above 28 inches. The quicksilver thus supported in a glass tube, is found to be a nice counterbalance to the weight or pressure of the air, and to shew its alterations at different times. And being now generally used to denote the changes in the weight of the air, and of the weather consequent upon them, it is called the *barometer*, or *weather-glass*. See BAROMETER. The pressure of the air being equal on all sides of a body exposed to it, the softest bodies sustain this pressure without suffering any change in their figure; and so do the most brittle bodies without being broken.

S E C T. II.

DESCRIPTION OF THE COMMON AIR-PUMP AND ITS USES.

The air-pump is one of the most useful of all philosophical instruments, whose actions depend on the properties of the air. By the help of this machine, all that has been shewn concerning the weight and elasticity of the air, is demonstrated in the most simple and elegant manner. Its construction is as follows: EFGH (*fig.* 9, Plate III.) is a square table of wood; AA are two strong barrels or tubes of brass, firmly retained in their position by the piece TT which is pressed on them by screws OO, fixed on the tops of the brass pillars NN. These barrels communicate with a cavity in the lower part D. At the bottom within each barrel is fixed a valve, opening upwards, and in each a piston works, having a valve likewise opening upwards. The pistons are moved by a cog-wheel in the piece TT, turned by the handle B, and whose teeth catch in the racks of the pistons CC. PQR is a circular brass plate, having near its center the orifice K of a concealed pipe, that communicates with the cavity; in the piece D at V is a screw that closes the orifice of another pipe, for the purpose of admitting the external air when required. LM is a glass receiver, out of which the air is to be exhausted. It is placed on the plate PQR, first covered with a wet sheep-skin, or smeared with wax, to prevent the air from insinuating under the edge of the glass. When the handle B is turned, one of the pistons is raised, and the other depressed; a void space is consequently left between the raised piston and the lower valve in the correspondent barrel: the air contained in the receiver LM, communicating with the barrel by the orifice K, immediately raises the lower valve by its spring, and expands into the void space; and thus a part of the air in the receiver is extracted. The handle then being turned the contrary way, raises the other piston, and performs the same act in its correspondent barrel; while, in the mean time, the first mentioned piston being depressed, the air, by its spring, closes the lower valve, and, raising the valve in the piston, makes its escape. The motion of the handle being again reversed, the first barrel again exhausts while the second discharges the air in its turn: and thus, during the time the pump is worked, one barrel exhausts the air from the receiver, while the other discharges it through the valve in its piston. Hence it is evident, that the vacuum in the receiver of the air-pump can never be perfect; that is, the air can never be entirely exhausted:

B b b

fo

PNEUMATICS.

For it is the spring of the air in the receiver that raises the valve, and forces air into the barrel, and the barrel at each exsuction can only take away a certain part of the remaining air, which is in proportion to the quantity before the stroke, as the capacity of the barrel is to that of the barrel and receiver added into one sum. This, however, is an imperfection that is seldom, if ever, of any consequence in practice, because all air-pumps, at a certain period of the exhaustion, cease to act, on account of their imperfect construction. For the valves usually consist of a piece of oiled bladder, tied over a hole, so that the air is at liberty to pass, by lifting up the bladder, but cannot return again, and there will unavoidably be a small space left between the lower valve and the piston when down. Now it will happen, when the air in the receiver is very rare, that its spring will not be strong enough to overcome the adhesion of the bladder forming the lower valve, which, consequently, will remain shut, and the exhaustion cannot proceed. Or, before this period, it may happen that the air between the valves, when the piston is up, may be so small as to lie in the space between the two valves when the piston is down, without being sufficiently condensed for its spring to overcome the adhesion of the bladder forming the upper valve, and the weight of the atmosphere that presses it: in this case the upper valve will remain shut, and the exhaustion cannot proceed. In the best air-pumps these imperfections are in a great degree removed. For the adhesion of the bladders is much diminished, and the action of the air upon them increased, by substituting a number of large holes of passage, instead of one smaller. By causing the rod of the piston to pass through a collar of leathers, screwed to the upper part of the barrel, and placing another valve for the passage of the extruded air, the pressure of the atmosphere is prevented from acting on the piston, so that the whole spring of the air between the piston and the lower valve is exerted in overcoming the resistance afforded by the valve of the piston. There are also contrivances for opening a communication between the receiver and the barrel, without depending on the spring of the air. One of the best of these consists in an additional piece that lifts the lower valve when a lever is pressed with the foot: the lever communicates with the interior piece, by means of a rod that passes through a collar of leathers at the lower end of the barrel. The best sort of air-pumps are usually made with a single barrel. In measuring the exhaustion, there are two methods of proceeding. The one shews the density of the air left in the receiver, without regarding such vapours as may assume an elastic form in the vacuum: the other exhibits the spring of the elastic fluid in the receiver, without shewing whether it be permanently elastic air. The quantity of air is shewn by an instrument called the pear-gage. It consists of a glass vessel, in form of a pear, with graduations near its upper end, that denote certain known parts of its bulk. This is included in the receiver, together with a vessel of mercury, into which its mouth may be occasionally plunged. When the exhaustion is made, the pear-gage is plunged into the mercury, and the external air admitted into the receiver. The mercury rises in the gage, and occupies the whole of its cavity, except a space at top, possessed by a bubble of air, whose magnitude is known from the graduations, and is in proportion to the whole contents of the gage, as the quantity of air in the exhausted receiver is to an equal volume of the common atmospherical air. This gage would be accurate for all purposes, if it were not that the moist fluid or moist substances assume an elastic form when the pressure of the atmosphere is removed. For this reason it seldom indicates the elasticity or actual pressure of the fluid remaining in the receiver. The barometer gage is used for this purpose. If a barometer be included beneath a receiver, the mercury will stand at the same height as in the open air; but when the receiver begins to be exhausted, the mercury will descend, and rest at a height which is in proportion to its former height, as the spring of the remaining air is to its original spring before the exhaustion. It is usual to say, the air is as many times rarer than the atmosphere, as the column it sustains is less than the height the mercury stands at in a detached barometer. On account of the inconvenience of including a barometer in a receiver, a tube of six or eight inches in length is filled with mercury, and inverted in the same manner as the barometer. This being included, answers the same purpose, with no other difference than that the mercury does not begin to descend till about three-fourths of the air is exhausted. It is called the short barometer gage. Others place a tube, of a greater length than the barometer, with its lower end in a vessel of mercury, while its upper end communicates with the receiver. Here the mercury rises as the exhaustion proceeds, and the pressure of the remaining air is shewn by the difference between its height and that of the barometer. This is called the long barometer gage. These gages are not often constructed so as to answer the purpose of shewing the degree of exhaustion to a great degree. For the mercury though at first boiled, to clear it of the air and moisture that adhere to it, and to render it sensibly lighter, gradually becomes again contaminated by exposure to the air in the basin of either gage. They cannot, therefore, with strictness, be compared with a good barometer, in which this does not happen. If the tubes of the gages be less than half an inch in diameter, the mercury will be sensibly repelled downwards, so as to require a correction for the long gage when compared with a barometer, whose tube is of a different bore, and to render the short

gage useless in great exhaustions. Thus, for example, if the short gage have a tube of one-tenth of an inch in diameter, the mercury will fall to the level of the basin when the exhaustion is 150 times, and will stand below the level for all greater degrees of rarefaction.

These difficulties may all be removed, by making the short gage in the form of an inverted syphon, with one leg open, and the other hermetically sealed. It must be confessed, however, that it is not easy to boil the mercury in these; and the method of doing it with success cannot, with sufficient conciseness, be described here.

Few air-pumps exhaust to so great a degree as one-thousand times by the barometer gage: but the pear-gage, in some circumstances, will indicate an exhaustion of many thousand times. Several of the uses of the air-pump have already been mentioned. The weight of the air is shewn by exhausting it out of a bottle; and its pressure is proved to be the cause of the ascent of the mercury in the barometer, because in the vacuum it is no longer sustained. It will be proper to subjoin a few more instances. If a square bottle, in whose neck is fixed a valve, opening outwards, be placed under the receiver, and the air exhausted, the bottle will be crushed to pieces by the weight of the atmosphere, when the air is permitted to return into the receiver. For the air is prevented from entering the bottle by the valve, which, before the exhaustion, sustained the pressure of the atmosphere on its external surface, by means of the spring of the included air acting equally on the internal surface; but in this experiment, being deprived of its internal air, it is incapable of bearing the weight of the atmosphere which presses it on all sides. If the bottle were round, instead of square, it would sustain the pressure, notwithstanding the exhaustion, by reason of its arched figure, that would prevent its giving way inwards.

Explanation of the Use and Construction of Prince's American Air-Pump, as represented in Plate III.

Fig. 1. A view of the pump when opened and uncovered for experiments. *Fig. 3.* A perpendicular section of one of the barrels, the two cisterns, condensing gage, &c. where AB represents the barrel: CD the cistern on which it stands; a a a the leathered joint sunk into a socket, and buried in oil: EF the piston; the cylindrical rod passing through a collar of leathers, GG, in the box HI; K shows the place of the valve on the plate KL covered by the cross piece MM, into which the pipe OO is soldered, that conveys the air from the valve to the duct, going under the valve-pump, as may be seen in *fig. 4*; p is part of the said duct; P is the joint sunk into a socket, in the cross piece PP, which connects the cisterns, and has a duct through it leading to them. Into this duct open the ducts q and r, the first leading to the gage in front of the pump, the other to the cock and receiver. The other barrel is left out of the figure, to show some of the parts more distinctly; except QQ, which is the top of the barrel retained and brought down out of its place to show the top plate, that shuts up the barrel, separated from the box which contains the collar of leathers. S shows one of the holes in the plate over which the valve lies, and which is covered by R in the cross piece. VV is the piston, showing the valve open on the top, which is to prevent labour when the pump condenses. WX is the cistern, in which is more distinctly seen the shoulder for the leather which closes the joint between this and the barrel, and also the socket in which the oil lies over the leather. YZ is the condensing gage with the orifice of the tube raised above the surface of the quicksilver; ee is the collar of leathers through which the glass tube moves; i is a small pipe coming through the quicksilver to make a communication between the valves and the gage.

Fig. 7. is a view of the upper surface of the top plate which closes the barrel, being folded into it, showing the place of the valve over the three small holes, one of which only can be seen at S in *fig. 3*.

Fig. 4. is a perpendicular section of the bottom piece, pipes, valve-pump, cock, &c. at right-angles with the other section (*fig. 3*). AB is the pipe between the barrels. The button o is here screwed into the top instead of the gage; CD is the valve-pump and its cistern; e the place of the valve under the tap. EF the cock, showing the duct through it leading to the atmosphere; GH the pipe leading from it to the stem of the receiver plate, in which is the cock. I to shut up the duct when the plate is used as a transferer; KK is the plate; L a piece to shut up the hole into which tubes, &c. are occasionally screwed to perform experiments without removing the plate: the pricked line at O shows the place of the screws which presses the plate against the pipe; PQ the pipe and common gage standing in front of the pump.

Fig. 5. is a horizontal section of the cock and pieces, containing the ducts leading from it to the receiver, the cisterns and the valves on the tops of the barrels; AB the duct connecting the cisterns together, CD the duct leading from the cisterns to the cock, GH the duct leading from the cock through the pipe AB (*fig. 4*) to the valves, DE the duct through the cock, which occasionally connects the two last-mentioned ducts with the duct EF, leading from the cock to the receiver, I the duct in the cock, leading to the atmosphere, which, when connected with the duct at D, lets the air into the cisterns and barrels for condensation; the other duct through the cock at the same time connecting H and E. This duct also, when connected with E, restores the equilibrium in the receiver; KL is part of the duct leading from the cisterns to the gage; the pricked circles show the places of the pipe and the valve-pump.

PNEUMATICS.

pump, on the piece, and the place where the air enters the valve-pump from the duct GH, and is thrown into the atmosphere when the pump exhausts.

Fig. 6, shows the under surface of the boxes, which contain the collar of leather, with the cross piece which connects them together, having a duct through it, as represented by the pricked line, through which the air passes from the valves to the pipe: this figure is designed chiefly to show the places in which the valves play, as at I.

Fig. 7, is a side-view of the pumps, showing the situation of the valve-pump and handle of the cock, where A is the pump, and B the handle.

Fig. 8, is the top plate, which screws the key of the cock into its shell, and keeps it tight; the upper surface of it is marked with directions to turn the key so as to produce the effect desired; for when the mark on the key agrees with the mark on the plate, the pump exhausts, and so of the rest.

Mr. Prince has endeavoured to remedy the defects of former air-pumps, and to form one more perfect, upon very simple principles. Mr. Smeaton had already done much to facilitate the opening of the valves at the bottom of the barrel, and in the piston, by which means he carried the degree of rarefaction much farther than it could be carried by the common pump. Mr. Prince, therefore, justly supposed that if those valves were entirely removed, the air in the barrel would be more perfectly expelled, and the rarefaction carried still further. It is upon this principle that Mr. Prince has constructed his pump, removing the lower valve, and opening the bottom of the barrel into a cistern on which it is placed, and which has a free communication with the receiver; for the valve on the plate at the top of the barrel renders it unnecessary that there should be any at the bottom, in order to rarely the air in the receiver. The next advantage obtained by Mr. Prince, is that of expelling the air more perfectly out of the barrel than can be done by Mr. Smeaton's construction; and this he effects by forming a better vacuum between the piston and the top-plate; but this, as well as other peculiarities, will be plain to every intelligent workman, from the description we have given of this machine.

VARIOUS EXPERIMENTS ON THE AIR-PUMP, TO PROVE THE EXPANSION, OR ELASTIC FORCE, OF AIR.

EXPERIMENT I. FIG. I.

Take a bladder, exhaust the air to a degree that but a very small quantity shall remain; then tie it in such a manner that no more of the air which remains can evaporate; to effect this with the greater ease, moisten the neck of the bladder, and tie it very hard below the neck. Suspend the bladder to the hook which is annexed to the button of the receiver of the glass A. Pump the air of the receiver, and then the elastic force of the air will cause the bladder to extend to such a degree that it will be in danger of bursting; the cause of which is, that the bladder is no longer prefixed by external resistance, as it was before, when it was suspended in the air, or before it was shut up in the receiver. There is nothing more necessary than to introduce the air again into the receiver, and the bladder will resume its original figure; the internal air which it contains being then compressed by the exterior air.

EXPERIMENT II. FIG. II.

By this experiment we proceed to prove that air can expand itself in an extraordinary manner. Take a phial with a long neck, fill it with water, leaving in it only a very small bubble of air; turn it upside down, and immerse the nozzle in a high glass of water; place afterwards the glass B above it; pump the air, and you will see the little bubble expand itself, and drive the water out of the bowl. If we compare the first size of this bubble of air with that it forms after it is expanded, a judgment may be formed how much the air is expanded; the best way on this occasion is to take the water from which the air has been exhausted, either by boiling it, or by putting it under a receiver to exhaust the air. In the course of pumping no bubble of air remains in the water, which could increase the size of the first bubble, and by this means render the calculation of the different sizes uncertain.

EXPERIMENT III. FIG. III.

Take a new-laid hen's egg, cut off about a third part of it at the small end, turn it upside down, take out the yolk, and you will find a little bubble of air concealed between the shell and the skin; place the egg in a little hollow glass A, and cover it with the little glass bell A, which rests on the plate of copper; if you then pump out the air you will see this little bubble expand against the shell, and distend the skin in such a manner that it will fill all the shell, and will appear as one whole egg.

EXPERIMENT IV. FIG. IV.

Take a glass bowl, furnished with copper, as A, to which may be joined a spigot B, by means of a screw, weigh this bowl full of air, in a very exact pair of scales, and join it afterwards to the pump, by means of a little piece X; when you have carefully pumped the air out of the bowl, weigh it again, and you will find that it has become much lighter; if you afterwards draw only the spigot B, and cause the air to enter again into the bowl, it will be found of the same weight as at first.

SECOND PART OF EXPERIMENT IV. FIG. IV.

If, after weighing the foregoing bowl, A, when exhausted, you

should immerse it entirely under water; and then open the spigot; it will be filled with water, because the air is exhausted; wipe the outside of it well, without leaving any moisture on it; weigh it again, closing the spigot to prevent any water from coming out; the difference of weight between this bowl, from which the air is exhausted, and the same bowl filled with water, will discover how much heavier water is than air.

EXPERIMENT V. FIG. V.

Take little bowls of glass which have a small neck at one end; take also the figures of little boys made of glass, which are hollow within; place them in a high glass of water; cover them with a glass bell B, and let this bell rest upon a plate of copper; pump out a little of the air, so much as to draw off some bubbles of air from the little boys and the little bowls; cause the air to enter again into the glass bell; and you will perceive that a quantity of water, equal to that of the exhausted air, will enter into the little boys and little bowls, which will render them more heavy; pump out then so much air, till the water which occupies the place causes them to sink to the bottom of the glass A, then pump the air again from the glass bell, and you will perceive that the elastic force of the air will cause the little boys and little bowls to lose so much water, and will by that means render them so light that they will float on the water; but if you cause the air to enter again into the glass bell, they will sink immediately to the bottom, as before, and will again mount to the top every time the air is exhausted.

EXPERIMENT VI. FIG. VI.

The same experiment may be tried in the case of a bladder, which, being but half full of air, and close stopped, becomes so heavy, by means of a weight suspended, that it sinks to the bottom of the water; for as soon as a little air is pumped out of the glass bell, under which the glass of water and the bladder have been placed, the bladder swells and floats on the water, falling afterwards to the bottom as often as the air is permitted to enter.

EXPERIMENT VII. FIG. VII.

The power of elastic air may be perceived from this circumstance: take a box of wood, B, upon which place a covering of lead, with a pin of copper, A; this covering enters into the box B at the depth of an inch. Place in the box a bladder bound, hard and close stopped; having previously exhausted the greatest part of the air from the bladder. Place upon the covering some pieces of lead of a flat round figure, CC, with a hole in the middle. Place all these under a glass bell, narrow but high; pump out the air, and you will perceive that the bladder, by swelling, will raise the covering of lead, and the weight which has been placed on it.

EXPERIMENT VIII. FIG. VIII.

When it is desired to deprive fish of air, the way is to place them in a large glass full of water, B, which ought then to be placed on a circular piece of wood, C, which would be fixed on the plate of copper; in the middle of the circular piece of wood let there be made a hole, through which let there pass the little piece X; join this piece to the plate of copper, to hinder water from entering into the pump, otherwise the fish, beginning to move and flounder, would throw the water out of the glass B; cover B with the glass bell A, and you will perceive that as soon as the air is pumped out, the fish will begin to float on the water, and will not be able to sink again without difficulty, because there is within their bodies, a small bladder full of air; which dilating itself, swells them up, and renders them lighter. As soon as air comes again into the glass they sink spontaneously, particularly if they have thrown up some bubbles of air in the course of pumping.

EXPERIMENT IX. FIG. IX.

Take a little glass A; put some new beer, wine, or brandy, into it; cover it with the glass bell B; pump out the air; and then the air which is contained in the beer, or the other liquors, will discover itself and expand: the beer will change entirely to froth; but this froth will disappear as soon as air shall be admitted into the glass bell; the wine and brandy will appear to bubble up; and large bubbles of air will be seen to issue from them; if these liquors are tasted, after the have continued a little time *in vacuo*, on comparing them with other fresh liquors of the same kind, it will be found that they have a vapid flavour.

EXPERIMENT X. FIG. X.

Take a little brass cup A; place a little piece of glass, not too thick, upon the top of the cup A, where there is a ledge; then close it up with wax, and place a little glass at top; when you come to pump the air, the piece of glass will burst within, with a great noise; it will be proper to place upon the plate a large round piece of leather or a piece of lead, with a little hole in the middle, that you may be able to take away the little piece of glass at once, and prevent the plate's being damaged, when the glass comes to burst within.

EXPERIMENT XI. FIG. XI.

Take a glass bell, of a moderate height, A; clean it well, and make it very dry. Place it upon a plate of copper, and pump out a little air; hold a lighted candle B on the side of the glass bell, opposite to that where the eye C is placed, and the eye will perceive in the glass bell, a ring or coloured circle, which will not appear but at the beginning of the pumping; for, when a large quantity of air has been pumped out, all the colours will disappear, and they will re-appear as the air is permitted to enter; the same thing will invariably

PNEUMATICS.

invariably happen every time that you chuse to repeat the same experiment.

EXPERIMENT XII. FIG. XII.

If a phial is placed in a glass filled with water, and a fillet to cover it, and a glass C above it, the glass will burst in pieces, when the air is pumped out, and the shock will even be so violent as to shake the pump.

EXPERIMENT XIII. FIG. XIII.

Take a glass A, cover it with a lid B, and the button C; hang to it the little balance D; annex to one of the arms of this balance a small piece of wax E, and at the other arm a small piece of lead F; which in open air are of the same weight; pump the air from A, and you will perceive that the piece of wax preponderates and becomes the heaviest.

EXPERIMENT XIV. FIG. XIV.

Take a gun-lock A, annexed to a piece of wood furnished with a screw, to assist which it may be placed on a plate of copper; the piece B, is annexed to the little piece of steel X, and to a wire thread d; the end of which is shaped into a circular form; when this wire thread is raised, after having fastened the lock of the gun, the lock loosens itself, snaps, and gives fire, as in ordinary cases; put some powder then in the pan, fasten the lock, and place above it a large glass C, open at top; place upon this glass the lid D, with the box F, of which we have spoken before; turn E, make T enter into the circumference of D, stop the little piece H, at the height where it ought to be; pump the air out of the glass bell; then draw up the wire thread E, so as to make the lock snap; when the flint strikes against the hammer it will not give fire, nor light the powder, for want of air.

EXPERIMENT XV. FIG. XV.

Pump the air out of these two half circles, and having joined them together, and placed a wet leather between them, hang them in a glass A, and cover them with the top B; then put on the plate a wooden ring C, and the half circles will disunite, on pumping out the air contained in the glass. The ring C serves to receive the half circle that falls, and prevent its being damaged.

EXPERIMENT XVI. FIG. XVI.

Take a glass A, cover it with a lid which has a cock annexed to it, and to which has been affixed a long pipe. Pump the air out of A, open the cock of the lid and cause the air to enter very slowly into the glass A, but however in such a manner that it may be obliged first to pass over some wood cinders which are lighted and glowing, or to pass over a fire of turf in which the end of the pipe B rests: when the glass is filled with this air, then raise the lid; instantly put a small live animal into the glass; immediately after cover the glass again, and you will perceive that this air is poisoned, and that it will cause the little animal to die very shortly. If you put a lighted candle or a *bougie* into the glass which is filled with this poisoned air, it will instantly be extinguished, but it will purify the air to that depth it is sunk to, and where it continues to burn. In this manner one may light the *bougie* a number of times over again, and cause it to descend deeper before it is extinguished, till all the air contained in the glass is purified.

EXPERIMENT XVII. FIG. XVII.

One or two powders may be made to blend *in vacuo*, with a liquid in the manner following: fasten upon the plate of copper of the pump, the little rod to which is annexed the little plate A, and for this purpose make use of the screw; this little plate A, which is of the shape of a quarter of a circle, is pierced in the middle with a hole, and has in its circumference a deep channelling, where you may place the powder that you wish to blend; cover all this apparatus with the glass furnished with its lid, and with its little box F; the wire E, ought to have a little arm G, which has annexed to it a little round leaf; this may be joined as the foregoing arm upon the wire E, a little farther from the end, in order that the extremity of the wire may project a little, and may be able to pass through the hole which is in the centre of the plate A; the consequence of which is, that when you turn E, it rests exactly in its place. Let H be a little glass in which the liquid is placed, with which you are desirous to blend the powder, after having pumped out the air, turn E, and by means of G, take of the powder which is in the groove A, as much as you wish; cause this powder to fall into the glass H; in this manner one may cause either all the powder to fall out at one time, or as little as you please.

EXPERIMENT XVIII. FIG. XVIII.

If you wish to shut up a bottle in a glass, from which the air has been exhausted, the following is the manner of performing it: take a little bottle as A, which has a stopple of glass, which fits exactly the mouth of A; fix, by means of a screw, the stopple in the opening of the little piece C; fasten this piece to the little rod E; cover A, with the glass D, furnished with its lid, and the box F; by this means you may, after having exhausted the air, cause the stopple B, to enter into A, by pressing down E, without the entrance of air, and afterwards you may remove the little bottle B, to lay it by. It is in this manner, that by putting a small quantity of pure mercury in a bottle A, very clean; and by stopping the bottle after the air is exhausted, that you may make mercurial phosphorus, or luminous Mercury, on shaking the bottle. One may also shut up in the same manner, a little bottle filled with water, when the air is exhausted, for the purpose of seeing by that means, if water

when there is no air, freezes quicker or slower than common water.

EXPERIMENT XIX. FIG. XIX.

Take the flint glass bottle with the brass-head, and put a little Mercury in the bottom, then take the tube which is made for that purpose and screw it into the hole: so that the end may almost touch the bottom of the bottle; then setting the receiver, with the large tube to cover the small one over bottle and tube; as you exhaust it you will see the Mercury rise in the tube, according to the expansion of the air in the bottle; which, when the receiver is quite exhausted, will stand at the height of the Mercury in the common barometer.

N.B. If you compare the height of the Mercury in the gage under the pump, with the height of the Mercury in the tube of the bottle, they will appear to be of the same height; which shews that the spring of the air is just equal to the pressure of the atmosphere.

EXPERIMENT XX. FIG. XX.

Sound cannot expand itself *in vacuo*; for, take a small piece of lead A, whose two pillars support a little bell by the assistance of a string; place this lead upon a plate of copper, but place between the two a little cushion filled with wool A; place over them the glass open at top, and covered with the lid D; to which may be fixed the little box B, filled with small pieces of leather moistened with oil, across which pass a brass wire, which becomes by that means moveable; but, however, in such a manner, that the air cannot evaporate across the leather, along the wire; then affix to the lower part of the wire E, a little arm G; by means of which, in turning the wire E, we can move the little curved arm I, and make the little bell sound, before the exhausting move the bell; its sound will then be distinctly heard; then exhaust the air carefully, and on moving the bell it will no longer return any sound; on the upper part of the wire may be seen a little piece of copper H, which may be raised, lowered, or checked at any interval; the use of it is to prevent the air, which presses the wire E, from sinking entirely in pumping; it is also of use to keep this wire at such a height as we please on turning. The little box F has at top a small lid, which is put on when it is necessary to turn this lid: it is also proper to bind the wire E, in order to prevent it from moving too easily: by this means the little pieces of leather surround and embrace the wire more firmly, and entirely close the passage by which the air could evaporate: it is also proper to pour a little oil upon this lid, as well to repel the air as to render the wire E more easy to be removed.

EXPERIMENT XXI. FIG. XXI.

To blend one or more liquids with any other thing in a glass; let the phial A be made use of, which is suspended by means of the curved piece of copper B; under this, place the little glass D, in which may be placed some liquid, or any other thing upon which we may pour out the liquid of the phial A; place above it the top F; lower E until the little arm G turns the phial A upside down, and till the liquid pours upon that which is in the little glass D, by this means the whole process may be discovered, if the blending excites any great agitation; and then, whether this agitation be more or less great, than if the experiment had taken place in the open air.

If on this occasion a thermometer is placed in the little glass D, we can at the same time discover if this blending excites heat or cold, and what degree of it, it produces. If we wish to blend two liquids together, pouring them out drop by drop, it would then be necessary to fix two of these phials, one joining to the other, or directly opposite to each other, and to make a slight alteration in the disposition of the pieces; we may also, in place of the little glass D, use in the same manner a hot iron on which the liquid may be dropped.

EXPERIMENT XXII. FIG. XXII.

This experiment has for its object to prove that Mercury does not remain suspended in a tube, but from the circumstance of its being pressed by the weight of the atmosphere. Place the tube C, filled with Mercury, under the glass D, exhaust the air from D; the Mercury of the pipe C will immediately sink, and will fall almost as low as the Mercury of the little glass E; let the air in again, and you will immediately see the Mercury mount again in the same height where it was before. Do not neglect to fix the little tube X on the plate of copper of the pump, to prevent the Mercury from falling into the pump.

EXPERIMENT XXIII. FIG. XXIII.

Take a high cylindrical glass A, or place two, one upon the other, in order to make the greater height; place A, upon a plate of copper; annex to the lid the little box F, and join to the other side of the lid a spring made of copper, D; pass into the box F the little rod E, until it enters into the inner part of the spring D; then annex a small oval plate C; place a guinea and a feather in the spring D; place the lid, with every thing annexed to it upon the glass A; exhaust the air carefully, and turn the rod, and you will then see that the longest diameter of the oval plate will remove the two branches of the spring, that the feather and guinea will disengage themselves, that they will fall together, and will come to the ground at the same time.

EXPERIMENT XXIV. FIG. XXIV.

To make a shower of luminous Mercury, take a high cylindrical glass A; place within it another narrow glass B, closed at top, and which at its base rests on a piece of wood C; take a large lid

e
t
a
e
e
e
n

ge
ne
at
e.

of
fa
en
he
ed
an-
the
in
ake
und
on
per
may
s to
y in
we
nich
r to
by
the
e air
lid,
ved.

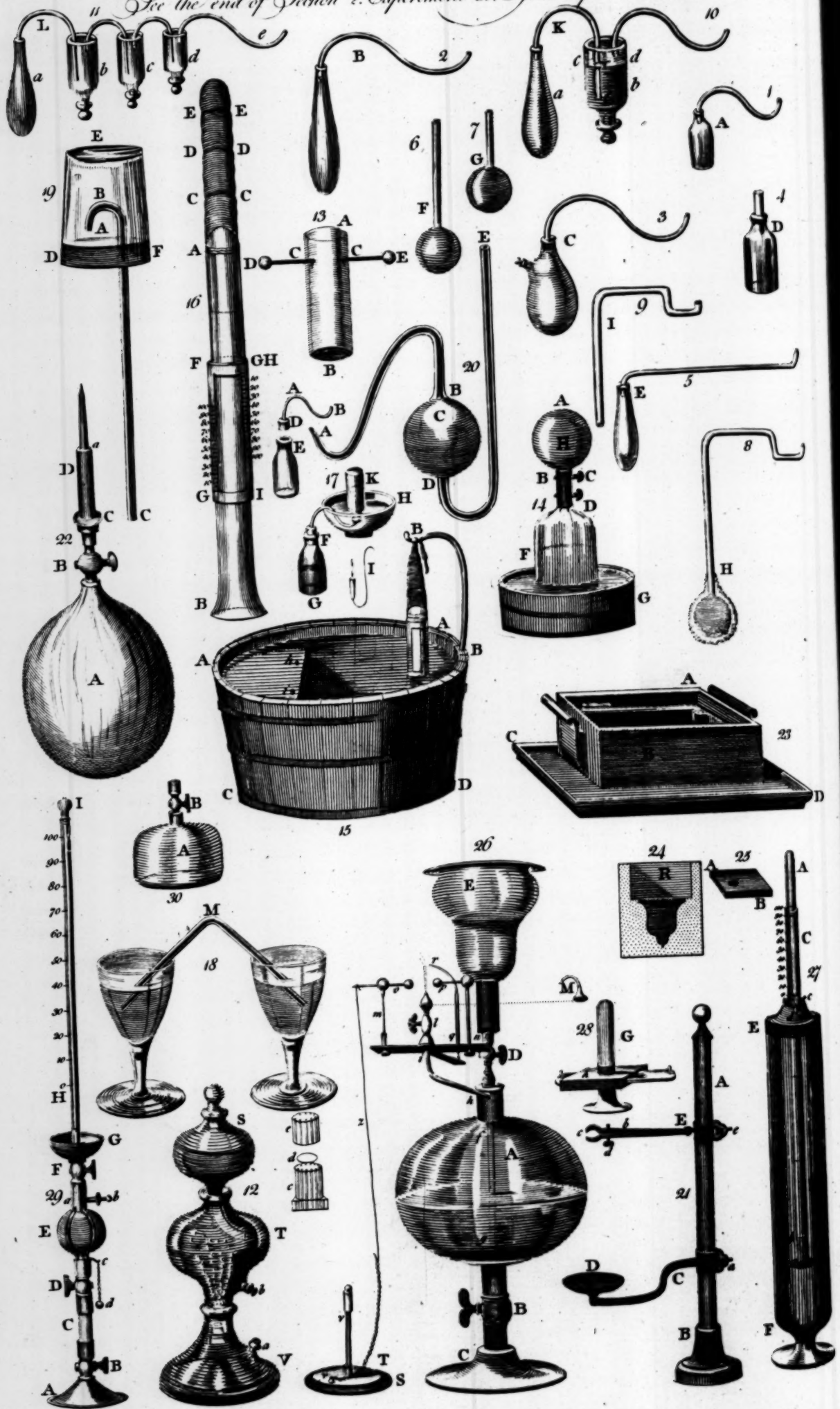
lafs;
is of
fs D,
hich
p F;
, and
y this
cites
ore or
n air,
fs D,
at or
d two
en be
er, or
on in
little
d may

y does
of us
ube C,
D; the
almost
in, and
e same
tute X
y from

on the
upon a
n to the
the box
ring D;
er in the
the glafs
will then
the two
fengage
e to the

lindrical
d at top,
a large
lid

Pneumatical Apparatus for ascertaining Experiments on Fluid, Air and other Elastic Fluids, Plate 1.
See the end of Section 2. Experiment 31. System of Pneumatics.



PNEUMATICS.

lid D, annex a cock to it, in which you may put a little pipe *b* and join D to the plate of the pump; place upon D the wood C and the two glasses A and B: take another lid E, place it at top upon A, annex to it a little tunnel of the glass F, furnished with copper, and in which has been fixed a very small pipe, whose opening is stopped by means of a stopple made in form of the pin G; fill F with mercury, which is dry and clean; exhaust the air from the vessel A, then raise the stopple G, of the tunnel, to leave room for the mercury to enter into A, and to fall upon the glass B, in the shape of a fountain; the drops of mercury will spread, *in vacuo*, a great light whilst falling; but it is necessary that the weather should be very dry, and the glasses very clean, for without it, this experiment will very likely fail of success. It is necessary to move all this apparatus with great care; you must begin by taking off the lid D, with great precaution, lest some of the mercury should enter into the pump, or fall upon the plate. The wood C serves to receive the mercury, and the use of the little pipe *b*, is to prevent the mercury from flowing out whilst taking off the pieces; or from entering into the pump whilst it falls from F.

EXPERIMENT XXV. FIG. XXV.

Take a pump A, annex to the pump the little pipe of the glass C; and afterwards the pump to the lid E. Place this lid upon a vessel B that fits it, which is high and narrow; and place in this same vessel a small glass of water D, in such a manner, that the lower end of the little pipe C, may reach as far as the bottom of the water; when you raise the sucker of the pump, the water will flow a little by the assistance of the pressure of the air; but if the air has been well exhausted from the vessel B, there will rise but a small quantity of the water of D, in the pipe C, although you raise the sucker of the pump. To succeed well in this experiment, we cannot do better than to cover with wax the two edges of the vessel B, as well the upper as the lower; when this experiment is making, too much precaution cannot be taken to prevent the air from entering into the vessel B; it is also necessary to pour a little water on the top of the sucker of the pump.

EXPERIMENT XXVI. FIG. XXVI.

Place a high glass bell A, upon the plate of an air-pump; fix to the cock B, a small narrow pipe C, and to the other end of B, the long pipe D, in such a manner that the cock and the pipe may come together below, in the hole of the plate of copper M; fix also in the little hole of the plate of copper the long pipe E, then exhaust the air from A, after having closed the cock B; place the end of D in a cistern; open B, and then the pressure of the air will cause a copious stream of water to mount in the glass A; which will continue to play till the glass is filled as high as the upper end of the little pipe E.

EXPERIMENT XXVII. FIG. XXVII.

To cause gunpowder in a glass, from which the air has been exhausted, to take fire; choose such a glass as A, which has to the neck, next to A, a box made of cork-tree wood, the bottom of which is pierced with a hole, through which may be passed a square wire of copper B, which has at the end B, an oblong groove, like to that which is at the end of a needle; when the wire has been passed into the bottom of the box, let it be filled with powder, which may be poured in from the top; let the little box be then fitted with a moveable wire E, and the wire be fixed in the pin B; fix F at such a height so as to be able to make the wire E descend sufficiently low; because the groove which passes through the bottom of the box projects a good deal beyond; when every thing is adjusted in this manner, and the pin B, in A, has been raised as high as possible, then place a piece of hot iron D, upon the stone G, which rests upon the round plate of copper; or rather place D in a little stone pot that has been varnished; which will prevent the heat of the iron from spreading to every thing about it, and from communicating itself too soon to the glass; then place the glass A, over it, after having first made it moderately warm, that the sudden heat of the iron may not injure the glass; exhaust the air slowly, and carefully; lower the wire E, and you will see some grains of powder fall upon the iron, which will dissolve, create a smoke, and will cause the mercury to sink considerably in the elastometer, which is fixed to the pump; but when the glass is exhausted of all the air it contains, the grains of powder will not blaze at all, or if the iron continues very hot, the grains will take fire one after another; when air is again permitted to enter, it will be necessary to do it very slowly, lest the glass should cool too quick. When the powder has been made to fall on the iron a number of times repeatedly, it will be necessary to continue the pumping at the same time, for the powder, in catching fire, produces a great deal of air; should this be neglected; the remainder of the powder would catch fire, and the glass would run the risk of being broken in pieces.

EXPERIMENT XXVIII. FIG. XXVIII.

Take a pump A, manage it so that the sucker shall play easy, and may move without much friction; to effect this, grease the sucker well with oil, and fill the pump two or three different times with water, then stop the former opening with a screw B, suspend to it a weight G, of about six or seven pounds, and the pressure of the air will hinder the sucker from loosening itself from the bottom of the pump that way; one may even increase the weight without

this happening, till the weight outweighs the pressure of the exterior air.

EXPERIMENT XXIX. FIG. XXIX.

If a small light weight is suspended to the pump A, and the upper opening is stopped with a screw *b*, and the pump is suspended in the glass B, to the hook of the lid; if the air be afterwards exhausted from the glass, the weight will sink with the pump, and the sucker will be as it were drawn from the pump; cause the air to enter again, and you will immediately see the weight mount again by means of the pressure of the external air that enters.

EXPERIMENT XXX. FIG. XXX.

Take a little springing stream of the glass B, turn it upside down, and place it with its pipe in a small glass of water; place a glass bell over it, then pump out a small portion of air, so that one may see some bubbles of air from the fountain issue forth; then cause the air to enter again into the bell, and stop the stream of the fountain, and place it as it is represented under a high glass bell A; immediately exhaust the air from the bell, a small stream of water will begin to spring from B, which will rarify the air in the fountain.

DESCRIPTION OF PNEUMATICAL APPARATUS, WITH VARIOUS USEFUL AND ENTERTAINING EXPERIMENTS, As represented in PLATE I.

We shall first proceed to describe the apparatus necessary to make experiments relative to the nature and properties of permanently elastic fluids. They chiefly consist of glass bottles with bent tubes, which are nicely ground into their necks, as represented in *fig. 1*, to *11*, in Plate I.

A (*fig. 1*) is the simplest and most useful sort; its capacity being of about four ounces measure, and the bottom being round and moderately thin, so as to admit the flame of a candle being applied under it without much fear of cracking it. B (*fig. 2*) is of the same shape, only somewhat longer. C (*fig. 3*) has two necks, viz. one in which the bent tube is fitted, and another having a glass stopple, which is occasionally removed, and then something may be introduced into the phial while the process is going on. E (*fig. 5*) has a straight tube, whose extremities only are bent, nearly at right-angles. This phial is useful, when the receiver wherein the produced elastic fluid is to be introduced, is far from that part of the edge of the tube, where the phial with the effervescing mixture, &c. may be conveniently situated. D (*fig. 4*) is a common glass bottle with a ground glass stopple, through which many capillary holes are perforated. Sometimes the bent glass tube may be applied to the phial by means of a cork: the phials whose tube is ground into their necks, are by far the more preferable, because the cork is subject to be corroded by the acids employed, and besides, the tubes can seldom be fitted in them so nicely as effectually to exclude the passage of any elastic fluid.

The bottles of elastic gum, or India rubber, are exceedingly useful for experiments of this sort. They answer both the purpose of retaining elastic fluid, like bladders or receivers, for which use they are preferable to bladders, and of holding the materials which must produce the elastic fluids; but only when no heat is required for the process. Any bent tube may be easily applied to them, and there is no fear of their breaking like glass bottles.

When concentrated nitrous acid has been put many repeated times into those bottles of elastic gum, commonly called India rubber, they lose, in part, their elasticity; so that the inside becomes brittle, as if partly corroded, and then they are easily broken; however, they may be used a long time before they come to that state; but vitriolic acid, which is used in the common processes for making fixed inflammable air, seems not to affect them. When these bottles are required to be used instead of bladders, they should be as large as can be got, and should be rather thin, so as to be easily compressed, in order to expel the common air they contain, previously to their being filled with any particular sort of permanently elastic fluid.

These are the phials more commonly used, when the elastic fluid that is extricated from several substances is required to pass immediately into the receiver, inverted in water or quicksilver; but sometimes it is necessary to let those elastic fluids pass through some other particular fluid or mixture, previously to their entering into the inverted receiver. In this case the glass instruments K and L, *fig. 10* or *11*, must be used. The construction of K may be clearly understood by inspecting the figure: it consists of a phial *a*, with a round bottom, into which the materials that must yield the elastic fluid are put. To the neck of this phial a tube is fitted, whose other leg fits a hole made at the bottom of the phial *b*, and its extremity *c* comes as far as the neck of the phial, but not quite so near as to touch it. The phial *b*, has a glass stopple, ground into its neck, and at the bottom has another hole, into which a bent tube, like those of the phials, *fig. 1, 2, 3*, is fitted. Now, when the elastic fluid, that is yielded by the materials in *a*, must be let through some fluid or mixture, as, for instance, through lime-water previous to its being received into the inverted receiver or bladder; the lime-water is put into the phial *b*, so as to fill it to about *c d*; in which case, it is plain that the elastic fluid coming out of the orifice *e* of the tube, must necessarily go through the lime-water, before its reaching the tube *f*, through which it is conveyed into the receiver. The instrument L is useful, when the elastic fluid is

C c c required

PNEUMATICS.

required to be sent through various mixtures, as lime-water, spirit of wine, oil, &c. which fluids are put into the phials *b, c, d*, and then the elastic fluid produced by the materials in *a*, must pass through them all before its going through the last tube *e* into the receiver.

In various experiments, the materials which are to yield the elastic fluid, require a stronger degree of heat than that of the flame of a candle; in this case several things must be minded, viz. that by the application of strong heat, as a charcoal fire, the phials are easily broken, that part of the materials stick fast to the glass so as to render the phial unfit for further use; and that the tube becomes very hot, even at a good distance from the phial; and as its extremity is immersed in cold water, it is in great danger of breaking: from which observation it follows, that the phials for these experiments should be as cheap as can be possibly contrived, and should have a very long neck or tube. The bottles with ground tubes for those experiments are very subject to break, and are very expensive, Mr. FONTANA used to have several balls blown at the extremities of glass tubes, as *F, G*, (*fig. 6* and *7*) which were of various sizes between one and four inches in diameter, and also several tubes bent in the manner represented by *T*, (*fig. 9*); into one of those glass balls he used to put the materials that were to yield the elastic fluid: and by means of the flame of a lamp and a blow-pipe, he used to fasten the tube *T* upon it, viz. *a* upon *b*; which altogether formed the long-necked phial *H*. After performing the experiment, if the phial appeared to be useful for other experiments, the tube was broke with a file about the place where it had been joined, and the materials being poured out, the phial was kept for farther use. Sometimes the balls of those phials were coated with clay, or that lute which chymists use to put round their glass retorts. This coat is necessary in order to let the glass sustain a greater degree of heat than it is capable of without it.

Several experiments require a very strong red or white heat, which is much greater than that which the above-mentioned phials can bear, even when guarded with a coat of clay. In this case earthen retorts or earthen phials are the only vessels that can be used; but these cannot be safely used more than once, because in cooling they generally crack, and the fissures are sometimes imperceptible. Small phials made of tobacco-pipe-clay do not crack very easily in cooling, and consequently are more useful than those made with the clay used for chymical retorts.

When the materials to be used are in small quantity, and require only a strong red heat, then Mr. Bergman's method may be safely used. This excellent chymist used to put the materials into a small oblong phial, nearly in the shape of *B* (*fig. 2*) of green glass, which phial is furnished with a bent tube, &c. This phial he puts into a tall crucible, and fills the interstices between the crucible and the phial with powdered chalk, which, when heated, forms a strong incrustation, and defends the glass exceedingly well. Thus the crucible, with the phial in it, is surrounded with coals, in a portable furnace, and may sustain a strong fire. Could platina be shaped into any required form, a retort or phial of this metal would be a very valuable acquisition to an experimental philosopher, because it could sustain a prodigious heat, and would not be subject to break, like glass or earthen retorts, or to yield any effluvia, like heated iron.

The stand (*fig. 21*) is useful to sustain a lamp under a phial, like *A, B, C*, *fig. 1, 2, 3*, in order to let its contents yield the elastic fluid. The arm *E*, which holds the lamp, is made like a pair of tongs, which are open, more or less, by means of a screw, and it slides up and down the pillar *A B*, so that by the screw *e* it may be fastened at any required distance, between *C* and *D* from the floor.

Fig. 12, represents the apparatus necessary for impregnating water, and other elastic fluids with fixed air. This elegant instrument was first invented by Dr. Nooth, and a description of it was published in the Philosophical Transactions, for the year 1775, and afterwards received some improvements, in which state it is represented in the plate: it consists of three glass vessels *S, T, V*, fitted into one another by grinding. The lower vessel *V*, besides the large neck, into which the bottom of the second vessel is ground, has another small aperture *a*, to which a glass stopple is fitted. The second vessel *T* has three apertures, viz. the upper and larger one, which receives the under part of the vessel *S*; the lateral aperture *b*, to which a glass stopple is fitted; and the under aperture, by which this vessel communicates with the vessel *V*; but this aperture is furnished with a valve, whose parts are distinctly shewn by *c, d, e*, upon a larger scale. This piece *c* is a perforated cylinder, ground into the extremity of the vessel *T*. The piece *e* is a like cylinder, perforated with many capillary holes, which is fitted by grinding into the same extremity, but above the piece *c*; a small space remaining between those two cylinders, in which a plano-convex lens *d* can freely move.

The plane surface of this lens is downwards, so as to cover the hole of the piece *c*. In this manner it may be easily conceived, that a fluid can pass from the vessel *V* into *T*, but cannot go backwards from *T* into *V*. The third vessel *S* terminates in a long bent tube, which goes into the vessel *T*. Its other aperture, at the top, has a glass stopple, which is very acutely conical, so that a very small force from within the vessel can raise it up. In the lowermost vessel of this apparatus the chalk and diluted oil of vitriol is put; the second vessel is filled with water, and the whole apparatus

is put together to work in the manner exhibited in this figure. Now as the fixed air is produced from the materials in *V*, it passes through the valve into the vessel *T*, and necessarily goes to the upper part of it; and because this vessel is filled with water, the fixed air pressing upon the water will force it into the empty vessel *S*. In this manner the water that remains in the vessel *T*, being in contact with the fixed air, which passes continually through it, becomes gradually impregnated with that elastic fluid, and may be drawn out through the aperture *b*, in which case the water forced into the vessel *S* returns backwards into the vessel *T*. This impregnation may be much accelerated by shaking the apparatus; for then the fixed air is made to touch a greater surface of water. The impregnation of water with fixed air in this apparatus is facilitated also by the pressure of the column of water (for pressure facilitates it considerably) raised in the vessel *S*; which pressure might be still more increased by adapting a safety-valve (like those used for fire-engines) to the neck *f* of the vessel *S*, instead of the glass stopple. To the aperture *b* of the middle vessel, sometimes a glass stop-cock is fitted instead of the stopple. The aperture *a* of the lowest vessel is useful to introduce any materials into the vessel, or to stir its contents whilst the process is going on. Before the invention of this apparatus, the fixed air was made to pass through a bladder into a phial partly filled with water; but repeated experiments have shewn that the bladder always imparts a disagreeable taste to the water, which is not at all the case with the above-described glass apparatus.

M. Fontana, towards the latter end of the year 1779, communicated a method of determining the specific gravities of different elastic fluids, which he had very lately used, and which is certainly superior to any other practised before. This method is as follows: *H* (*fig. 14*) of Plate I. is a globular glass vessel, of about four inches in diameter, to whose neck a metal stop-cock is cemented. The aperture, which, through the stop-cock, communicates with the inside of the vessel, is very small, as about one-fortieth of an inch, or rather less, and the whole is made very light. *D F* is a glass vessel, to the open top of which another stop-cock is fitted, to which the vessel *H* is adapted by a screw. The aperture through the stop-cock *D*, of the receiver *D F*, is also very narrow. Now suppose that a given elastic fluid is required to be weighed with this instrument, for instance fixed air. First, the receiver *D F*, having the stop-cock *D* closed, is filled with mercury, and inverted in a basin containing also mercury; then the fixed air is introduced into it after the usual manner, which occupying the other part of the receiver, will depress the quicksilver, as at *F*. The quantity of elastic fluid thrown into this receiver should be more than that which is sufficient to fill the vessel *H*. This done, the vessel *H*, must be screwed to a good air-pump, and the air must be exhausted from it; after which the stop-cock is to be closed, and the exhausted vessel being removed from the air-pump, must be screwed to the stop-cock *D*, in the situation represented by *AB*. Now both the stop-cocks *C* and *D* being opened, the fixed air contained in the receiver *D F* will rush into the vessel *A*.

In order to avoid the error, which might arise from the pillar of mercury in the vessel *D F*, this vessel should now be lowered so far into the quicksilver of the basin *G*, that the surface of the quicksilver *F* might coincide with the surface of the quicksilver in the tub; then the stop-cock *C* being closed, the vessel *A* is unscrewed from the vessel *D F*, and is weighed in a nice pair of scales. It is plain, that if from this weight, the weight of the vessel *A* weighed when exhausted of air, be subtracted, the remainder will be the weight of the fixed air; which being divided by the number of cubic inches, to which the capacity of the vessel is equal, the quotient is the weight of one cubic inch of fixed air.

Thus Mr. Fontana tried the weight of all the known elastic fluids, and found, that air phlogisticated by saturation with nitrous air, is specifically lighter than common air; for, according to his observations, a cubic inch of the former weighed $\frac{117}{100}$ of a grain; whereas a cubic inch of the latter weighed $\frac{100}{100}$ of a grain. These experiments were made when the barometer was at a mean height, and the thermometer stood at temperate. This accurate method, therefore, seems to put it out of all doubt, that phlogisticated air is lighter than common air. Probably the specific gravity of phlogisticated air is different, according to the various causes that phlogistificate the air; but this has not yet been ascertained.

Fig. 16. Plate I. represents an eudiometer, *AB* being the glass tube, to the upper end or closed end of which a loop, *A E C*, should be fastened, which is made of waxed silk lace, and has several cross threads *CC, DD, EE, &c.* The use of this loop is to suspend the instrument to a hook *AB*, *fig. 15*, Plate I. which should be either fastened continually to that side of the tub which is opposite to the shelf, or so constructed as to be easily removed and fixed again, as occasion requires. It is formed of a thick brass wire, the lower extremity of which fits a hole made in the side of the tub. The brass piece, with the scale, which slides upon the eudiometer, is formed of two brass slips, *FG, HI*, joined by two brass rings *FH, GI*, to which they are soldered. Upon one of the brass slips are marked one hundred divisions, beginning from the upper edge of the lower ring *GI*, and all together are equal to the space contained between two of the marks or measures made upon the glass tube; so that they shew the parts of a measure. Upon the

PNEUMATICS.

the other brass slip H I are likewise marked one hundred divisions, but they begin from the lower edge of the upper ring F H.

N.B. These divisions must be made after the divisions are marked upon the tube; and are to be made in the following manner:

When the tube AB, *fig. 1*, is filled with water, a measure of air should be thrown into it; then the tube must be suspended to the hook by the loop, as shewn in *fig. 15*, Plate I. so high that the surface of the water within the tube may be very near the surface of the water in the tub, as, for instance, about two inches above it; then, looking horizontally through the tube, a mark should be made, by sticking a bit of soft wax upon the tube, just coinciding with the lower part of the surface of the water within it, in which place, afterwards, a circular mark should be made with the edge of a flint, or with a piece of agate, or a diamond, but not so deep as to endanger the breaking of the tube. Thus the first measure is marked upon the tube, and in a similar manner are the other measures also marked, viz. by throwing two measures of air into the tube, suspending it, and marking it as before; then throwing in three measures, &c. The polish of the inside surface of the tube A B, should be taken off by rubbing it with fine emery. The operation, however, is very laborious. At least the measure should be done so.

With this apparatus the degree of the air's purity must be tried in the following manner: First, fill the eudiometer-tube with water, taking care that no bubbles of air remain in it, and inverting it with the mouth downwards, leave it in the water, against the side of the tub. Secondly, fill the measure with that respirable elastic fluid that is required to be examined. Thirdly, put the eudiometer-tube upon the shelf of the tub; keeping it perpendicular, and with the mouth exactly upon one of the holes of the said shelf, and throw the measure of air into it. Fourthly, fill the measure again with the same air, and throw it likewise into the tube. Fifthly, fill the measure with nitrous air, and throw it also into the tube; but immediately after this operation the tube must be shook, by moving it alternately up and down in the water of the tub for about a quarter of a minute; then it is left a short while at rest, after which it is suspended to the hook BB, (*fig. 15*, Plate I.) so that the surface of the water within it may be about two inches above the water in the tub, and the brass scale is slid upon it, till the upper edge of the lower ring coincides with the middlemost part of the surface of the water within the tube, and then is observed what division of the scale coincides with any of the divisions on the tube, by which means the quantity of elastic fluid remaining in the tube may be clearly seen, to the hundredth part of a measure. This quantity, which shews the first diminution, is then set down in the following clear manner, viz. First, the two measures of air introduced first into the tube are expressed by a Roman number, after which the one measure of nitrous air is expressed by another Roman number, and the measures, with the parts of a measure, remaining in the tube after the diminution, are expressed by common numbers with decimals; thus suppose, that after introducing two measures of common air and one of nitrous air, and after shaking, &c. in the manner above directed, the quantity of elastic fluid remaining in the eudiometer is such, that when the upper edge of the lower ring of the scale-piece coincides with the lower point of the surface of the water in the tube, the 56th division of the scale falls against the second circular division on the tube, then this diminution is marked thus, II, I, 2.56, which signify, that two measures of common air, and one measure of nitrous air, after being diminished by their mixing together, were reduced to two measures and fifty-six hundredth parts of a measure. Lastly, after marking the first diminution, throw a second measure of nitrous air into the tube, shake the instrument, and after a little rest, as before, observe this second diminution, which (supposing to have reduced the whole quantity of elastic fluid to three measures, more than seven hundredth parts of a measure) is marked down in the memorandum-book thus, II, II, 3.07.

Sometimes one, or two, or three more measures of nitrous air must still be added, in order to observe the diminution of some very pure species of respirable elastic fluid.

The divisions, which begin from the upper ring of the scale-piece of the eudiometer, are useful, when the quantity of elastic fluid contained in it is so small that the edge of the lower brass ring cannot be raised so high as to coincide with the surface of the water within the tube, on account of the silk loop, in which case, the under edge of the upper ring is brought to that point, and then must be observed which of these inverted divisions coincides with the first circular division upon the tube.

To make dephlogisticated air. The easiest method to procure some dephlogisticated air, is to put some red-lead into the bottle, together with some good strong oil of vitriol, but without any water. Let the red-lead fill about a quarter of the bottle, and the vitriolic acid be about the same quantity, or very little less; then apply the bent tube to the bottle.

But it must be remarked, that without heat this mixture of red-lead and vitriolic acid will not give any dephlogisticated air, or it yields an inconsiderable quantity of it, for which reason the flame of a candle (that of a wax taper is sufficient) must be applied under the bottom of the bottle, which for this purpose must be rather thin,

otherwise it will be easily cracked. In this manner the red-lead will yield a good quantity of elastic fluid, the greatest part of which is dephlogisticated air, but not the whole quantity of it, for a good portion of fixed air comes out with it. In this operation, the flame of the candle, when once applied, must be kept continually near it; and when the mixture does not produce any more elastic fluid, or the operation is required to be intermitted, care should be taken to remove the extremity of the bent tube from the water *first*, and then to take off the flame of the candle from under the bottle; otherwise, if the flame of the candle be first removed, the materials within the bottle condensing by cold, the water immediately enters, which in an instant fills the bottle, and generally breaks it. In order to separate the fixed from the dephlogisticated air, the inverted bottle, when filled with the compound of both, as it is emitted from the red-lead, must be shook in the basin; by which means the water will absorb the whole quantity of fixed air, and leave the dephlogisticated air by itself.

When a bottle is thus entirely, or in good part, filled with dephlogisticated air, stop it with your thumb, or any stopper; take it out of the water of the basin; turn it with the mouth upwards; then light a bit of wax taper, fastened to the extremity of a wire, in the manner shewn in letter I, (*fig. 17*) and removing the stopper from the bottle, let the lighted taper down into it, and it will be found that as soon as it comes into contact with the dephlogisticated air, its flame is increased to a prodigious degree. It burns with a kind of violence or deflagration, and an increased light, that is very beautiful to behold: but in proportion as the dephlogisticated air becomes contaminated, the flame gradually lessens, and at last is extinguished, in the same manner as if it were put into common air. Chips of wood, with only a red coal at their extremities, when let down into a jar, containing dephlogisticated air, will instantly flame, and burn very rapidly, till the dephlogisticated air becomes contaminated. If a quantity of inflammable be mixed with an equal quantity of dephlogisticated air, and the mixture be fired, the explosion is incomparably greater, than if common air had been mixed with the inflammable gas. By placing an animal in a receiver filled with this elastic fluid, and another like animal in an equal receiver filled with common air, it will be found that the former will live much longer than the latter; all which clearly shews, that this sort of elastic fluid, called dephlogisticated air, is much more fit to assist respiration and combustion than common air is; and accordingly, if a measure of it, with a measure of nitrous air, be put into an eudiometer, the diminution will be found to be much more considerable than if a measure of common air, and another measure of nitrous air, were mixed together.

Fig. 18, 19, 20. Plate I. represent the apparatus which Mr. Cavendish used in his experiments on the nature of air. The air, through which the electric spark was intended to be passed, was confined in a glass tube M, bent to an angle, as in *fig. 18*, which, after being filled with quicksilver, was inverted into glasses of the same fluid, as in the figure. The air to be tried, was then introduced by means of a small tube, such as is used for thermometers, bent in the manner represented by A B C, *fig. 19*, the bent end of which, after being previously filled with quicksilver, was introduced, as in the figure, under the glass D E F, inverted into water, and filled with the proper kind of air, the end C of the tube being kept stopped by the finger; then, on removing the finger from C, the quicksilver in the tube descended in the leg B C, and its place was supplied with air from the glass D E F. Having thus got the proper quantity of air into the tube A B C, it was held with the end C uppermost, and stopped with the finger; and the end A, made smaller for that purpose, being introduced into one end of the bent tube M, *fig. 18*, the air, on removing the finger from C, was forced into that tube by the pressure of the quicksilver in the leg B C. By these means he was enabled to introduce the exact quantity he pleased of any kind of air into the tube M; and by the same means, could let up any quantity of soap-lees, or any other liquor which he wanted to be in contact with the air. In one case, however, in which he wanted to introduce air into the tube many times in the same experiment, he used the apparatus represented in *fig. 20*, consisting of a tube A B of a small bore, a ball C, and a tube D E of a larger bore. This apparatus was first filled with quicksilver; and the ball C, and the tube A B, were filled with air, by introducing the end A under a glass inverted into water, which contained the proper kind of air, and drawing out the quicksilver from the leg E D by a syphon. After being thus furnished with air, the apparatus was weighed, and the end A introduced into one end of the tube M, *fig. 18*, and kept there during the experiment; the way of forcing air out of this apparatus into the tube, being by thrusting down the tube E D *fig. 20*, a wooden cylinder, of such a size as almost to fill up the whole bore, and by occasionally pouring quicksilver into the same tube, to supply the place of that pushed into the ball C. After the experiment was finished, the apparatus was weighed again, which shewed exactly how much air had been forced into the tube M during the whole experiment; it being equal in bulk to a quantity of quicksilver, whose weight was equal to the increase of weight of the apparatus.

The

PNEUMATICS.

The bore of the tube M, used in most of the following experiments, was about one-tenth of an inch; and the length of the column of air, occupying the upper part of the tube, was in general from $\frac{1}{4}$ to $\frac{1}{2}$ of an inch.

Fig. 21. Plate I. represents a stand, useful in pneumatical experiments. It is about eighteen inches in height, strongly fixed upon a foot (B), well loaded with lead at the bottom. Upon the shaft there are two sliders lined with cloth (slit behind, and have a spring to tighten them): one of them C, supports an arm which holds a sort of platter, or iron plate D, upon which we can put a chafing-dish, when we have occasion for fire; the other, E, carries two branches, *b* and *c*, which opens with a hinge like a compass, and terminates in an iron ring or collar; the size of which is increased, or diminished by the help of a screw *d*, so contrived as to receive and secure the necks of the different glass vessels, which may be put upon the chafing-dish, when laid upon the platter D; the two sliders C and E can be at any time fastened tight to the stand, by means of the screws *a* and *e*, on the hinder part. Such is the construction of this apparatus, the extent of whose various uses will be seen in the experiments we shall next describe.

Fig. 22. Plate I. represents an apparatus, by which, through means of inflammable air, some very diverting fireworks may be made, such as gerbes, fixed or vertical fons, &c. We have nothing more to do than to force the fixed air to pass through metal tubes, properly bored and placed conveniently; to do this, we make use of the bladder A, which is to be filled with the electrical fluid, and fitted to the tubes by the neck and cock B, upon which it is to be fastened very nicely: on pressing the bladder, the inflammable air will escape; it comes through every aperture made in the tubes, and will take fire at the flame of a candle, which is to be held to it at the instant of pressing the bladder. By this means we may have a sun with its luminous rays darting every way, if upon the brass tube CD, instead of the appendage *a*, we fix a round hollow ball of the same metal, and pierced circularly in a number of places; the ball may be about an inch and a half diameter.

Fig. 23. Plate I. represents a mercurial apparatus well joined and put together, of close-grained wood, about 7 inches long, by 3 and $\frac{1}{2}$ wide, and 4 inches in depth. The inside of this case or box is lessened by two slips of wood glued lengthways, the cavity of which is represented in *fig. 24*. The diameter or inward space is reduced by these means to 16 lines near the bottom, but this space is sufficient for the reception of the vessels which are to be plunged in it. These two slips or cheeks go sloping from bottom to top, and do not exceed the half of the depth of the box: they end at *a*, *b*, where they form a little groove on each side of the box: at *d*, you observe a little bracket on each side; they are to receive the tablet AB (*fig. 25*) beforementioned, and which slides easily upon it, when it is necessary to use it. This tablet, which goes across the whole width of the box, has but two inches of its other dimension; a hole is made through it, four lines in diameter, open at bottom, and throughout the thickness of the wood in the shape of a funnel, in which is glued above, and screwed in, a little piece of wood that projects, pierced through, and one line above the surface of the shell.

Fig. 26. Plate I. represents a lamp of inflammable air. A is the principal part of this machine, which is a crystal vessel near 10 or 11 inches at its least diameter, open at top and bottom, and very nicely cemented in with two ferules of brass. These ferules are furnished with two cocks, by which we can open a communication between the vessel A, and the hollow brass foot C, by means of the cock B, and by the other cock D, with the conic crystal vase E, which is less than the vessel A, and of which the pipe *fg*, may be looked upon as a prolongation. This pipe is of brass, and folderled to the base of the cock B, and opened at its extremities: *h* is another pipe folderled to the upper ferule of the vessel A, and communicating with it: this pipe, which is crooked and rather larger than the first, receives, by means of a screw, the cock *l*, with a cross piece of brass between the two; from one of the extremities of that cross piece, which has three horizontal branches forming a double square, rises a small solid crystal trunk or shaft *m*, whose foot, which is brass, is kept in its place by a groove, with a screw button; the shaft *n*, which is set up in the same manner in the opposite extremity of the cross piece, is of brass, as are the other two shafts *o*, *p*, which the first-mentioned ones support, and which are terminated by knobs on the side of the cock *l*, beyond which they extend a few lines: the third branch of the cross piece serves for the base or support of a small brass cannon *q*, in which is fixed a small bougie *r*, which by being bent or twisted at pleasure, its extremity may be brought above the fixture on the cock *l*, and the two knobs belonging to the shafts or bars marked *o*, *p*: we must remember to light the bougie beforehand.

In short, S is an electrophorus, with its conductor T upon it, from the centre of which rises a solid pillar of crystal *v*, topped with a ferule and brazen ball, which we lay hold of when it is necessary to take up the conductor T, and place it in contact with the hemisphere *y*, which is of metal, and hung by a chain upon a wire *z*, of the same metal, which is hooked upon the little rod *o*, which is supported by that of crystal *m*. All the pieces which compose the lamp we have been describing, being very exactly joined together,

with bladders between, it is to be set on the shelf of the tub (Plate I. *fig. 25*) in order to fill the vessel A, with inflammable air; but it must be first filled with water, to expel the atmospheric air, which can only be done by keeping the cock B shut, and leaving the cocks D and *l* open; the former in order to permit the water which is poured into the vase E, to run in proper quantity into the vessel A, through the pipe *fg*; and the latter to leave room for the air to escape which the water takes place of; having thus expelled the air from the vessel A by means of the water, the cocks D and *l* must be shut, and the cock B opened. The quantity of air confined under the foot C, being bathed in the water of the tub, will mount up into the vessel A, and the two bodies of water will unite. We must then again shut the cock B, and likewise open them at D and *l*, and complete the filling of the vessel A. Lastly, we shut again, for the second time, the upper cocks, D and *l*, and open the lower one B, and proceed to produce and disengage inflammable air in the manner before directed, taking care not to receive that fluid into the vessel A, until we are certain of its being very pure. When it is nearly or quite filled, we may shut the cock B, and carry the apparatus wherever we think proper to fix it, with the electrophorus S T, which is to furnish the electrical spark, to fire the inflammable air.

This last apparatus has the advantage of retaining, for months together, the electricity which we may give it, by rubbing, or, which is far better, by beating with a fox's brush, well dried, the refined plane S, for a few seconds.

Fig. 27 and 28. Plate I. represent two eudiometers constructed by Monsieur Fontana. The largest (*fig. 27*) is a glass or crystal tube AB, from 15 to 18 inches in length, and six times at least in diameter, not reckoning its thickness. This tube, instead of a foot, base, or pedestal, is cemented into a brass ferule *b*, to which is folderled a little metal plate open to the whole diameter of the tube. This serves for a foot when we want to place it upon the shelf or platform of the tub.

The small figure G, (*fig. 28*, Plate I.) is also a cylindrical tube of crystal, the diameter of which is nearly equal to the largest or great tube AB. Its capacity answers exactly to each division in the former, or which is the same thing, it contains only the quantity of air necessary to fill up three inches in the great tube.

Fig. 29. Plate I. represents De Volta's eudiometer. A is a funnel of brass, about five inches diameter, mounted with a cock B, which opens and shuts, as may be required, the communication between the cavity in the funnel and the little cylindric vessel of crystal C above it. This vessel is the measure used for the mixture of the inflammable air, of which we wish to know the goodness and quality. It is finished with a cock D, by means of which it communicates at pleasure with the spherical crystal vessel E, whose contents ought to be three or four times longer than that of the measure G. This globe E, is embraced by three hoops of brass, bent to the shape of its convexity, which keeps up a communication between the two cemented ferules above and below the two necks of the globe. We may observe near to the middle, and on the outward part of the ferule *a*, a little knob of metal *b*; this knob terminates the extremity, a wire of the same materials cemented and insulated in a glass tube inserted in a little metal pipe folderled to the ferule *a*, so that the extremity of the wire may cross the inward part of the ferule, and finish at two lines at most at the opposite inward side *a*. We may observe also near the base of the ferule *c*, in which is cemented the lower neck of the globe, a little hook, to which is fastened a chain *d*, terminated by a brass ball. Above the ferule *a*, is a cock F, crowned by a thick hemisphere of brass, pierced at the bottom. The cock F supports at its upper extremity *a*, an inward screw, by which we can raise at pleasure the glass tube H which finishes at the top with a ball of blown glass I.

This tube ought to be perfectly cylindrical, and contain a little more than the measure C; and the capacity of the ball I, ought to be of such dimension, as, joined to that of the tube, should make the complement of a second measure, that is to say, that the ball and the tube, taken together, should contain just twice the quantity of liquor necessary to fill the measure C.

Lengthways of the tube H, are fitted and applied two brazen plates, divided into one hundred equal parts, counting from bottom to top, from the place where the length of the tube, up to the beginning of the ball I, represents the capacity of the cylindric vessel C. Such is the construction of the eudiometer of Mr. Volta.

Fig. 30. Plate I. is a crystal flaggon or bottle A, containing about two pints, that it may serve for several experiments: upon its neck, which is cemented into a ferule of brass, is fitted the cock B, and above the cock a socket with an inward screw, by which means it can admit the cock B in the apparatus before described: let us suppose this bottle full of inflammable air; laying aside then the funnel A (*fig. 30*) belonging to the eudiometer. This figure it may be mounted upon, and it is obvious that if we open both the cocks, the measure C will fill itself with inflammable air. In the same manner we may proceed to send up into that measure whatever sort of air we wish to try, and with which the bottle will immediately be filled; and by this means we may work without the assistance of the tub.

POD, among botanists, a species of pericarpium, consisting of two valves, which open from the base to the point, and are separated by a membranaceous partition, from which the seeds hang by a kind of funiculus umbilicalis. It is, in plain language, the shell or bulk of any kind of pulse. See the System, Sect. III. Art. V.

PODAGRA, Πονάγρα, thus called from πόνος, foot, and ἀλγος, capture, seizure, in medicine, the gout in the feet. For description, causes, and cure, of the several kinds of gout, see the System, Genus 24.

PODURA, in entomology, a genus of the aptera insects. For description and classification, see the System, Order VII.

POEM, Ποίημα, a composition in verse, of a due length and measure.

POETICAL, Ποιητικός, something that relates to poetry or poets. In this sense we say, a poetical genius, a poetical phrase, poetical licence, poetical fury, &c. Most languages have their poetical words, which are never used on other occasions. These prove of great advantage to the poets, who are hereby enabled to raise the style and diction into the poetical character, with the greater ease. The French often lament the want of a set of such words in their language; for want whereof, their poetry appears in too familiar a garb, not sufficiently distinguished from the common language. It is too reserved, not being allowed any boldness or flights, but what might pass in prose. To this, in good measure, is attributed the little success their authors have met with in the epic way.

POETRY, Ποίησις, the art of composing poems, or pieces in verse. The word is formed from the Greek, ποιήσα, of ποιέω, facio, I make. Amidst those thick clouds which envelope the first ages of the world, reason and history throw some lights on the origin and primitive employment of this divine art. Reason suggests, that before the invention of letters, all the people of the earth had no other method of transmitting to their descendants the principles of their worship, their religious ceremonies, their laws, and the renowned actions of their sages and heroes, than by poetry; which included all these objects in a kind of hymns that fathers sung to their children, in order to engrave them with indelible strokes in their hearts. History not only informs us, that Moses and Miriam, the first authors that are known to mankind, sung, on the borders of the Red Sea, a song of divine praise, to celebrate the deliverance which the Almighty had vouchsafed to the people of Israel, by opening a passage to them through the waters; but it has also transmitted to us the song itself, which is at once the most ancient monument and a masterpiece of poetic composition.

The Greeks, a people the most ingenious, the most animated, and in every sense the most accomplished, that the world ever produced—strove to ravish from the Hebrews the precious gift of poetry, which was vouchsafed them by the Supreme Author of all nature, that they might ascribe it to their false deities. According to their ingenious fictions, Apollo became the god of poetry, and dwelt on the hills of Phocis, Parnassus, and Helicon, whose feet were washed by the waters of Hyppocrene, of which each mortal that ever drank was seized with a sacred delirium. The immortal swans floated on its waves. Apollo was accompanied by the Muses—those nine learned sisters—the daughters of Memory: and he was constantly attended by the Graces. Pegasus, his winged courser, transported him with a rapid flight into all the regions of the universe. Happy emblems! by which we at this day embellish our poetry, as no one has ever yet been able to invent more brilliant images.

The literary annals of all nations afford vestiges of poetry, from the remotest ages. They are found among the most savage of the ancient barbarians, and the most desolate of all the Americans. Nature asserts her rights in every country, and every age. Tacitus mentions the verses and the hymns of the Germans, at the time when that rough people yet inhabited the woods, and while their manners were still savage. The first inhabitants of Runnia, and the other northern countries, those of Gaul, Albion, Iberia, Ausonia, and other nations of Europe, had their poetry, as well as the ancient people of Asia, and of the known borders of Africa. But the simple productions of nature have constantly something unformed, rough, and savage. The Divine Wisdom appears to have placed the ingenious and polished part of mankind on the earth, in order to refine that which comes from her bosom rude and imperfect: and thus art has polished poetry, which issued quite naked and savage from the brains of the first of mankind.

But what is poetry? It would be to abridge the limits of the poetic empire, to contract the sphere of this divine art, should we lay, in imitation of all the dictionaries and other treatises on versification, That poetry is the art of making verses, of lines or periods that are in rhyme or metre. This is rather a grammatical explanation of the word, than a real definition of the thing, and it would be to degrade poetry thus to define it. The justest definition seems to be that given by Baron Bielsfield. That poetry is the art of expressing our thoughts by fiction. In fact, it is after this manner (if we reflect with attention) that all the metaphors and allegories, all the various kinds of fiction, form the first materials of a poetic edifice: it is thus that all images, all comparisons, illusions, and figures, especially those which personify moral subjects, as virtues and vices, concur to the decorating of such a structure. A work, therefore, that is filled with invention, that incessantly presents images which render the reader attentive and affected, where the author gives in-

teresting sentiments to every thing that he makes speak, and where he makes speak, by sensible figures, all those objects which would affect the mind but weakly when clothed in a simple prosaic style, such a work is a poem. While that, though it be in verse, which is of a didactic, dogmatic, or moral nature, and where the objects are presented in a manner quite simple, without fiction, without images or ornaments, cannot be called poetry, but merely a work in verse; for the art of reducing thoughts, maxims, and periods, into rhyme or metre, is very different from the art of poetry.

An ingenious fable, a lively and interesting romance, a comedy, the sublime narrative of the actions of a hero, such as the Telemachus of M. Fenelon, though written in prose, but in measured prose, is therefore a work of poetry; because the foundation and the superstructure are the productions of genius, as the whole proceeds from fiction; and truth itself appears to have employed an innocent and agreeable deception to instruct with efficacy. This is so true, that the pencil also, in order to please and affect, has recourse to fiction; and this part of painting is called the poetic composition of a picture. It is therefore by the aid of fiction that poetry, so to speak, paints its expression, that it gives a body and a mind to its thoughts, that it animates and exalts that which would otherwise have remained arid and insensible. Every work, therefore, where the thoughts are expressed by fictions or images, is poetic; and every work where they are expressed naturally, simply, and without ornament, although it be in verse, is prosaic. Verse, however, is not to be regarded as foreign or superfluous to poetry. To reduce those images, those fictions, into verse, is one of the greatest merits in a poem: and for these reasons, the cadence, the harmony of sounds, particularly that of rhyme, delight the ear to a high degree, and the mind insensibly repeats them while the eye reads them. There results, therefore, a pleasure to the mind, and a strong attachment to these ornaments: but this pleasure would be frivolous, and even childish, if it were not attended by a real utility. Verses were invented, in the first ages of the world, merely to aid and to strengthen the memory; for cadence, harmony, and especially rhyme, afford the greatest assistance to the memory that art can invent; and the images, or poetic fictions, that strike our senses, assist in graving them with such deep traces in our minds, as even time itself frequently cannot efface. How many excellent apophthegms, sentences, maxims, and precepts, would have been buried in the abyss of oblivion, if poetry had not preserved them by its harmony? To give more efficacy to this lively impression, the first poets sung their verses, and the words and phrases must necessarily have been reduced, at least in cadence, or they could not have been susceptible of musical expression. One of the great excellencies, therefore, though not a necessary constituent, of poetry, consists in its being expressed in verse.

If a verse be considered as a mere series of just six feet following one after another in the same line, poetry and versification will appear two very different things; but Boffu, in his idea of verse, includes cadences, peculiar constructions, arrangements, and expressions unknown in common discourse; and, above all, a certain noble, bold, elevated, and metaphorical turn and manner of diction. These, he observes, are so essential to poetry, that without them the most exact arrangement of long and short syllables make little else but a kind of measured prose; whereas these, in a discourse that has no poetical feet or measures, do yet give it the poetical character, and make it a kind of unmeasured poetry. The rules of poetry and versifying are taught by art, and acquired by study; but this force and elevation of thought, which Horace calls, something divine, and which alone makes the poetry of any value, must be derived from nature; or, according to Aristotle, from some happy transports, to which that author gives the name of madness: Εὐφροσύνη ἢ τῷ πνεύματι ἐστὶν ἡ μαδία. But there must be conceived a just solid judgment, to direct and govern this fury of the poet's imagination.

Hence the critic concludes, that the end of poetry is to please; its cause, either the excellence of the poet's genius, or a poetical fury, and transport of the soul, manageable by the judgment; its matter, long and short syllables, and feet composed hereof, with words furnished by grammar; and its form, the arrangement of all these things in just and agreeable verse, expressing the thoughts and sentiments of the author after the manner already mentioned. But, after all, how narrow are these bounds, if we consider poetry in the light wherein the works of Homer and Virgil have set it. What is here laid down pretends to no praise, which a mere translator may not rise to, and which the war of Catiline might not merit, if turned out of the prose of Sallust. It is with reason, therefore, that we distinguish the low and simple from the greater poetry; by giving the former the title of versification; and that we make poetry and versification two distinct arts: in effect, there is not more difference between grammar and rhetoric, than between the art of making verses, and that of inventing poems. The greater poetry, then, consists principally in fiction, or the invention of fables; in the expressing of things by allegories and metaphors; and in the inventing of actions, under which the truths which the poet has to teach may be agreeably disguised.

In this view, scarce any poems retain the nature and essence of the grand poetry, but the epopœia, tragedy, and comedy; the rest, be they elegies, satires, songs, or what they will, come under the name of versification. The ancient eloquence, it is observed, was

full of mysteries and allegories. The truth was by them usually disguised under those ingenious inventions, called *μῦθοι*, *fables*, q. d. *words*; as if there were as much difference between these fabulous discourses of the learned, and the common language, as between the speech peculiar to man and the voice of brutes.

At first, fables were chiefly used in treating of the divine nature, after the manner they then conceived of it; this occasioned the first poets to be called divines, and poetry the language of the gods. The divine attributes they separated into a number of persons; because the weakness of the human mind could not conceive so much power, and so much action, in a simplicity so strict and indivisible as that of God. Nor could they speak of the operation of this almighty cause, without speaking likewise of its effect. They therefore added physics to their theology, handling both after the same manner, without quitting their veils or allegories.

Now man being the most considerable of all the works of the Deity, and there being nothing so proper for poets, or of such general use to mankind as such a subject, they therefore added ethics to the former, and treated the doctrine of manners in the same way as they had done divinity and physiology: and hence arose the *epopœia*, or epic poem. The epic poets have done with regard to morality, just the contrary of what the divine poets did for their theology. As the too great diversity of divine actions and perfections, so little proportioned to our understanding, occasioned the latter to divide the single idea of the simple essence of God into several persons, under different names, as Jupiter, Juno, Neptune, &c.; so, on the contrary, the nature of moral philosophy, which never gives any rules for particular things, occasioned the epic poets to unite in one single idea, in the same person, and even in a single action, whatever of the like kind occurs in different persons and different actions.

Thus, says Aristotle, *poetry* teaches moral philosophy, not by reciting historically what Alcibiades has done or suffered, but proposing what such a person, whom the poet calls by any name he pleases, would necessarily or probably have done or said on the like occasion. It is in this manner that *poetry* represents either the unhappy consequences of designs ill concerted, of wicked actions, &c.; or the reward of good actions, and pleasure reaped from a design laid in virtue, and conducted by prudence. Thus, according to our critic, the poetical actions and persons are all feigned, allegorical, and universal, and historical, and singular. This is likewise the sentiment of Horace; who adds, that poets teach morality as well as philosophy; but the preference herein he gives to Homer. This advantage of the poets over mere philosophers arises hence, that all *poetry* is an imitation. Now imitation is a thing extremely natural; and hence this manner of proposing things becomes better fitted to engage the auditors. Again, imitation is an instruction given by examples; and examples are the more proper to persuade, because they prove the thing possible. In effect, imitation is so much the nature of *poetry*, that, Aristotle tells us, it is to this the art owes its rise. But the poets, by becoming philosophers, did not cease to be divines; on the contrary, the morality they taught obliged them frequently to introduce the Deity in their works; and the share so august a Being had in the action, obliged the poet to make it grand, important, and conducted by the persons of kings and princes. Add to this that it likewise obliged the poet to think and speak after a manner elevated above the common pitch of men, and to use phrases equal, in some measure, to the divine persons he introduced; and to this purpose served the poetical, figurative language, and the majesty of heroic verse. To convey their truths to the best advantage, and adapt them to the particular purposes they were intended for, poets found out various forms. Hence the *epopœia* and drama. Epic *poetry* is more for the habits and manners than the passions; these last rise all at once, and their violence is but of a short duration; but the habitudes are cooler and more gentle, and rise and fall more slowly. The epic action, therefore, could not be restrained to a day or two, as that of the drama; a longer and a juster space was required for this than for tragedy, which is only for the passions. And hence arose a still greater difference between tragedy and the *epopœia*. For the tragic violence required a stronger and more lively representation than the epic; and accordingly it consists wholly in the action, the poet never speaking, as he does in the *epopœia*, where there are no actors.

POINT, in geography and astronomy, a point marked in the globes, and distinguished by its peculiarity. See *Treatise on the Globes*.

POINTS, in electricity, are those acute terminations of bodies which facilitate the passage of the electrical fluid from or to such bodies. For experiments on the influence of *points*, see the *System*, Sect. II. ART. V.

POINT, in geometry, according to Euclid, is a quantity which has no parts, or which is indivisible. See the *System*, Part I. Sect. I.

POINT, in grammar, is a character used to mark the divisions of discourse. The *point proper* is what we otherwise call a *full stop*, or period, and serves to denote the sense complete, and the period ended. Two *points* usually mark the middle of a period, and shew a construction complete, and the sense to be perfect; yet intimating something to come after it: this we call a COLON. See the *System*, Part II. Chap. IV. ART. PUNCTUATION.

POINTS, in heraldry, are divisions of the eschutcheon into several squares, sometimes to the number of 9, sometimes to 15; some whereof are of one colour or metal, the others of another; called also *equipollent points*. There is also another, and that more frequent division of the eschutcheon into *points*, which have several names and values, according to their several places. There are nine principal *points* in an eschutcheon. See the *System*, Sect. I.

POINT, in optics, is that wherein converging rays meet; generally called the *focus*. See the *System*, Part I. Sect. I.

POINT, in perspective, a term used for various places with regard to the perspective plane. See the *System*, Sect. III.

POISON, any substance which proves destructive to the life of animals in a small quantity, either taken by the mouth mixed with blood, or applied to the nerves. Of poisons there are many different kinds, and these are various in their operations. The mineral poisons, as arsenic and corrosive mercury, seem to attack the solid parts of the stomach, and to produce death by eroding its substance: the antimonials seem rather to attack the nerves, and to kill by throwing the whole system into convulsions; and in this manner also most of the vegetable poisons seem to operate. All of these, however, appear to be inferior in strength to the poison of some of the more deadly kinds of serpents, which operate so suddenly that the animal bit by them would be dead before another that had swallowed arsenic would be affected. Some poisons attack equally all the parts; some only a particular one. Thus, the *lepus marinus* is an enemy to the lungs, cantharides to the bladder, &c. Some things, again, which prove *poison* to man, serve for food to other animals. Thus, *mendragora* and *henbane* feed hogs, though they kill man: and thus that deadly *poison* hemlock is wholesome for goats. The *casivi* plant, sir Hans Sloane tells us, *poisons* unprepared; but prepared, is the common bread of the West-Indies, particularly in Jamaica, and the hotter parts; and is used to victual ships. Nay, what is more, some *poisons* are not only food, but even physic, to other animals. In the *Philos. Transact.* we have an instance of a horse, troubled with a farcy, which could not be cured by the most famed remedies, which yet cured himself in a short time, by feeding greedily on hemlock. Fontanus also tells us of a woman, who ate hemlock for some time, to procure sleep, and with very good effect, though repeated doses of opium had no operation.

Much has been written concerning a poison made use of by the African negroes, by the Americans, and by the East Indians. This *poison*, which seems to be of a very subtle and dangerous nature, is extracted by fire from divers plants, especially from those which the French call *lianes*. To this, very strange effects have been ascribed. It has been said, that by this poison a man might be killed at any certain time; as, for instance, after the interval of a day, a week, a month, a year, or even several years. These wonderful effects, however, do not seem worthy of credit; as the abbé Fontana has given a particular account of an American poison, called *ticunas*, which in all probability is the same with that used in Africa and the East Indies; and from this account it is extremely improbable that any such effects could be produced with certainty.

With this poison the Abbé was furnished by Dr. Heberden. It was closed and sealed up in an earthen pot inclosed in a tin case. Within the tin case was a note containing the following words: "Indian poison, brought from the banks of the river of the Amazons by Don Pedro Maldonado. It is one of the sorts mentioned in the Philosophical Transactions, vol. xlvii. number 12." In the volume of the Philosophical Transactions here quoted, mention is made of two poisons little different in their activity; the one called the *poison of Lamas*, and the other of *Ticunas*. The poison in the earthen vessel used by the Abbé Fontana was that of the *Ticunas*; but he was also furnished with a number of American arrows dipped in poison, but whether that of the *Lamas* or *Ticunas* he could not tell. Our author begins his account of the nature of this poison with detecting some of the mistakes which had been propagated concerning it. It had been asserted that the *Ticunas* poison proves noxious by the mere effluvia, but much more by the steam which exhales from it in boiling or burning; that, among the Indians, it is prepared only by women condemned to die; and that the mark of its being sufficiently prepared is when the attendant is killed by its steam. All these assertions are by the Abbé refuted in the clearest manner. He exposed a young pigeon to the smell of the poison when the vessel was opened, to the steam of it when boiling, and to the vapour of it when burning to the sides of the vessel, without the animal's being in the least injured; on which, concluding that the vapours of this poison were not to be dreaded, he exposed himself to them without any fear.

The most fatal operation of this poison is when mixed with the blood. The smallest quantity, injected into the jugular vein, killed the animal as if by a stroke of lightning. When applied to wounds in such a manner that the flowing of the blood could not wash it away, the animal fell into convulsions, and a train of fatal nervous symptoms, which put an end to its life in a few minutes. Yet, notwithstanding these seeming affections of the nerves, the poison proved harmless when applied to the naked nerves themselves, or even to the medullary substance of them slit open. The strength of this poison seems to be diminished, and even destroyed by mineral acids, but not at all by alkalis or ardent spirits; but if the

fresh poison was applied to a wound, the application of mineral acids immediately alter could not remove the pernicious effects. So far, indeed, was this from being the case, that the application of nitrous acid to the wounded muscle of a pigeon, killed the animal in a short time, without any poison at all. The effects of the arrows were equally fatal with those of the poison itself. The Indians, in various places of South America, prepare this *poison*, and make use of it for the killing of wild beasts, in this manner. Those savages are very dextrous at making long trunks, which are the most common weapons used by them in hunting. To these trunks, or tubes they fit little arrows, made of palm-tree, on which they put a little roll of cotton, exactly fitting the bore of the tube. They shoot these with their breath, and seldom miss their mark. They dip the points of these little arrows, as well as of those of their bows, in this *poison*; which is so active, that in less than a minute, especially when fresh, it kills certain animals from which the arrow has drawn blood.

Though a very small drop of this *poison*, conveyed into the blood by puncture, is sometimes sufficient to kill a man, or at least to cause great disturbance in the animal economy, it is quite otherwise when taken in at the mouth; for then it does no sort of mischief. See Phil. Trans. loc. cit. The negroes use a *poison* of an extraordinary nature. The dose is very small; and it hath no ill taste; so that, mixed with meat or drink, it is not perceivable.

The poison of the viper is analogous in its effects to that of ticusas, but inferior in strength; the latter killing more instantaneously, when injected into a vein, than even the poison of the most venomous rattle-snake.

In the Philosophical Transactions, No. 335, we have a number of experiments which show the effects of many different poisons upon animals; from whence it appears, that many substances which are not at all accounted poisonous, yet prove as certainly fatal when mixed with the blood, as even the poison of rattle-snakes, or the ticusas itself. A drachm and a half of sal-ammoniac dissolved in an ounce and a half of water, and injected into the jugular vein of a dog, killed him, with convulsions, almost instantly. The same effect followed from injecting a drachm of salt of tartar dissolved in an ounce of warm water; but a drachm and a half of common salt, injected into the jugular, produced little other bad consequence than a temporary thirst. A drachm of purified white vitriol, injected into the crural vein of a dog, killed him immediately. Diluted aquafortis, injected into the jugular and crural vein of a dog, killed him immediately, by coagulating the blood. Oil of sulphur (containing some quantity of the volatile vitriolic acid) did not kill a dog, after repeated trials. On the contrary, as soon as he was let go, he ran into all the corners of the room searching for meat; and having found some bones, he fell to gnawing them with strange avidity, as if the acid, by injection into the veins, had given him a better appetite. Another dog, who had oil of tartar injected into his veins, swelled and died, after suffering great torment. His blood was found florid, and not coagulated. A drachm and a half of spirit of salt, diluted with water, and injected into the jugular vein of a dog, killed him immediately.

These are the results of the experiments where saline substances were injected into the veins. Many acids proved equally fatal, a description of two drachms of white hellebore, injected into the jugular vein, killed like a stroke of lightning. Another dog was killed in a moment by an injection of an ounce of all rectified spirit of wine, in which a drachm of camphor was dissolved. Two drachms of highly rectified spirit of wine, injected to the crural vein of a dog, killed him in a very short time: he died quietly, and licking his jaws with his tongue, as if with pleasure. In the vena cava and right ventricle of the heart, the blood was coagulated into a great many clots. An ounce of strong decoction of tobacco, injected into a vein, killed a dog in a very short time, in terrible convulsions. Ten drops of oil of sage, rubbed with half a drachm of sugar, and thus dissolved in water, did no harm by being injected into the blood.

Mercury, though seemingly void of all acrimony, proves also fatal when injected into the blood. Soon after the injection of half an ounce of this mineral into the jugular vein of a dog, he was seized with a dry short cough, which came by intervals. About two days after, he was troubled with a great difficulty of breathing, and made a noise like that of a broken-winded horse. There was no tumour about the root of the tongue, or the parotid glands, nor any appearance of a salivation. In four days he died; having been for two days before so much troubled with an orthopnea, that he could not sleep, only when he leaned his head against something. When opened, about a pint of bloody serum was found in the thorax, and the outside of the lungs, in most places, was blistered. Some of the blisters were larger, and others smaller, than a pea; but most of them contained mercurial globules. Several of them were broken; and upon being pressed a little, the mercury ran out, with a mixture of a little sanies; but upon stronger pressure, a considerable quantity of sanies issued out. In the right ventricle of the heart some particles of quicksilver were found in the very middle of the coagulated blood lodged there, and the same thing also was observed in the pulmonary artery. Some blood also was found coagulated in a very strange and unusual manner between the columns of the right ventricle of the heart, and in this a greater quantity of quicksilver than any where else. In the left ventricle was found a

very tenacious blood, coagulated, and sticking to the great valve, including the tendons of it; and a little resembling a polypus. No mercury could be found in this ventricle by the most diligent search; whence it appears, that the mercury had passed no farther than the extremities of the pulmonary artery, where it had stuck, and occasioned fatal obstructions. In another dog, which had mercury injected into the jugular, it appears to have passed the pulmonary artery, as part of it was found in the cavity of the abdomen, and part also in some other cavities of the body. All the glandules were very turgid and full of liquor, especially in the ventricles of the brain, and all round there was a great quantity of serum.

In like manner, oil of olives proves certainly fatal when injected into the blood. Half an ounce of this, injected into the crural vein of a dog, produced no effect in half a quarter of an hour: but after that, the animal barked, cried, looked dejected, and fell into a deep apoplexy; so that his limbs were deprived of all sense and motion, and were flexible any way at pleasure. His respiration continued very strong, with a snorting and wheezing, and a thick humour, sometimes mixed with blood, flowing out of his mouth. He lost all external sense: the eyes, though they continued open, were not sensible of any objects that were put to them; and even the cornea could be touched and rubbed, without his being in the least sensible of it: his eye-lids, however, had a convulsive motion. The hearing was quite lost; and in a short time the feeling became so dull, that his claws and ears could be bored with red-hot pincers without his expressing the least sense of pain. Sometimes he was seized with a convulsive motion of the diaphragm and muscles subservient to respiration; upon which he would bark strongly, as if he had been awake: but this waking was only in appearance; for all the time of this barking, he continued as insensible as ever. In three hours he died; and on opening his body, the bronchiae were filled with a thick froth. An ounce of oil of olives injected into the jugular of another dog, killed him in a moment; but a third lived an hour after it. He was seized with great sleepiness, snorting, and wheezing, but did not bark like the first. In all of them, a great quantity of thick froth was found in the lungs. The poisons which prove mortal when taken by the mouth, are principally of arsenic, corrosive mercury, glass of antimony, and lead. The effects of opium, when injected into the veins, seem to be similar to its effects when taken by the mouth. The pernicious effects of laurel-water is confirmed by the late experiments of the Abbé Fontana; who tells us, that it not only kills in a short time when taken by the mouth, but that, when given in small doses, the animal writhes so that the head joins the tail, and the vertebræ arch out in such a manner as to strike with horror every one who sees it.

We ought now to give some account of the proper antidotes for each kind of poison; but from what has been related concerning the extreme activity of some of them, it is evident that in many cases there can be but very little hope. People are most commonly bit by serpents in the legs or hands; and as the poison, from the Abbé Fontana's experiments, appears to act only in consequence of being absorbed into the blood, it is plain, that to prevent this absorption is the chief indication of cure. Various methods have been recommended for this purpose; but the Abbé Fontana proposes a method, namely, a ligature. This, if properly applied between the wounded part and the heart, must certainly prevent the bad effects of the poison: but then it tends to produce a disease almost equally fatal; namely, a gangrene of the part; and our author gives instances of animals being thus destroyed, after the effects of the poison were prevented; for which reason he prefers amputation. But the good effects of either of these methods, it is evident, must depend greatly on the nature of the part wounded, and the time when the ligature is applied, or the amputation performed. If the teeth of the serpent, or the poisoned arrow, happens to strike a large vein, the only possibility of escaping instant death, is to compress the trunk of the vein above the wounded place, and to enlarge the wound, that the blood may flow freely and in large quantity, in order to wash away the poison, and discharge the infected parts of the blood itself. If this is neglected, and the person falls into the agonies of death, perhaps strongly stimulating medicines, given in large doses, and continued for a length of time, may enable nature to counteract the virulence of the poison. For this purpose volatile alkalies seem most proper, as acting soonest; and perhaps a combination of them with ether might be advantageous, as by the volatility of that medicine the activity of the alkali would probably be increased. In the Philosophical Transactions, we have an account of the recovery of a dog seemingly by means of the volatile alkali, when probably he was in a dying condition. This dog indeed, seems to have had a remarkable strength of constitution. The poor creature had first got two ounces of the juice of nightshade, which he bore without any inconvenience. An equal quantity of the juice of hemlock was then given him without effect. He then got a large dose of the root of wolfsbane, with the same success. Two drachms of white hellebore-root were next given. These caused violent vomitings and purgings, but still he outlived the operation. He was then made to swallow five roots of the colchicum, or meadow-saffron, dug fresh out of the earth. The effect of these was similar to that of the white hellebore, but still he did not die. Lastly, he got two drachms of opium; and he outlived this dose. He was first cast into a deep sleep by it; but soon

soon awaked, and was seized with violent vomitings and purgings, which carried off the effect of the opium. Seeing, then, that the animal had resisted the most violent poisons, it was resolved to try the effects of the bite of a viper; and he was accordingly bit three or four times on the belly, a little below the navel, by an enraged viper. The immediate consequence of this was an incipient gangrene in the parts adjoining to the wound, as appeared by the rising of little black bladders filled with a sanious matter, and a livid colour, which propagated itself all around. The motion of the heart became very faint and irregular, and the animal lay without strength or sensation, as if he had been seized with a lethargy or apoplexy. In this condition his wound was cupped and scarified, and Venice treacle (a famous antidote) applied to it. In two hours after this all the symptoms were increased, and he seemed to be near death: upon which half a drachm of volatile salt of hartshorn, mixed with a little broth, was poured down his throat; and the consequence was, that, in a short time, he was able to stand on his feet and walk. Another dose entirely dispelled his lethargy, and the heart began to recover its strength. However, he continued very weak; and though he ate no solid meat for three days, yet, at the end of that time, his strength was evidently increased. The first day he drank water plentifully and greedily; and, on the second day, he drank some broth. On the third day he began to eat solid meat, and seemed out of danger; only some large and foul ulcers remained on that part of the belly which was bit, and before these were healed he was killed by another dog.

From comparing this with some other observations, indeed, it would seem that volatile alkali is the best antidote against all poisons which suddenly kill by a mixture with the blood, and even of some others. Thus, on the testimony of Dr. Mead, it counteracts the deadly effects of the laurel-water. Here we see that it cured the bite of a viper; and, from Dr. Wolfe's experiments on hydrophobic patients, it may even claim some merit there. Still, however, there is another method of attempting a cure in such deplorable cases; and that is by injecting into the veins any thing which will not destroy life, but will destroy the effects of the poison. It is much to be regretted that, in those cruel experiments which we have already related, the intention seems almost always to have been to kill the animal at all events; whereas it ought to have been to preserve him alive, and to ascertain what medicines could be safely injected into the blood, and what could not, with the effects which followed the injection of different quantities, none of which were sufficient to destroy life. But, in the way they were managed, scarce any conclusion can be drawn from them. Thus, when it was found that half an ounce of olive-oil, injected into the jugular vein, killed a dog in a short time, to what purpose, except to gratify mere wanton cruelty, was it to inject a whole ounce into the jugular of another dog? Certainly, instead of this quantity, only a few drops ought to have been tried, which might have acted medicinally, or, at worst, brought on a disorder that would have been curable. A quantity of diluted aquafortis, we are told, coagulated all the blood in the vessels; but this effect might easily have been guessed *a priori*, from its effect on the blood taken out of the body. Ought it not, then, to have been tried in such small quantity, and so much diluted, that its coagulating power would not have destroyed life? However, even as they stand, the experiments are useful; because they shew that some medicinal liquors may be injected into the veins of animals without destroying life; that thus they produce powerful effects, and therefore may remove diseases. They deserve, therefore, to be well considered, and often repeated, but in a more merciful manner. As to the performance of such operations on the human body, it is by no means to be encouraged. What we have said concerning a possibility of curing poisons by this method, is to be looked upon as merely speculative, and thrown out as a hint for further experiments. Besides all this, there remains another method of cure in desperate cases, when there is a certainty that the whole mass of blood is infected: and that is, by the bold attempt of changing the whole diseased fluid for the blood of a sound animal. Experiments of this kind have also been tried; and the method of making them, together with the consequences of such as are recorded in the Philosophical Transactions; and such are related under the article TRANSFUSION.

Poisons are distinguished, by some authors, by several names, according to the different time and manner of their taking effect. Some are called *venena terminata*. These are such poisons as perform their fatal office, according to the opinion of the world, at certain stated or determinate periods of time; thus, according to the quantity given, or the nature of the species of poison, a man must be killed by it at the pleasure of the giver. Others are called *delibutoria venena*. These are such as kill without being taken internally, and are surely fatal if rubbed upon the skin, put into gloves, or the like. Of the number of poisons which take a long time to kill, and that different, according to their dose and the habit of the person, are the venom of the toad, and of the mad dog, whether the saliva be communicated immediately to the blood by a wound, or swallowed with food, or with the spittle. The poison of the tarantula is also of this number. The poison of the French pox, *lues venerea*, is also of this kind, and is esteemed highly acrid and alkaline. The poison of cantharides, the acid ones of nitre, salt, vitriol, sulphur; the solutions or crystals of gold, silver, and the other metals;

and the precipitates of mercury, and the very fatal common arsenic. To these are added many others, and among them some which act merely mechanically, by their numerous sharp points and edges. Of the temporaneous poisons, many are taken under the common denominations of food and drink, and seem at first to be of no injury; but by degrees they impair the constitution, and bring on diseases and death. Coffee, tea, and all the spirituous liquors, are accounted of this kind.

Animal Poisons, which are those drawn from animals by the bite or sting: as, the viper, scorpion, *lepus marinus*, &c. The theory of the effects, operations, &c. of animal poisons, is very accurately and mechanically delivered by Dr. Mead, in those remarkable cases, the bites of a viper, tarantula, and mad dog. See his doctrine, under TARANTULA, VIPER, and HYDROPHOBIA.

Vegetable Poisons, as aconite, *cicuta* or hemlock, hellebore, nappellus, &c. which are generally of a narcotic or stupefying quality. With regard to the operation of vegetable poisons, it is observed that, besides heat and pain, they commonly occasion some degree of giddiness, and often a kind of stupidity or folly. See OPIATE and OPIUM.

It has been a general complaint, and indeed too just a one, that the qualities of plants are much less studied than their external appearances; and the best modern authors have contented themselves with nicely characterising plants according to their flowers and seeds, and ascertaining the proper names to each, without at all enquiring how they might be beneficial or hurtful to mankind, or distinguishing whether they were safe medicines or destructive poisons. Nor, indeed, is the investigating the virtue of plants, yet untried as medicines, an easy task; since neither chymical analyses nor experiments on brutes, nor even the taste and smell, and other sensible qualities of plants, can ever certainly assure us what effects they will have on the human body. Chymical analyses alter the substance too much to give any certain knowledge; and the effects things have on one animal, are no assurance of what they will do to another; as is familiar to us in a thousand instances. Bitter almonds, and many other things, wholly harmless to us, kill birds; and goats will eat the tithymals, to give them an appetite when they want it; while those very plants are fatal to fishes, and very dangerous to man. The sensible qualities as often deceive us, of which we might give many instances; and what some have observed of the botanical characters of plants, telling us their virtues, or that all of the same class possess the same qualities, is the most erroneous, and if trusted to, might prove the most fatal of all opinions; since the known poisons, hemlock, phellandrium, and waterdrop-wort with the poisonous juice, are all umbelliferous plants, and consequently of the same family with fennel and angelica.

Nothing can, indeed, assure us, with any degree of certainty, of the virtues of plants, but experiments made on ourselves; but few are to be found who wish so well to the public, as to venture their own lives for its service: and perhaps the honest Gesner is the only man who ever carried these attempts to any degree, and he unhappily died a martyr to them, perishing by the dose he took of the scorpion-rooted dieronicum: the very root which has of late with us been so fatal, by being accidentally mixed with our gentian. What we learn of the vegetable poisons must therefore be either by the consequences of the rash prescriptions or mistakes of ignorant pretenders to medicine, or by the misfortune of those who have unwarily eaten them.

We have accounts in the Memoirs of the Academy of Sciences of Paris, of many things of this kind. An apothecary, a very honest man, but of no knowledge in botany, had made his extract of black hellebore from the roots of christophoriana, or bane-berries, a plant always accounted a poison, and a berry of which is capable of killing several animals; yet so far had the fire dissolved the roots of their poisonous qualities, that twelve grains of this given as an extract of hellebore, proved of no ill effect. Mem. Acad. Scienc. Par. 1739. Another apothecary having learned, that hermodactyls were the roots of a species of colchicum, dried the roots of the common colchicum and sold them in its place; yet there is no knowledge of any ill effects from them. The enquiry into things of this kind has its use, which is very important; since poisons often differ only in dose from medicines, and many of the vegetables esteemed poisonous, may perhaps be found useful remedies, with proper management, and in proper quantities.

The laurel-leaves are well known to afford a poisonous water in distillation, yet it is well known that they have been long used in cookery, to give a taste like that of bitter almonds, to cream, &c. and that without any ill effect. The rose-bay, or oleander, is well known to be a poison to goats, yet is taken by countrymen of strong and robust habits as a purge, and that with very good success. Nay, opium, one of the greatest of all medicines, if it had first been discovered by persons taking over doses of it, and dying by it, as they naturally must have done, might very naturally have been recorded to us as a very fatal poison. The plumbago, or dentillaria of Rondeletius, is so violent a caustic, that a poor girl who once anointed herself with it, to cure her of the itch, was dead alive by it; yet this, properly managed, and infused in oils, has proved one of the greatest of all remedies for cancers. The shrub used in dying, and called by the French *redoul*, by some authors *coriaria*, and by others the mayrtle-leaved *rhys*, is generally known to the world only as a drug

useful in the dressing of leather; but Pliny and some other old writers, have given it the character of an useful external medicine, and a remedy against poison; yet with all this inattention of the moderns, and all the praises of the ancients, this plant is truly a very terrible poison. The grown cattle refuse to feed upon it, but the young lambs and kids often eat of it in those parts of Europe where it is common; and if they eat the full-grown leaves they are killed by it; if the young shoots only, which is more usually the case, they are then only affected with spasms and a sort of drunkenness, of which, after a few hours, they recover. Nor is this singular to this poisonous plant; since it is well known, that many plants, of very improper kinds for food, are yet eaten in their young shoots; and Linnæus has recorded it of the Laplanders, that they even eat the young shoots of the poisonous blue aconite, or wolf's-bane; and even in France they eat the first shoots of the clematis, or flammularepens, the full-grown leaves of which are of so acrid a nature, that they serve the beggars to eat ulcers in their arms and legs, to give them a pretended title to charity.

Mineral POISONS, as arsenic, corrosive sublimate, cerusse, orpiment, realgal, &c. which are commonly of an acrid or corrosive quality. As to mineral poisons, they all bear so much analogy to that made of quicksilver in the common sublimate, that their operation will be easily conceived, from what is laid down under the heads **MERCURY** and **SUBLIMATE**.

They are all more or less dangerous, as their salts receive a greater or less force from the metallic particles: and hence, as the most virulent may be mitigated, by breaking the points of the saline crystals, so the most innocent minerals may become corrosive, by combining them with salts, as is seen in the preparations of silver, antimony, iron, &c. As to the effect of arsenic, to which that of every other species of corrosive poison is similar, it is observed, that the person who has taken it, soon perceives a burning heat, and a violent pricking pain in his stomach and bowels, with an intolerable thirst, and an inclination to vomit. The tongue and throat feel rough and dry, and, without proper help, the patient is soon seized with great anxiety, hiccupping, faintings, and coldness of the extremities. These are succeeded by black vomits, fetid stools, with a mortification of the stomach and intestines, which are the immediate forerunners of death.

When these symptoms first appear, the patient should drink large quantities of new milk and salad-oil, till he vomits, or warm water with oil; or fat broths; or fresh butter melted or mixed with the milk or water: these are to be drunk, as long as the inclination to vomit continues; nor is it safe to leave off drinking as long as one particle of the poison remains in the stomach. If these liquors do not produce vomiting, half a drachm or two scruples of the powder of ipecacuanha may be given, or a few spoonfuls of the oxymel, or vinegar of squills, may be mixed with the water which is drunk. Or, if other methods fail, half a drachm of white vitriol, or five or six grains of emetic tartar must be administered. If tormenting pains are felt in the lower belly, and there be reason to apprehend, that the poison has got down to the intestines, clysters of milk and oil must be thrown up; and the patient must drink emollient decoctions of barley, oatmeal, marshmallows, and such like. He must likewise take an infusion of fenna and manna, a solution of Glauber's salts, or some other purgative. After the poison has been evacuated, the diet for some time should be cooling and healing, such as milk, broth, gruel, light puddings, and spoon-meats of easy digestion; and the drink should be barley-water, linseed-tea, or infusions of any of the mild mucilaginous vegetables; but all flesh, and strong liquors, should be avoided. *Buchan's Dom. Med. p. 515, ed. 5th.*

Liver of sulphur Mr. Navier recommends as an antidote against metallic poisons. This has been long and successfully applied by others; and in the sixth volume of the *Edinburgh Medical Commentaries*, there is a paper, in which alkaline salts are recommended on the same principle. Dr. Houlston observes, that in all cases of poison, it is prudent immediately to give a solution of an alkali, followed by a vomit. If the poison be corrosive sublimate, an alkali, either fixed or volatile, will decompose it, and precipitate the metal in a form nearly inoffensive. It will have a similar effect on the sugar of lead, emetic tartar, or any metallic salt. If the poison be arsenic, Neumann observes, that alkalis will very plentifully dissolve it: and therefore the vomit will succeed the better to discharge it. If the poison be of the vegetable class, an alkali can be of no service, nor interfere with the other means of remedying by evacuation, nor by the subsequent use of acids, so much insisted upon by Tissot, as counteracting the effects of narcotics; because acids administered with alkaline salts, are pronounced, by Dr. Mead and others, to be attended with great success in this case. The writer, therefore, directs, when symptoms of poison appear, to mix a tea-spoonful of any of the following ingredients: salt of tartar, salt of wormwood, pearlsh, potash, spirit of hartshorn, or sal-volatile, with half a pint of water; and of this let one-half be given to the patient immediately, and the other soon after. It will sometimes give relief, and the vomiting will soon cease. The vomiting, however, is to be promoted by warm water, ipecacuanha, &c. and after each vomiting, a dose of this solution of salt of tartar should be given, and repeated every two or three hours, if the pain of the stomach returns. It should be continued too in small doses, No. 130. Vol. III.

for some time after the symptoms disappear. A little wood-ashes, mixed with boiling water, suffered to stand, and pouring off the water, or filtering it through linen, will answer the same purpose.

The general remedies against poisons are known by the name of *antidotes*, *alexipharmics*, and *alexiterials*. The following rules should be strictly observed with regard to every kind of poison; that when any poisonous substance has been taken into the stomach, it ought as soon as possible to be discharged by vomits, clysters, and purges; and when poison has been received into the body by a wound, that it be expelled by medicines, which promote the different secretions, especially those of sweat, urine, and insensible perspiration; to which may be joined antispasmodics, or such medicines as take off tension and irritation, the chief of which are opium, musk, camphor, and assafoetida.

POISON of Copper. This metal, though when in an undissolved state it produces no sensible effects, becomes exceedingly active when dissolved; and such is the facility with which the solution is effected, that it becomes a matter of some consequence to prevent the metal from being taken into the human body even in its proper form. It does not, however, appear that the poison of copper is equally pernicious with those of the arsenic or lead; much less with some others treated of in the last article. The reason of this is, that it excites vomiting so speedily as to be expelled, even though taken in considerable quantity, before it has time to corrode the stomach. Roman vitriol, which is a solution of copper in the vitriolic acid, has been used as a medicine in some diseases with great success. Verdigris, also, which is another very active preparation of the metal, has been by some physicians prescribed as an emetic, especially in cases where other poisons had been swallowed, in order to procure the most speedy evacuation of them by vomit. Where copper is not used with this view, it has been employed as a tonic and antispasmodic, with which it has been admitted into the last edition of the *Edinburgh Dispensatory*, under the title of *Cuprum Ammoniacale*. The effects of this metal, however, when taken in a pretty large quantity, and in a dissolved state, or when the stomach abounds with acid juices sufficient to dissolve it, are very disagreeable, and even dangerous; as it occasions violent vomitings, pains in the stomach, faintness, and sometimes convulsions and death. The only cure for these symptoms is to expel the poison by vomiting as soon as possible, and to obtund its acrimony; for which purpose drinking warm milk will probably be found the most efficacious remedy. In order to prevent the entrance of the poison into the body, no copper vessels should be used in preparing food but such as are either well tinned or kept exceedingly clean. The practice of giving a fine blue or green colour to pickles, by preparing them in copper vessels ought not to be tolerated; for Dr. Falconer, in a treatise on this subject, assures us, that these are sometimes so strongly impregnated by this method of preparing them, that a small quantity of them will produce a slight nausea. Mortars of brass or bell-metal ought, for the same, to be avoided, as by this means a considerable quantity of the pernicious metal may be mixed with our food, or with medicines. In other cases, an equal caution ought to be used. The customs of keeping pins in the mouth, of giving copper halfpence to children to play with, &c. ought to be avoided; as thus a quantity of metal may be insensibly taken into the body, after which its effects must be uncertain. It is proper to observe, however, that copper is much more easily dissolved when cold than when hot; and therefore the greatest care should be taken never to let anything designed for food, even common water, remain long in copper vessels when cold: for it is observed, that though the confectioners can safely prepare the most acid syrups in clean copper vessels without their receiving any detriment whilst hot, yet if the same syrups are allowed to remain in the vessels till quite cold they become impregnated with the pernicious qualities of the metal.

POLAR, something that relates to the poles of the world. In this sense we say polar virtue, polar tendency, &c. See **POLARITY**.

POLARITY, the quality of a thing considered as having poles. By heating an iron bar, and letting it lie in a vertical posture, it acquires a polarity. The lower end becomes the north pole, the upper the south. Iron bars acquire a polarity, by being kept a long time in an erect posture, even without heating. Thus, the bars of windows, &c. are frequently found to have poles. Nay, a rod of iron acquires a polarity, by the mere holding it erect; the lower end, in that case, attracting the south end of a magnetic needle, and the upper, the north end. But these poles are mutable, and shift with the situation of the rod. See **MAGNET**. Some modern writers, particularly Dr. Higgins, in his *Philosophical Essay concerning Light*, have maintained the polarity of the parts of matter, or that their simple attractions are more forcible in one direction, or axis of each atom, than in any other.

POLE, *Polus*, Πόλος, formed from *πολεω*, to turn, in astronomy, one of the extremities of the axis, whereon the sphere revolves. These two points, each 90 degrees distant from the equator, are called, by way of eminence, the *poles of the world*. See the *System*, Sect. IX.

POLE in geography, is the extremity of the earth's axis, or one of the points on the surface of our globe, through which the axis passes. See *Treatise on the Globes*, under the article *Description*.

POLES, in magnetics, are two points in a loadstone, corresponding

ing to the poles of the world; the one pointing to the north, the other to the south. See MAGNET.

POLE-Cat, the English name of the *Putorius*, a species of the genus *Mustela* in the system of mammalia. For the description, see MUSTELA. For representation, see the Plates, Genus 15.

POLICY, or **POLITY**, ΠΟΛΙΤΕΙΑ, the laws, orders, and regulations, prescribed for the conduct and government of states and communities. The word is of Greek original, being derived from the Greek πολις, *civitas*, city or state. In the general, policy is used in opposition to barbarism. Different states have different kinds of policy: thus the policy of Athens differed from that of Sparta. Loiseau observes, that policy properly signifies the course and administration of justice in a city. The direction of the policy of London is in the hands of the lord-mayor. Some divide policy into two parts, *agoronomy*, that relating to affairs of merchandize; and *astynomy*, that concerning the civil and judiciary government of the citizens. Some add a third branch, viz. what relates to the ecclesiastical government. In much the same sense is used the modern term *police* or *public economy*, to denote the due regulation and domestic order of the kingdom; whereby the individuals of the state, like members of a well-governed family, are bound to conform their general behaviour to the rules of propriety, good neighbourhood, and good manners; and to be decent, industrious, and inoffensive, in their respective stations. See GOVERNMENT.

POLITICAL Arithmetic, is the application of arithmetical calculations to political uses and subjects: as the public revenues, number of people, extent and value of lands, taxes, trade, commerce, manufactures, or whatever relates to the power, strength, riches, &c. of any nation or commonwealth; or, as Davenant concisely defines it, the art of reasoning by figures, upon things relating to government. See the articles CHANCE, MORTALITY, and the System of ANNUITIES.

POLITICS, Πολιτικη, πολιτικη from πολις, *civitas*, state, the first part of economy, or ethics, consisting of the governing and regulating of states, for the maintenance of the public safety, order, tranquillity, and good morals. Lord Bacon divides politics into three parts, with regard to the three grand ends thereof, or the three offices incumbent on those who have the administration, viz. the preservation of the state; the happiness and flourishing of the state; and the enlargement of its bounds. The two first parts, he observes, are well handled by several authors; but about the third there is a deep silence. He ranks this, therefore among the number of the desiderata, and gives us a specimen of an essay to supply it.

POLLEN, the fecundating or fertilizing dust contained within the antheræ or tops of the stamina, and dispersed upon the female organ when ripe, for the purpose of impregnation, see the System of BOTANY, Sect. III. Art. III.

This dust, corresponding to the seminal fluid in animals, is commonly of a yellow colour; and is very conspicuous in the summits of some flowers, as the tulip and lily. Its particles are very minute, and of extreme hardness. Examined by the microscope, they are generally found to assume some determinate form, which often predominates, not only through all the species of a particular genus, but also through the genera of a natural family or order. The powder in question being triturated, and otherwise prepared in the stomach of bees, by whom great quantities are collected in the hairy brush with which their legs are covered, is supposed by some authors to produce the substance known by the name of wax; a species of vegetable oil, rendered concrete by the presence of an acid, which must be removed before the substance can be rendered fluid.

POLL-MONEY, or capitation, a tax formerly imposed by authority of parliament, on the person, or head, either on all indifferently, or according to some known mark of distinction; as quality, calling, &c. Thus, by the statute 18 Car. II. every subject in the kingdom was assessed by the head or poll, according to his degree; every duke 100*l.* marquis 80*l.* baronet 30*l.* knight 20*l.* esquire 10*l.* &c. and every single private person 12*d.* This was no new tax, as appears by former acts of parliament; particularly that anno 1380, where, *quilibet tam conjugatus quam solutus, utriusque sexus, pro capite suo solve cogebatur*. Walsing. Camden in his Remains of Coins, says, there was anciently a personal tribute called *capitatio* or *poll-silver*, imposed on the poll or person of every one; on women from the age of twelve years, and on men from fourteen.

POLLUTION, or *Self-POLLUTION*, is used for the abusing or defiling of one's own body, by means of lascivious frictions and titillations, raised by art, to produce emission. We read in scripture, that Onan, and, as some critics also think, Er, were severely punished for having polluted themselves by spilling their seed on the ground; whence the crime has been denominated by some ONANIA. See that article. Of *pollutions*, some are voluntary, others involuntary, and nocturnal.

POLLUTION, *pollutio nocturna*, in medicine, the name of a disease which consists in an involuntary emission of the seed in the night, in time of sleep. This, in different persons, is very different in degree; some being affected with it only once a week, a fortnight, three weeks, or even a month, and others being subject to it almost every night. The Romish church puts up prayers in the close

of the evening offices, to be preserved from nocturnal *pollutions*.

POLLUX, in astronomy, the hind twin, or the posterior part of the constellation GEMINI.

POLLUX, is also a fixed star of the second magnitude, in the constellation GEMINI, or the Twins. See the System, Sect. VIII.

POLYADELPHIA, in the Linnæan system of botany, the eighteenth class of plants, whose stamina are formed into three or more separate bodies, comprehending four orders, viz. *pentandria*, *dodecandria*, *icosandria*, and *polyandria*, having respectively five, twelve, and twenty, and many in each set or body. For representation of the several orders, see the System, Plate V.

POLYANDRIA, in the Linnæan system of botany, the thirteenth class of plants with hermaphrodite flowers, and a large number of stamina, or male parts, in each; comprehending seven orders, viz. *monogynia*, *digynia*, *trigynia*, *tetragynia*, *pentagynia*, *hexagynia*, and *polygynia*, distinguished by having one, and three styles. For representation of the several orders, see the System, Plate V.

POLYGAMY, Πολυγαμία, formed from πολυς, *multus*, and γαμη, *uxor*, wife; a plurality of wives, or husbands, held by the same man, or woman, at the same time. Polygamy is prohibited among Christians: but it was allowed among the Jews; as it is still among the Mahometans; and under all the religions that have obtained in Asia. In the kingdoms of Boutan and Thibet, *polygamy* is at this time almost general; one wife frequently serving all the males of a whole family, without being the cause of any uncommon disunion or jealousy among them.

Dr. Percival, Phil. Transf. vol. lxxvi. part i. p. 163, has very justly observed, that the practice is brutal, destructive to friendship and moral sentiment, inconsistent with one great end of marriage, the education of children; and subversive of the natural rights of more than half of the species: besides, it is injurious to population, and, therefore, can never be countenanced or allowed in a well regulated state; for, though the number of females in the world, may considerably exceed the number of males, yet there are more men capable of propagating their species than women capable of bearing children: and it is a well known fact that Armenia, in which a plurality of wives is not allowed, abounds more with inhabitants than any other province of the Turkish empire.

Yet Selden has proved, in his *Uxor Hebraica*, that plurality of wives was allowed of, not only among the Hebrews, but also among all other nations, and in all ages. It is true, the ancient Romans were more severe in their morals, and never practised it, though it was not forbid among them: and Mark Antony is mentioned as the first who took the liberty of having two wives. From that time it became pretty frequent in the empire, till the reigns of Theodosius, Honorius, and Arcadius, who first prohibited it by express law in 393. After this the emperor Valentinian, by an edict, permitted all the subjects of the empire, if they pleased, to marry several wives: nor does it appear, from the ecclesiastical history of those times, that the bishops made any opposition to this introduction of polygamy. In effect there are some even among the Christian casuists, who do not look on polygamy as in itself criminal. Jurieu observes, that the prohibition of polygamy is a positive law; but from which a man may be exempted by sovereign necessity. Baillet adds that the example of the patriarchs is a very powerful argument in favour of polygamy.

It has been much disputed among the doctors of the civil law, whether polygamy be adultery. In the Roman law it is called *stuprum*, and punished as such, that is, in some cases, capitally. But a smaller punishment is more consistent with the Jewish law, wherein the prohibition of adultery is perpetual, but that of polygamy temporary only. See Selden, lib. i. cap. 9, de Uxore Hebraica. In Germany, Holland, and Spain, this offence is differently punished. By a constitution of Charles V. it was a capital crime. By the laws of ancient and modern Sweden, it is punished with death. In Scotland it is punished as perjury.

In England it is enacted by statute 1 Jac. I. cap. 11, that if any person, being married, do afterwards marry again, the former husband or wife, being alive, it is felony, but within the benefit of clergy. The first wife in this case shall not be admitted as an evidence against her husband, because she is the true wife: but the second may, for she is indeed no wife at all; and so *vice versa*, of a second husband. This act makes an exception to five cases, in which such second marriage, though in the three first it is void, is, however, no felony, 1. Where either party hath been continually abroad for seven years, whether the party in England had notice of the other's being alive or no. 2. Where either of the parties hath been absent from the other seven years, within this kingdom, and the remaining party hath not notice of the other's being alive within that time. 3. Where there is a divorce or separation *à mensa et thoro* by sentence in the ecclesiastical court. 4. Where the first marriage is declared absolutely void by any such sentence, and the parties loosed *à vinculo*. Or, 5. Where either of the parties was under the age of consent at the time of the first marriage; for in such case the first marriage was voidable by the disavowment of either party, which this second marriage very clearly amounts to. But if at the age of consent the parties had agreed to the marriage, which completes the contract, and is indeed, the real marriage, and afterwards one of them should marry again, judge Blackstone

Justice apprehends that such second marriage would be within the reason and penalties of the act. Comment. book iv. p. 164.

Bernardus Ochinus, general of the order of Capuchins, and afterwards a protestant, published, about the middle of the sixteenth century, Dialogues in Favour of Polygamy, which were answered by Theodore Beza. And about the conclusion of the last century, we had at London an artful treatise, published in behalf of a plurality of wives, under the title of Polygamia Triumphatrix: the author whereof assumes the name of Theophilus Aletheus; but his true name was Lyserus: he was a native of Saxony. It has been answered by several.

In the year 1780, the Rev. Mr. Madan published a treatise, artfully vindicating, and strongly recommending, polygamy, under the title of Thelyphthora; or a Treatise on Female Ruin, in its Causes, Effects, Consequences, Prevention, and Remedy, &c. Marriage, according to this writer, simply and wholly consists in the act of personal union, or *actus coitus*. Adultery, he says, is never used in the sacred writings but to denote the defilement of a betrothed or married woman, and to this sense he restricts the use of the term; so that a married man, in his opinion, is no adulterer, if his commerce with the sex be confined to single women, who are under no obligations by espousals or marriage to other men: but, on the other hand, the woman who should dare to have, even but once, an intrigue with any other man besides her husband (let him have as many wives as Solomon) would, *ipso facto*, be an adulteress, and ought, together with her gallant, to be punished with immediate death. This, he boldly says, is the law of God; and on this foundation he limits the privilege of polygamy to the man; in support of which he refers to the polygamous connections of the patriarchs and saints of the Old Testament, and infers the lawfulness of their practice from the blessings which attended it, and the laws which were instituted to regulate and superintend it. He contends for the lawfulness of Christians having, like the ancient Jews, more wives than one; and labours much to reconcile the genius of the evangelical dispensation to an arrangement of this sort. With this view he asserts, that there is not one text in the New Testament that even hints at the criminality of a polygamous connection; and he would infer from St. Paul's direction, that bishops and deacons should have but one wife, that it was lawful for laymen to have more. Christ, he says, was not the giver of a new law: but the business of marriage, polygamy, &c. had been settled before his appearance in the world, by an authority which could not be revoked. Besides, this writer not only thinks polygamy lawful in a religious, but advantageous in a civil light, and highly politic in a domestic view.

In defence of his notion of marriage, which, according to his account of it, consists in the union of man and woman as one body, the effects of which, in the sight of God, no outward forms or ceremonies of man's invention can add to or detract from; he grounds his principal argument on the Hebrew words made use of in Gen. ii. 24, to express the primitive institution of marriage, viz. *תָּשָׁבַד וְהָיוּ בֶּשֶׁר אֶחָד* rendered by the LXX *προσκαλληθήσεται ὁ ἄνθρωπος τὴν γυναῖκα αὐτοῦ*, which translation is adopted by the evangelist (Matt. xix. 5) with the omission only of the superfluous proposition (*καὶ*) after the verb. Our translation, he says—"shall cleave to his wife," doth not convey the idea of the Hebrew, which is literally, as Montanus renders the words, "shall be joined or cemented in his woman, and they shall become (i. e. by this union) one flesh." But on this criticism, it is well remarked, that both the Hebrew and Greek terms mean simply and literally attachment or adherence; and are evidently made use of in the sacred writings to express the whole scope of conjugal fidelity and duty, though he would restrain them to the grosser part of it. See Deut. iv. 4; Joshua, xxiii. 8; Acts, v. 36.

With respect to the Mosaic law, for which Mr. Madan is a warm advocate, it was certainly a local and temporary institution, adapted to the ends for which it was appointed, and admirably calculated, in its relation to marriage, to maintain and perpetuate the separation of the Jewish people from the Gentiles. In attempting to depreciate the outward forms of marriage, this writer would make his readers believe, that because none are explicitly described, therefore none existed: and, consequently, that they are the superfluous ordinances of human policy. But it is evident, from comparing Ruth, iv. 10, 13, with Tobit, vii. 13, 14; and from the case of Dinah, related Gen. xxxiv. that some forms were deemed essential to an honourable alliance, by the patriarchs and saints under the Old Testament, exclusive of the carnal knowledge of each other's person. It is also evident in the case of the woman of Samaria, whose connection with a man not her husband, is mentioned in John, iv. that something besides cohabitation is necessary to constitute marriage in the sight of God.

Having stated this notion of marriage, he urges, in defence of polygamy, that notwithstanding the seventh commandment, it was allowed by God himself, who made laws for the regulation of it, wrought miracles in support of it by making the barren woman fruitful, and declared the issue legitimate to all intents and purposes. God's allowance of polygamy is argued from Exod. xxi. 10, and particularly from Deut. xxi. 15, which, he says, amounts to a demonstration. This passage, however, at the utmost, only presupposes that the practice might have had existence among so hard-hearted and fickle a people as the Jews; and therefore wisely pro-

vides against some of its more unjust and pernicious consequences; such as tend to affect the rights and privileges of heirship. Laws enacted to regulate it cannot be fairly urged in proof of its lawfulness on the author's own hypothesis; because laws were also made to regulate divorce, which Mr. Madan condemns, as absolutely unlawful, except in cases of adultery. Besides, it is more probable that the "hated wife" had been dismissed by a bill of divorcement, than that she was retained by her husband: and moreover, it is not certain that the two wives, so far from living with the same husband at the same time, might not be dead; for the words may be rendered thus "if there should have been to a man two wives," &c. The words expressing the original institution of marriage, Gen. ii. 24, compared with Matt. xix. 4, 5, 8, afford insuperable objections against Mr. Madan's doctrine of polygamy. See also Lev. xviii. 18; 1 Cor. vii. 2, &c.

If we appeal, on this subject, from the authority of scripture to the writings of some of the earliest fathers in the Christian church, there is not to be found the faintest trace of any thing resembling a testimony to the lawfulness of polygamy; on the contrary, many passages occur, in which the practice of it is strongly and explicitly condemned. See Justin Martyr's Dial. with Trypho the Jew, Greek edit. by Thyrilby, fol. p. 336, 423, 372. Clemens Alexandrin. Stromata, lib. iv. p. 312, 335, 336, edit. Heinii, &c. Lug. Bat. fol. 1616.

We shall close this article with the words of an excellent anonymous writer, to whose critique on Mr. Madan's work we are indebted for the above remarks; in a word, when we reflect, that the primitive institution of marriage limited it to one man and one woman; that this institution was adhered to by Noah and his sons, amidst the degeneracy of the age in which they lived, and in spite of the examples of polygamy, which the accursed race of Cain had introduced; when we consider how very few (comparatively speaking) the examples of this practice were among the faithful: how much it brought its own punishment with it; and how dubious and equivocal those passages are in which it appears to have the sanction of divine approbation; when to these reflections we add another, respecting the limited views and temporary nature of the more ancient dispensations and institutions of religion—how often the imperfections, and even vices of the patriarchs, and people of God, in old time, are recorded, without any express notification of their criminality—how much is said to be commanded, which our reverence for the holiness of God and his law, will only suffer us to suppose, were, for wise ends, permitted—how frequently the messengers of God adapted themselves to the genius of the people to whom they were sent, and the circumstances of the times in which they lived; above all, when we consider the purity, equity, and benevolence of the Christian law; the explicit declarations of our Lord, and his apostle St. Paul, respecting the institution of marriage, its design and limitation; when we reflect too, on the testimony of the most ancient fathers, who could not possibly be ignorant of the general and common practice of the apostolic church; and, finally, when to these considerations we add those which are founded on justice to the female sex, and all the regulations of domestic economy and national policy, we must wholly condemn the revival of polygamy; and thus bear our honest testimony against the leading design of this dangerous and ill-advised publication. Monthly Review, vol. lxiii. p. 338.

POLYGON, Πολύγωνος, formed from *πολύς* many, and *γωνία*, angle; in geometry, a multilateral figure, or a figure whose perimeter consists of more than four sides and angles. See the System, Part I. Sect. VI.

POLYGON, in fortification, denotes the figure or perimeter of a fortress, or fortified place. See the System, article DEFINITIONS.

POLYGRAPHY, *Polygraphia*, or *Polygraphia*, the art of writing in various unusual manners or cyphers; as also of decyphering the same. The word is formed from the Greek, *πολύ* multum, and *γραφία*, *scriptura*, "writing." The ancients seem to have been very little acquainted with this art; nor is there any mark of their having gone beyond the Lacedæmonian scytala. Trithemius, Porta, Vigenere, and father Nicéron, have written on the subject of polygraphy or cyphers. See CYPHER.

POLYMATHY, *Polymathia*, Πολυμαθία, from *πολύ*, multum, and *μαθῆναι*, *disco*, I learn; the knowledge of many arts, and sciences; or an acquaintance with a great number of different subjects. *Polymathy* is frequently little more than a confused heap of useless erudition, occasionally detailed, either pertinently or impertinently, for parade. The genuine *polymathy* is an extensive erudition, or a knowledge of a great number of things, well digested, and applied to the purpose, and never but where they are necessary.

POLYPE, or *Polypus*, in vermetology, a small fresh-water insect, belonging to the genus *Hydra*, which, when cut into a number of separate pieces, becomes, in a day or two, so many distinct and separate animals; each piece having the surprising property of producing a head and tail, and the other organs necessary for life, and all the animal functions. For a particular account of the fecundity and reproduction of these extraordinary animals, see the article MICROSCOPIC OBJECTS. For representation of their several species, in different positions, see Plate I.

POLYPUS, Πολύπους, or *πολύπους*, in surgery, a fleshy tumour, or excrescence, arising from the inside of the nostrils, prejudicial to respiration.

POP

piration and speech; called also by way of distinction, *polypus partum*.

POLYSYLLABLE, Πολυσυλλαβος, from πολυ, *much*, and συλλαβος, *syllable*, in grammar, a word consisting of more than three syllables.

POLYTHEISM, from πολυ, *much*, and θεος, *deus*, the doctrine or belief of a plurality of gods. See **GOD**, **IDOLATRY**, and **JUPITER**.

POMEGRANATE-Tree, in botany, the English name of the genus *Punica*, see **PUNICA**.

POMEIS, in heraldry, are green roundles; so called by the English heralds, who express different coloured roundles by distinct names.

POMME, or **POMMETTE**, in heraldry. *A cross pommé*, or *pommette*, called also *trophe*, is a cross with a ball or knob, like an apple, at each end. See the **System**, Sect. II.

POMONA, in mythology, an amiable nymph, for whose favour the deities of the fields were competitors. The name was originally appropriated to some person who had merited divine honours by the culture of fruit-trees, and especially of apple-trees. This nymph is represented as sitting on a large basket full of fruit, holding a number of apples in her left hand, and in the right, a nosegay of flowers. At Rome she had a temple and altars. Her priest was called *flamen Pomonalis*, and sacrifices were offered to her for the preservation of the fruits of the earth.

POMUM, an *Apple*; a species of seed-vessel, composed of a succulent fleshy pulp; in the middle of which is generally found a membranous capsule, with a number of cells, or cavities, for containing the seeds. Seed-vessels of this kind have no external opening, or valve. At the end opposite to the foot-stalk is frequently a small cavity, called by the gardeners *the eye of the fruit*, and by botanists *umbilicus*, the "navel," from its fancied resemblance to the navel in animals. Gourd, cucumber, melon, pomegranate, pear, and apple, furnish instances of the fruit or seed-vessel in question.

PONTIF, *high-priest*, a person who has the superintendence and direction of divine worship; as the offering of sacrifices, and other religious solemnities. The Romans had a college of *pontiffs*, and over those a sovereign *pontif*, or *pontifex maximus*, instituted by Numa; whose function it was to prescribe the ceremonies with which each god was to be worshipped, compose the rituals, direct the vestals, regulate the calendar, and settle the several games, and assist at them; and for a good while to perform the business of augury; till, on some superstitious occasions, he was prohibited intermeddling therewith. He consecrated the statues of the gods, before they were put up in the temples; conducted the dedications of the temples; offered sacrifices; blessed the figures of some of Jove's thunderbolts to preserve the people from harm; and compiled their statutes. The Jews, too, had their *pontif*, or high-priest; and among the Romanists, the pope is still styled the *sovereign pontif*.

POOR, *Pauper*. A poor person, in a legal sense, is one who is a burden to, and charge upon a parish. Formerly, the maintenance of the poor was chiefly an ecclesiastical concern; and a fourth part of the tithes in every parish was set apart for that purpose. Afterwards, when the tithes of many parishes were appropriated to the monasteries, these societies were the principal resource of the poor, who were farther relieved by voluntary contribution. Judge Blackstone observes, that till 26 Hen. VIII. cap. 26, he finds no compulsory method of providing for the poor; but upon the total dissolution of the monasteries, abundance of statutes were made in the reign of king Henry VIII. Edw. VI. and Elizabeth, for this purpose. At length, by stat. 43 Eliz. cap. 2, **OVERSEERS** of the *Poor* were appointed in every parish.

POOR-Rate. By the 14 Eliz. cap. 5, was given to the justices to lay a general assessment; and this hath continued ever since. For by 43 Eliz. cap. 2, churchwardens, and overseers of the poor of every parish, or the greater part of them (with the consent of two justices, one of whom is of the quorum, dwelling in or near the parish) are empowered to raise weekly, or otherwise, by taxation of every inhabitant, parson, vicar, and other, and of every occupier of lands, houses, &c. materials for employing the poor, and competent sums for their relief. Notice shall be given in church of every such rate the next Sunday after it is allowed, which may be inspected by every inhabitant, paying 1s. and copies of it granted on demand, 6d. being paid for every twenty-four names; and a churchwarden or overseer refusing, shall forfeit 20s. to the party aggrieved. The rate is to be levied by distress on those who refuse to pay it; and appeals against it are allowed. 17 Geo. II. lib. 2, cap. 38. See **OVERSEERS**.

POPE, *Papa*, i. e. *universal father*, the bishop of Rome; being the head or patriarch of the Roman catholic church. Father le Gointe, in his *Annals*, observes, from St. Jerom, St. Cyprian, St. Gregory, St. Augustine, and Sidonius Apollinaris, that the title *pope* was anciently given to all bishops. Accordingly we find, that in the eighth general council held at Constantinople, in the year 869, which was composed of three hundred bishops, all the patriarchs were there called *popes*. Bishops were also addressed under the term *holiness*, and *beatitudes*; and their churches were called *apostolical sees*. He adds, that it was only in the eleventh century, that Gregory VII. first appointed, in a synod held at Rome, that the title *pope* should be restrained to the bishop of Rome, as a par-

POP

ticular distinction and prerogative. It is one of the maxims of Gregory, contained in a famous piece, entitled *Dictatus papa*, that there is no name in the world but his, i. e. as some understand it, he alone is to be styled *pope*; and F. Paul observes, that the name of *pope*, formerly common to all bishops, was appropriated by Gregory VII. to the Roman pontif. In the council in the Lateran, held under Innocent III. the *pope* was declared *ordinary of ordinaries*. The power of the *pope* has advanced by slow degrees to that plenitude in which it has been exercised in later times. It appears, that towards the end of the third century, the bishop of Rome, in common with those of Antioch and Alexandria, had a kind of pre-eminence over all others, because they were considered as rulers of primitive and apostolic churches. However, this pre-eminence implied no superior power and authority, infringing on the rights and liberties of other bishops, but merely a power of convening councils, of presiding in them, of collecting voices, and such other things as were essential to the order of those assemblies.

The law of Valentinian in 372, which empowered the bishop of Rome to examine and judge other bishops, that religious disputes might not be decided by profane and secular judges, approved and confirmed in a council in Rome in 378, proved very favourable to the ambition and advancement of the Roman pontif; and his votaries have likewise laid great stress on the fourth canon of the council held at Sardis, in 347, which prohibited the election of a successor to a bishop deposed by neighbouring prelates, before the bishop of Rome had examined the cause, and pronounced sentence: but the authority of this council has been generally considered as extremely dubious, and its decrees have been regarded by many as altogether fictitious and spurious. In the fifth century a variety of circumstances united in augmenting the power and authority of the bishop of Rome; though he had not, as yet, assumed the dignity of supreme lawgiver and judge of the whole Christian church. The bishops of Alexandria and Antioch, unable to make head against the lordly prelate of Constantinople, fled often to the Roman pontif for succour; and the inferior order of bishops used the same method, when their rights were invaded by those prelates. The protection afforded them by the Roman pontif was the means of extending his dominion in the East, and of imperceptibly establishing his supremacy. In the West, its increase was owing to other causes: the declining power, and the supine indolence of the emperors, left the authority of the bishop, who presided in their imperial city almost without control. The incursions, moreover, and triumphs of the barbarians contributed to its advancement; for the kings, who penetrated into the empire, when they perceived the subjection of the multitude to the bishops, and the dependence of the bishops upon the Roman pontif, resolved to reconcile this ghostly ruler to their interests, by loading him with various kinds of honours and benefits. However, the Africans could not be prevailed upon, by threats and promises, to submit the decision of their controversies, and the determination of their causes, to the Roman tribunal.

Although the Roman pontifs artfully availed themselves of every circumstance that could contribute to their obtaining universal dominion, yet it is certain, that towards the close of the sixth century, the emperors, and the nations in general, were far from being disposed to bear with patience the yoke of servitude, which the see of Rome was arrogantly imposing upon the Christian church. The Gothic princes set bounds to the power of the bishop of Rome in Italy, permitted none to be raised to the pontificate without their approbation, and reserved to themselves the right of judging concerning the legality of every new election. They enacted spiritual laws, called the religious orders before their tribunals, and summoned councils by their regal authority.

In the beginning of the seventh century, or about the year 606, Boniface III. as Baronius relates, engaged the emperor Phocas to take from the bishop of Constantinople the title of oecumenical or universal bishop, and to confer it upon the Roman pontifs; and thus, as it is said, introduced the papal supremacy. But the ambitious views of the bishops of Rome were still vigorously opposed not only by several emperors and princes, but also by whole nations; and the civil magistrate retained his influence in religious matters, and the Roman pontifs were obliged to acknowledge their subordination to the regal authority. No event seems to have been more favourable to their ambitious views than the part they took in the eighth century, in promoting the advancement of the traitor Pepin to the throne of Childeric III. in anointing and crowning him as king of France. This proved an abundant source of opulence and credit to the church, and to its aspiring ministers; for Pepin, having obtained two victories over Astolphus, king of the Lombards, in 754 and 755, compelled him to deliver up to the see of Rome, the exarchate of Ravenna, Pentapolis, and all the cities, castles, and territories, which he had seized in the Roman dukedom. And thus the bishop of Rome was raised to the rank of a temporal prince. The grant of Pepin was afterwards confirmed by his son Charlemagne, who also ceded to the Roman pontifs several cities and provinces in Italy, which were not contained in his father's grant; reserving to himself the supreme dominion. It is said, that a pretended grant of Constantine the Great was made use of both by Adrian I. and Leo III. in order to persuade Charlemagne to this donation.

At this time the power of the *pope* was subordinate to that of the

the emperors, and confined within very narrow limits. The right of election was vested in the emperor, and his approbation was necessary to the consecration of the bishops of Rome. However, their authority and affluence greatly increased from the time of Lewis the Meek, and more especially from the accession of Charles the Bald, to the imperial throne. Their power was augmented in a very considerable degree by the divisions and troubles that arose in the empire towards the close of the ninth century; the emperors were divested of their ecclesiastical authority; the power of the bishops was greatly diminished, and even the authority of both provincial and general councils began to decline. The Roman pontiffs availed themselves of various circumstances that occurred at this time to promote an opinion that the bishop of Rome was constituted by Jesus Christ supreme legislator and judge of the church universal; and that, therefore, the bishops derived all their authority from the Roman pontiff; and that the councils could not determine any thing without his permission and consent. They had also recourse to forged memorials, acts of councils, and epistles, in order to establish their claims to supremacy. The most notorious forgeries of this kind were the *DECRETAL* epistles, compiled by an obscure writer, but ascribed, in order to give them credit, to Isidore, bishop of Seville. In the tenth century, a novel doctrine was propagated by some mercenary and interested prelates, who publicly maintained, that the Roman pontiffs were not only bishops of Rome, but of the whole world; and that their authority, though divine in its origin, was conveyed to them by St. Peter, the prince of the apostles. The Crusades of the eleventh century very much contributed to the augmentation of the influence and authority of the Roman pontiffs; so that towards the close of this century they seem to have attained the zenith of their dominion. From the time of Leo IX. the Popes employed every method, which the most artful ambition could suggest, to render their dominion both despotic and universal. They not only aspired to the character of supreme legislators in the church, to an unlimited jurisdiction over all synods and councils, whether general or provincial, to the sole distribution of all ecclesiastical honours and benefices, as divinely authorised and appointed for that purpose; but they carried their insolent pretensions so far as to give themselves out for lords of the universe, arbiters of the fate of kingdoms and empires, and supreme rulers over the kings and princes of the earth. Gregory VII. seems to have exceeded all his predecessors in the lust of dominion, as well as in the success which attended his endeavours to obtain it. He considered the Roman pontiff, under the character of Christ's vicegerent, as the king of kings, and the whole universe as his rightful domain. Accordingly, with an arrogance hardly to be paralleled, he claimed tribute from France, Saxony, Spain, England, the most powerful of the German princes, Hungary, Denmark, Poland, &c. soliciting them to do homage to the Roman see, to make a solemn grant of their kingdoms and territories to the prince of the apostles, and to hold them under the jurisdiction of the vicar at Rome, as fiefs of the apostolic see. If the success of this pontiff had been answerable to the extent of his insolent views, all the kingdoms of Europe would have been this day tributary to the Roman see, and its princes the soldiers or vassals of St. Peter, in the person of his pretended vicar upon earth. Many of his attempts, however, were crowned with a favourable issue; and from the time of his pontificate the face of Europe underwent a considerable change, and the prerogatives of the emperors, and other sovereign princes, were necessarily diminished. In Italy his success was the more remarkable; for he prevailed upon Matilda, the daughter of Boniface, duke of Tuscany, to settle all her possessions in Italy and elsewhere upon the church of Rome; and though the Roman pontiffs have not been able to preserve the whole inheritance, thus granted to them, they still remain in the possession of a considerable part of it.

The monstrous power of erecting new kingdoms, which had been claimed by the pontiffs from the time of Gregory VII. was not only assumed, but exercised also by Alexander III. in a remarkable instance; for in the year 1179 he conferred the title of king, with the ensigns of royalty, upon Alphonso I. duke of Portugal, who under the pontificate of Lucius II. had rendered his province tributary to the Roman see. In the thirteenth century the same ambitious spirit governed the councils and proceedings of succeeding pontiffs; and they were industrious in inculcating the maxim, that the bishop of Rome is the supreme lord of the universe, and that neither princes nor bishops, civil governors nor ecclesiastical rulers, have any lawful power in church or state, that is not derived from them. In consequence of this arrogant pretension, they not only claimed the right of disposing of ecclesiastical benefices, but of conferring civil dominion, and of dethroning kings and emperors, according to their good pleasure. They also assumed to themselves the power of disposing of the various offices of the church, and of creating and deposing bishops, abbots, and canons, according to their fancy. Instances of these practices occur in the pontificates of Innocent III. Honorius III. Gregory IX. and of several of their successors. And Boniface VIII. maintained, in the most express and arrogant terms, that the universal church was under the dominion of the pontiffs, and that princes and lay patrons, councils, and chapters, had no more power in spiritual things than what they derived from Christ's vicar upon earth. Under

Innocent III. and Nicholas IV. the possessions and revenues of the Roman see received very considerable augmentation, partly by the events of war, and partly by the munificence of kings and emperors; and arrived at that high degree of grandeur and opulence, which it has maintained within this century. The former of these pontiffs followed the steps of Gregory VII. and not only usurped the despotic government of the church, but claimed also the empire of the world, and of nothing less than subjecting the kings and princes of the earth to his lordly sceptre. In Asia and Europe he disposed of crowns and sceptres with the most wanton ambition. The Roman pontiffs derived great advantages in the exercise of their dominion from the attachment and zeal of the several orders of Mendicants. In the fourteenth century the papal authority diminished, by reason of the continued residence of the popes in France: and in the fifteenth century, by the schism which happened in the papacy, the dawnings of the reformation, and a variety of other concurring causes. In the councils of Constance, held in 1414, and of Basil, opened in 1431, the power of the Roman pontiffs was declared to be inferior and subordinate to that of general councils, and the papal impositions, called expectatives, reservations and provisions, were entirely annulled. The revival of learning, and the progress of the reformation, in the succeeding century, contributed very much to the abridgment of the papal authority; not only by withdrawing several provinces from the yoke of papal tyranny, but by producing a change in the sentiments of many kings and princes, and sovereign states, who adhered to the religion of Rome.

It is well known, that when the authority of the pope declined in Europe, he sought to extend the limits of his spiritual dominion to other parts of the globe, and for this purpose deputed missionaries to gain proselytes. And a new order was formed, that became afterwards so famous, under the appellation of Jesuits, in order to preserve those parts of the papal dominions that remained yet entire, and augment them by new accessions. The fate of this fraternity is well known; and many circumstances seem to concur in different countries, hitherto devoted to the see of Rome, that are likely to reduce within very narrow limits the spiritual jurisdiction and dominion of the pope. The pope is chosen by the cardinals out of their own body. In the first ages of the church, the people and the priests, and sometimes only the priests, elected the pope, according to the plurality of voices. The emperors afterwards claimed the right of confirming the election. In the eighth century, pope Adrian I. in a council of bishops, assembled at Rome, conferred upon Charlemagne and his successors, the right of election; and they reserved to themselves the privilege of approving the person that was elected by the priest and people; nor was the consecration of the elected pontiff valid, unless performed in the presence of the emperor's ambassadors. The election, however, after undergoing many revolutions as to the form of it, is now referred to the CARDINALS IN CONCLAVE. The see of the pope is at Rome, whence he issues out his orders, called briefs and bulls, throughout the catholic world.

POPERY, in ecclesiastical history, comprehends the religious doctrines and practices adopted and maintained by the church of Rome. The following summary, extracted chiefly from the decrees of the council of Trent, continued under Paul III. Julius III. and Pius IV. from the year 1545 to 1563, by successive sessions, and the creed of pope Pius IV. subjoined to it, and bearing date November 1564, may not be unacceptable to the reader. One of the fundamental tenets, strenuously maintained by popish writers, is the infallibility of the church of Rome; though they are not agreed whether this privilege belongs to the pope, or a general council, or to both united; but they pretend that an infallible living judge is absolutely necessary to determine controversies, and to secure peace in the Christian church. However protestants alledge that the claim of infallibility in any church is not justified by the authority of Scripture; much less does it pertain to the church of Rome; and that it is inconsistent with the nature of religion, and the personal obligations of its professors; and that it has proved ineffectual to the end for which it is supposed to be granted, since popes and councils have disagreed in matters of importance, and they have been incapable, with the advantage of this pretended infallibility, of maintaining union and peace. See INFALLIBLE. Another essential article of the popish creed is the supremacy of the pope, or his sovereign power over the universal church. On this subject it is maintained, that every Christian, under pain of damnation, is bound to be subject to the pope: and that no appeals may be made from him; and that he alone is the supreme judge of all persons, in all ecclesiastical causes, but that he himself can be judged by no man.

This exorbitant power had been challenged by the pope for many successive ages, and in several instances actually exercised. Thus Gregory VII. excommunicated the emperor Henry IV. and gave away his kingdom to Rodolphus, duke of Sweden. Gregory IX. excommunicated the emperor Frederick II. and absolved his subjects from their oath of allegiance. Pope Paul III. excommunicated and deposed Henry VIII. king of England, and commanded all his subjects, under a curse, to withdraw their obedience from him. Pope Pius V. and Gregory XIII. damned and deposed queen Elizabeth, and absolved her subjects from their

allegiance. And this practice has been warranted by the decree of the third Lateran council under pope Alexander III. and by the fourth Lateran council under pope Innocent III. though it is contrary to the express language of Scripture, to the doctrine and conduct of the apostles and primitive fathers, and to the confessions and practice of the ancient bishops of Rome, and altogether inconsistent with the rights of government and the welfare of society. Farther, the doctrine of the seven sacraments is a peculiar and distinguishing doctrine of the church of Rome: these are baptism, confirmation, the eucharist, penance, extreme unction, orders, and matrimony. The council of Trent, (sess. 7, can. 1.) pronounces an anathema on those who say that the sacraments are more or fewer than seven, or that any one of the above number is not truly and properly a sacrament. And yet it does not appear that they amounted to this number before the twelfth century, when Hugo de St. Victore and Peter Lombard, about the year 1144, taught, that there were seven sacraments. The council of Florence, held in 1438, was the first council that determined this number. These sacraments confer graces, according to the decree of the council of Trent (sess. 7. can. 8.) *ex opere operato*, or by the mere administration of them; three of them, viz. baptism, confirmation, and orders, are said, (can. 9.) to impress an indelible character, so that they cannot be repeated without sacrilege; and the efficacy of every sacrament depends on the intention of the priest by whom it is administered (can. 11.) Pope Pius expressly enjoins, that all these sacraments should be administered according to the received and approved rites of the catholic church. With regard to the eucharist in particular, we may here observe, that the church of Rome holds the doctrine of TRANSUBSTANTIATION; the necessity of paying divine worship to the consecrated bread, or *HOSIA*; the propitiatory sacrifice of the *MASS*, according to the ideas of which Christ is truly and properly put to death as a sacrifice, as often as the priest says *mass*; and *solitary MASS*, in which the priest alone, who consecrates, communicates, and allows COMMUNION only in one kind, viz. the bread, to the laity. Sess. 14. The doctrine of merits is another distinguishing tenet of *popery*; with regard to which the council of Trent has expressly decreed (sess. 6. can. 32.) that the good works of justified persons are truly meritorious; deserving not only an increase of grace, but eternal life, and an increase of glory; and it has anathematized all who deny this doctrine. Of the same kind is the doctrine of satisfactions; which supposes that penitents may truly satisfy, by the afflictions they endure under the dispensations of providence, or by voluntary penances to which they submit, for the temporal penalties of sin, to which they are subject, even after the remission of their eternal punishment. Sess. 6. can. 30. and sess. 14. can. 8 & 9. In this connection we may mention the popish distinction of venial and mortal sins: the greatest evils arising from the former are the temporary pains of purgatory; but no man, it is said, can obtain the pardon of the latter without confession to a priest, and performing the penances which he imposes.

The council of Trent (sess. 14. can. 1.) has expressly decreed, that every one is accursed who shall affirm, that PENANCE is not truly and properly a sacrament instituted by Christ in the universal church, for reconciling those Christians to the divine majesty, who have fallen into sin after baptism: and this sacrament it is declared, consists of two parts, the matter and the form: the matter is the act of the penitent, including contrition, confession, and satisfaction; the form of it is the act of absolution on the part of the priest. Accordingly, it is enjoined, that it is the duty of every man, who hath fallen after baptism, to confess his sins, once a year at least, to a priest; that this confession is to be secret; for public confession is neither commanded nor expedient; and that it must be exact and particular, including every kind and act of sin, with all the circumstances attending it. When the penitent has so done, the priest pronounces an absolution, which is not conditional or declarative only, but absolute and judicial. This secret, or auricular confession, was first decreed and established in the fourth council of Lateran, under Innocent III. in 1215, (cap. 21.) And the decree of this council was afterwards confirmed and enlarged in the council of Florence, and in that of Trent, which ordains, that confession was instituted by Christ; that by the law of God it is necessary to salvation; and that it has been always practised in the Christian church. As for the penances imposed on the penitent, by way of satisfaction, they have been commonly the repetition of certain forms of devotion, as *PATER-NOSTERS* or, *AVE-MARIAS*, the payment of stipulated sums, pilgrimages, fasts, or various species of corporal discipline. But the most formidable penance in the estimation of many, who have belonged to the Romish communion, has been the temporary pains of PURGATORY. But under all the penalties which are inflicted or threatened in the Romish church, it has provided relief by its INDULGENCES, and prayers or masses for the dead; performed professedly for relieving and rescuing the souls that are detained in purgatory. Sess. 25. Another article that has been long authoritatively enjoined and observed by the church of Rome, is the celibacy of her clergy.

To the doctrines and practices above recited may be farther added the worship of IMAGES: to justify which, the papists often leave the second commandment out of their catechisms (see DECALOGUE): the invocation of saints and angels, with respect to which

the council of Trent decreed, that all bishops and pastors, who have the cure of souls, do diligently instruct their flocks, that it is good and profitable humbly to pray unto the saints, and to have recourse to their prayers, help, and aid; for which practice no scripture command or example, nor any testimony within the first three hundred years after Christ, can be pleaded; the worship of sacred RELICS, by which they understand not only the bodies and parts of the bodies of the saints, but any of those things that appertained to them, and which they touched; and the celebration of divine service in an unknown tongue, to which purpose the council of Trent hath denounced an anathema on any one who shall say, that *mass* ought to be celebrated only in the vulgar tongue. Sess. 25. and sess. 22. can. 9. Though the council of Lateran under Innocent III. in 1215 (can. 9.) had expressly decreed, that, because in many parts, within the same city and diocese, there are many people of different manners and rights mixed together, but of one faith, the bishops of such cities or diocese should provide fit men for celebrating divine offices, according to the diversity of tongues and rites, and for administering the sacraments. We shall only add, that the church of Rome maintains, that unwritten traditions ought to be added to the holy scriptures, in order to supply their defect, and regarded as of equal authority; that the books of the APOCRYPHA are canonical scripture; that the Vulgate edition of the Bible is to be deemed as authentic; and that the Scriptures are to be received and interpreted according to that sense which the holy mother church, to whom it belongs to judge of the true sense, hath held, and doth hold, and according to the unanimous consent of the fathers. Sess. 4.

Such are the principal and distinguishing doctrines of *popery*, most of which have received the sanction of the council of Trent; and that of the creed of pope Pius IV. which is received, professed and sworn to by every one who enters into holy orders in the church of Rome; and at the close of this creed, we are told, that the faith contained in it is so absolutely and indispensably necessary, that no man can be saved without it. Hardouin's Council, tom. x. p. 1—211.

POPULATION, the state of a country with respect to the number of people. See on this subject the System of Annuities, and the articles MARRIAGE and MORTALITY.

PORCELAIN, a fine kind of earthen ware, chiefly manufactured in China, and thence called *China-ware*. All earthen wares which are white and semi-transparent are generally called *porcelains*; but among these, so great differences may be observed, that, notwithstanding the similarity of their external appearance, they cannot be considered as matters of the same kind. These differences are so evident, that even persons who are not connoisseurs in this way must prefer the porcelain of some countries to that of others. The art of making porcelain is one of those in which Europe has been excelled by oriental nations. The first porcelain that was seen in Europe was brought from Japan and China. The whiteness, transparency, fineness, neatness, elegance, and even the magnificence of this pottery, which soon became the ornament of sumptuous tables, did not fail to excite the admiration and industry of Europeans; and their attempts have succeeded so well, that in different parts of Europe, earthen wares have been made so like the oriental, that they have acquired the name of *porcelain*. The first European porcelains were made in Saxony and in France; and afterwards in England, Germany, and Italy; but as all these were different from the Japanese, so each of them had its peculiar character. The illustrious Reaumur first attended to the manufacture of porcelain as a science, and communicated his researches in two memoirs before the Academy of Sciences in 1727 and 1729. He did not satisfy himself with considering the external appearance, the painting and gilding, which are only ornaments not essential to the porcelain, but he endeavoured to examine it internally; and having broken pieces of the Japanese, Saxon, and French porcelains, he examined the difference of their grains (which name is given to their internal structure.) The grain of the Japanese porcelain appeared to him to be fine, close, compact, moderately smooth, and somewhat shining. The grain of the Saxon porcelain was found to be still more compact, not granulous, smooth shining like enamel. Lastly, the porcelain of St. Cloud had a grain much less close and fine than that of Japan; not, or but little shining; and resembling the grain of sugar. Although, since Mr. Reaumur, no scientific person has written concerning porcelain, many have attempted to make it. Manufactories have been established in almost all the states of Europe. Besides that of Saxony, which has been long established, porcelain is also made at Vienna, at Frankendal, and lately in the neighbourhood of Berlin. All these German porcelains are similar to the Saxon; and are made of materials of the same kind, although they differ somewhat from each other. England and Italy also have their porcelains, the chief of which are those of Worcester, and of Naples. Mr. de la Condamine, in his last journey into Italy, visited a manufacture of porcelain established at Florence by the marquis de la Ginori, then governor of Leghorn. Mr. de la Condamine observed particularly the large size of some pieces of this porcelain. He says he saw statues and groupes half as large as nature, modelled from some of the finest antiques. The furnaces in which the porcelain was baked were constructed with much art, and lined with bricks made of

P O R

P O R

of the porcelain materials. The paste of this porcelain is very beautiful; and from the grain of broken pieces it appears to have all the qualities of the best Chinese porcelain. A whiter glazing would be desirable, which they might probably attain, if the Marquis Ginori was not determined to use those materials only which were found in that country. But in no state of Europe have such attempts been made to discover porcelain, or so many manufactories of it been established, as in France. Before even Mr. Reaumur had published on this subject, porcelain was made at St. Cloud, and in the suburb of St. Antoine at Paris, which was of the vitreous and fusible kind, but considerably beautiful. Since that time, considerable manufactories of it have been established at Chantilly, at Villeroi, and at Orleans; the porcelains of which have a distinguished merit. But the porcelain produced in the late king's manufacture at Sevres holds at present the first rank, from its shining white, its beautiful glazing, and coloured grounds, in which no porcelain has ever equalled it. The magnificence of the gilding, the regularity and elegance of its forms, surpass every thing of the kind.

We shall now shew what those qualities are which constitute the perfection of porcelain. We must first carefully distinguish the qualities which only contribute to the beauty and external appearance, from the intrinsic and essential properties in which the goodness and solidity of porcelain consist. All persons who have made experiments in this way have soon discovered the possibility of making compounds very white, beautifully semi-transparent, and covered with a shining glazing; but which cannot be worked for want of tenacity, are not sufficiently compact, are essentially fusible, are subject to break by sudden application of heat and cold; and lastly, the glazing of which cracks, becomes rough, and consequently loses its lustre by use, because it is too soft. On the other side, we shall also find it not difficult to compose very tenacious pastes, which shall be capable of being easily worked and well baked, which in the baking shall acquire the desirable hardness and density; which are infusible, and capable of sustaining very well the sudden change of heat and cold; and, in a word, which shall have all the qualities of the most excellent porcelain, excepting whiteness and beauty. We shall soon see that the materials fit for the composition of such porcelains may be found abundantly in every country. The only difficulty, then, in this inquiry concerning porcelain, is, to unite beauty and goodness in one composition; and indeed nature seems to be very sparing of materials fit for this purpose, and therefore perfect porcelain will always be a dear and valuable commodity. Those potteries which we call *stone-ware* are not of modern invention, and have all the essential qualities of the best Japanes. For if we except whiteness, on which alone the semi-transparency depends, and compare all the properties of Japanes porcelain with those of our stone-ware, no difference can be found betwixt them. The same grain appears internally in both, the same sound is produced by striking them when properly suspended; the same density, the same hardness by which they strike fire with steel, the same faculty of sustaining the heat of boiling liquors without breaking, and the same unfusibility in fire, are observable. Lastly, if the earths of which stone-ware is made were free from heterogeneous colouring matters, which prevent their whiteness and semi-transparency: if vessels were carefully formed, if all the proper attentions were given, and if these vessels were covered over with a fine glazing, they would be as perfect porcelain as that of Japan. The most perfect porcelain, therefore, is nothing else than a fine white stone-ware. Earths of this kind are probably more rare in Europe than in Japan, and China. And probably also the want of these earths was the cause that the first makers of porcelain in this country confined themselves to an external imitation, by employing nothing but vitrifiable matters with fusible salts and a small quantity of white earth, from which fusible and vitreous porcelains were composed, which might be called *false porcelains*. But things are much changed since these first attempts. Besides the discoveries of the Count de Lauraguais and of Mr. Guettard, genuine white porcelains have been made a long time ago in Germany, especially in Saxony and at Frankendal. These porcelains are not inferior in any respect to the oriental; they are even much superior in beauty and whiteness to the modern oriental porcelain, which has much degenerated in these respects; they seem even to excel the oriental in the most valuable quality of porcelain, namely, the property of sustaining the sudden change of heat and cold. We cannot judge of the quality of porcelain by a slight trial; for so many circumstances concur to make a piece of porcelain capable or incapable of sustaining the sudden application of heat and of cold, that if at the same time boiling water be poured into two vessels, one of which is good porcelain and the other bad; the former may possibly break, and the latter remain entire. The only true method of discovering good porcelain in this respect, is, to examine several pieces of it which are daily used; for instance, a set of coffee-cups. But it has been observed, that in many such pieces of oriental porcelain, which have been long and daily used, cracks in the direction of their height may be always perceived, which are never seen in the good European porcelains. We shall finish this article by giving a short description of the method of manufacturing porcelain. The basis of the porcelains which we have called *fusible, vitreous, or false porcelains*, is called

by artists a *fritt*; which is nothing else than a mixture of sand or of powdered flints, with salts capable of disposing them to fusion, and of giving them a great whiteness by means of a sufficient heat. This fritt is to be then mixed with as much, and no more, of a white tenaceous earth, of an argillaceous or marly nature, than is sufficient to make it capable of being worked upon the wheel. The whole mixture is to be well ground together in a mill, and made into a paste, which is to be formed, either upon the wheel or in moulds, into pieces of such forms as are required.

Each of these pieces, when dry, is to be put into a case made of earthen-ware; the cases are called, by English potters, *seggars*. They are generally formed of coarser clays, but which must be also capable of sustaining the heat required without fusion. By means of these cases, the contained porcelain is preserved from the smoke of the burning fuel. The whiteness of the porcelain depends much on their compactness of texture by which the smoke is excluded, and on the purity of the clay of which they are made. The cases are to be ranged in piles one upon another, in a furnace or kiln, which is to be filled with these to the roof. The furnaces are chambers or cavities of various forms and sizes; and are so disposed, that their fire-place is placed on the outside opposite to one or more openings, which communicate within the furnace. The flame of the fuel is drawn within the furnace, the air of which rarefying, determines a current of air from without inwards, as in all furnaces. At first a very little fire is made, that the furnace may be heated gradually, and is to be increased more and more till the porcelain is baked, that is, till it has acquired its proper hardness and transparency; which is known by taking out of the furnace from time to time, and examining small pieces of porcelain, placed for that purpose in cases which have lateral openings. When these pieces shew that the porcelain is sufficiently baked, the first is no longer to be supplied with fuel, the furnace is to be cooled, and the porcelain taken out, which in this state resembles white marble, not having a shining surface, which is afterwards to be given by covering them with a vitreous composition called the glazing.

The porcelain when baked and not glazed is called *biscuit*, which is more or less beautiful according to the nature of the porcelain. The manufacture of Sevres excels all others in this respect, and it is therefore the only one which can produce very fine species of sculpture; that is, in which all the fineness of the workmanship is preserved, and which are preferable in smoothness and whiteness to the finest marble of Italy. As no piece of sculpture of this kind can preserve all the delicacy of its workmanship when covered with a glazing; and as sculptors avoid polishing their marble figures, because the lustre of the polish is disadvantageous; therefore, in the manufactures at Sevres, all figures, or little statues, and even some ornamental vases are left in the state of biscuit. The other pieces of porcelain are to be glazed in the following manner. A glass is first to be composed suited to the nature of the porcelain to which it is to be applied; for every glass is not fit for this purpose. We frequently find that a glass which makes a fine glazing for one porcelain shall make a very bad glazing for another porcelain; shall crack in many places, shall have no lustre, or shall contain bubbles. The glazing then must be appropriated to each porcelain, that is, to the hardness and density of the ware, and to the ingredients of its composition, &c.

These glazings are prepared by previously fusing together all the substances of which they consist, so as to form vitreous masses. These masses are to be ground very finely in a mill. This vitreous powder is to be mixed with a sufficient quantity of water, or other proper liquor, so that the mixture shall have the consistence of cream of milk. The pieces of porcelain are to be covered with a thin stratum of this matter: and when very dry they are to be again put into the furnace in the same manner as before for the forming of the biscuit, and to be continued there till the glazing be well fused. The necessary degree of fire for fusing the glazing is much less than that for baking the paste. The pieces of porcelain which are intended to remain white are now finished; but those which are to be painted and gilded must undergo further operations. The colours to be applied are the same as those used for enamel painting. They all consist of metallic calxes, bruised and incorporated with a very fusible glass. Crocus of iron furnishes a red colour; gold precipitated by tin makes the purple and violet; copper calcined by acids and precipitated by an alkali gives a fine green; zaffre makes the blue; earths slightly feruginous produce a yellow; and, lastly, brown and black colours are produced by calcined iron, together with a deep blue of zaffre. These colours being ground with gum-water, or with oil of spike, are to be employed for the painting of the porcelain with designs of flowers and other figures. For gilding, a powder or calx of gold is to be applied in the same manner as the coloured enamels. The painted and gilded porcelains are to be then exposed to a fire capable of fusing the glass, with which the metallic colours are mixed. Thus the colours are made to adhere, and at the same time acquire a gloss equal to that of the glazing. The gold alone has not then a shining appearance, which must be afterwards given to it by burnishing with a blood-stone.

The operations for the unfusible porcelains, and also for such as are of the nature of stone-ware, are somewhat more simple. The sand

P O R

sands and stones which enter into their composition are to be ground in a mill; the earths or clays are to be washed; the materials are to be well mixed, and formed into a paste; the pieces are first rudely formed upon a potter's wheel; and when dry, or half dry, they are turned again upon the wheel, and their form is made more perfect; they are then placed in the furnace not to bake them, but only to apply a sufficient heat to give them such a solidity that they may be handled without breaking, and may receive the glazing. As the pieces of porcelain after this slight heat are very dry, they imbibe water readily. This disposition afflicts the application of the glazing. The vitrifiable or vitrified matter of this glazing, which has been previously ground in a mill, is to be mixed with such a quantity of water, that the liquor shall have the consistence of milk. The pieces of porcelain are hastily dipt in this liquor, the water of which they imbibe, and thus on their surface is left an uniform covering of the glazing materials. This covering, which ought to be very thin, will soon become so dry that it cannot stick to the fingers when the pieces are handled. The pieces of this porcelain are then put into the furnace to be perfectly baked. The heat is to be raised to such a height, that all within the furnace shall be white, and the cases shall be undistinguishable from the flame. When, by taking out small pieces, the porcelain is known to be sufficiently baked, the fire is discontinued, and the furnace cooled. If the baking has been well performed, the pieces of porcelain will be found by this single operation to be rendered compact, sonorous, close grained, moderately glossy, and covered externally with a fine glazing. The painting and gilding of this porcelain are to be executed in a manner similar to that already described.

PORCH, in architecture, a kind of vestibule supported by columns; much used at the entrance of the ancient temples, halls, churches, &c. A porch, in the ancient architecture, was a vestibule, or a disposition of insulated columns, usually crowned with a pediment, forming a covert place before the principal door of a temple or court of justice. Such is that before the door of St Paul's, Covent Garden, the work of Inigo Jones. When a porch had four columns in front, it was called *tetrapyle*, when six, *hexapyle*; when eight, *octopyle*, &c.

PORCUPINE, in mammalia, the English name of the genus *hystrix*. For description of the Genus see *HYSTRIX*. For representation, see plate VI. Genus 21.

PORE, formed from *πορος*, *aperture* or *duel*, a little interstice, between the particles of matter which constitute bodies either empty, or filled with some insensible medium. Condensation and rarefaction are only performed by closing and opening the pores. The transparency of bodies is usually supposed to arise from their pores being directly opposite to one another. The matter of insensible perspiration is conveyed through the pores of the cutis. Sir Isaac Newton shews, that bodies are much more rare and porous than is commonly believed: water, e. gr. is nineteen times lighter, and consequently rarer, than gold: and gold itself is so rare, as very readily, and without the least opposition, to transmit magnetic effluvia, and easily to admit quicksilver into its pores, and to let even water pass through it; for a concave sphere of gold hath, when filled with water, and folded up, upon pressing with a great force, let the water squeeze through it, and stand all over its outside in multitudes of small drops like dew, without bursting or cracking the gold. Whence it may be concluded, that gold has more pores than solid parts; and, by consequence, that water hath above forty times more pores than parts. The MAGNET transmits its virtues without any diminution or alteration, through all cold bodies that are not magnetic: as gold, silver, brass, glass, water, &c. The rays of light, let them be either bodies actually coming to us from the sun, or only motions or impressions upon the medium, move in right lines, and are hardly ever, unless by great chance, reflected back again in the same line, after their impingence upon objects: and yet we see, that light is transmitted to the greatest distances through pellucid bodies, and that in right lines.

Now how bodies should have pores sufficient for these effects, may be difficult to conceive, but not impossible; for Sir Isaac shews that the colours of all bodies arise from their particles being of such a determinate size or magnitude. Wherefore, if we conceive those particles to be so disposed, as that there is as much porosity as there is of matter; and, in like manner, those particles to be composed of others much less, and that have as much interspersed vacuity, or space, as their quantity of matter amounts to; and so on, till we come to solid particles without pores: then, if in any body there be (for instance) three of these sizes of particles, and that the last be of the solid, or least sort; that body will have seven times as much vacuity as solid matter: if four such degrees and the last be least, and solid, that body will have fifteen times as much porosity as solidity; if five such degrees, it will have thirty-one times as much space as solidity; and if six degrees, then it will have sixty-three times as much vacuity as solid matter. And perhaps, in the wonderful conformation and fabric of natural bodies, there may be other proportions of space to matter, which are to us wholly unknown: whence it is possible there may be yet farther great quantities of interspersed vacuity.

PORES, in anatomy, are certain permeable spaces, between the parts of the skin, whereby we sweat or perspire, &c. The pores are most remarkable in the hands and feet. By viewing the palm

P O R

of the hand with a moderate glass, after washing it well, we perceive innumerable little ridges, of equal size and distance running parallel to each other, especially on the tips and joints of the fingers, &c. where they are regularly disposed into spherical triangles, and ellipses. On these ridges stand the pores, in even rows, big enough to be seen by a good eye without a glass; but with one, every pore looks like a little fountain; and the sweat may be seen to stand therein, clear as rock-water; and as often as it is wiped off, it springs up again. The pores are placed on the ridges, not in the furrows between them; that they might be less liable to be stopped by compression: for the same reason, the pores of the hands and feet are larger than the rest, those parts being more used, and pressed than the rest; and hence, again, there are no ridges on other parts. These pores serve as a convenient outlet for the more noxious parts of the blood, which, by the continual use of the hands and feet are plentifully brought into them: whence in hypochondriac and hysterical people, there is a continual burning in the palms and soles. In the stoppage, or constriction of the pores of the skin, that disease which we popularly call a cold, is commonly supposed to consist; though Dr. Keill maintains a quite contrary opinion, in a dissertation at the end of his *Medicina Statica Britannica*. See *PERSPIRATION*.

PORK, the flesh of swine killed for the purpose of food. See *SUS*. The hog is the only domestic animal that we know of no use to man, when alive, and therefore seems properly designed for food. Besides, as loathsome and ugly to every human eye, it is killed without reluctance. The Pythagoreans, whether to preserve health or on account of compassion, generally forbade the use of animal food; and yet it is alleged that Pythagoras reserved the use of hog's flesh for himself. The Jews, the Egyptians, &c. and others in the warm countries, and all the Mahometans at present, reject the use of pork. It is difficult to find out the reason of this, or of the precept given to some of them, though commonly such as are not given without a particular one. The Greeks gave great commendation to this food; and Galen, though indeed that is suspected to be from a particular fondness, is every where full of it. The Romans considered it as one of their delicacies; and some of the inhabitants of the northern climates have taken an aversion to it, that probably arose from the uncultivated state of their country not being able to rear it. Pork is of a very tender structure; increased perhaps from a peculiarity in its economy, viz. taking on fat more readily than any other animal. Pork is a white meat even in its adult state, and then gives out a jelly in very great quantity. On account of its little perspirability and tenderness, it is very nutritious, and was given for that intention to the athletes. With regard to its alkalescency, no proper experiments have yet been made; but as it is of a gelatinous and succulent nature, it is probably less so than many others. Upon the whole, it appears to be a very valuable nutriment, and the reason is not very obvious why it was in some countries forbid. It is said that this animal is apt to be diseased; but why were not inconveniencies felt on that account in Greece? Again it has been alleged, that as Palestine would not rear these animals, and as the Jews had learned the use of them in Egypt, it was necessary they should have a precept to avoid them. But the Egyptians themselves did not use this meat; and this religious precept, indeed, as well as many others, seems to have been borrowed from them. Possibly, as pork is not very perspirable, it might increase the leprosy, which was said to be epidemic in Palestine, though this is far from being certain.

PORPESSE, an English name of the Phocæna, a species of the *Delphinus*. See *DELPHINUS*.

PORTA, or *Vena PORTÆ*, in anatomy, a very considerable vein employed in bringing the blood from several parts, by an infinite number of branches, which it is divided into, to the liver, through the whole substance whereof it is disseminated. See the *System*, Part IV. Sect II.

PORTATE, in heraldry. A *cross PORTATE* is a cross which does not stand upright, as crosses generally do, but lies athwart the escutcheon, in bend, as if it were carried on a man's shoulder.

PORT-GREVE, or *PORTGRAVE*, was anciently the principal magistrate in ports and other maritime towns. The word is formed from the Saxon *port*, a port, or other town, and *gereaf*, a governor. It is sometimes also written *port-reve*. Camden observes, that the chief magistrate of London was anciently called *port-greve*, instead of whom Richard I. ordered two bailiffs; and soon afterwards king John granted them a *MAYOR* for their yearly magistrate. The charter of William the Conqueror to the city of London runs thus: "William king, grete William bishop, and Godfrey port greve, and all the burghs within London, French and English. I grant you, that I will that ye be all your law-worth that ye were in Edward's day the king. And I will that each child be his father's eyer, and I will not suffer that any man you any wrongs breed, and God you keepe."

PORTICO, in architecture, a kind of gallery on the ground; or a piazza encompassed with arches supported by columns, where people walk under cover. See the *System* on the principles of the art. Among the modern porticoes, the most celebrated is the piazza of St. Peter of the Vatican. That of Covent-Garden, London, the work of Inigo Jones, is also much admired.

POR-

P O T

PORTRAIT, POURTRAIT, or POURTRAITURE, in painting, the representation of a person, and especially of a face, done from the life. In this sense we say, *portrait-painting*, in opposition to history-painting, where all resemblance of person is disregarded.

POSITION, in astronomy. The *position* of the sphere is either right, parallel, or oblique; whence arise the inequality of our days, difference of Seasons, &c. See the System, Sect. IV.

POSITION, in arithmetic. For definitions, rules, and questions. See the System, Chap. 26. throughout.

POSITIVE Degree, in grammar, is the adjective in its simple signification, without any comparison. Thus, good, *bonus*, fair, *pulcher*, &c. are in the *positive degree*; better, fairer, &c. in the comparative. See the System, Part III. Chap. III. Art. IV.

POSSESSION, in law, is either actual, where a person actually enters into lands or tenements descended or conveyed to him; or where lands are descended to a person, and he has not yet entered into them. A long possession is much favoured by the law, as an argument of right, even though no deed can be shown, and it is more regarded than an ancient deed without possession. If he that is out of possession of land brings an action, he must prove an undeniable title to it; and when a person would recover any thing of another, it is not sufficient to destroy the title of the person in possession, without he can prove that his own right is better than his. In order to make possession lawful upon an entry, the former possessor and his servants are to be removed from off the premises entered on: but a person by lease and release, is in possession without making any entry upon the lands.

POSSESSIVE Pronouns, in grammar. See the System, Part I. Chap. I. Sect. II. and Part II. Chap. III. Art. III.

POSTERIOR, a term of relation, implying something behind, or that comes after another. In which sense it is used in opposition to *prior* and *anterior*.

POSTHUMUS, or POSTHUMOUS, composed of *post*, and *humus*, ground, a child born after the death of his father, or taken out of the body of a dead mother. By 10 and 11 Will. III. cap. 16. it is enacted, that *posthumous* children shall be capable of taking in REMAINDER, in the same manner as if they had been in their father's life-time; that is, the remainder is allowed to vest in them while yet in their mother's womb.

POSTULATE, in mathematics, &c. is described to be such an easy and self-evident supposition, as needs no explication or illustration to render it intelligible; as that a right line may be drawn from one point to another.

POSTURE, in painting and sculpture, the situation of a figure with regard to the eye, and of the several principal members thereof with regard to one another, whereby its action is expressed. A considerable part of the art of a painter, consists in adjusting the postures; in giving the most agreeable ones to his figures, in accommodating them to the characters of the respective figures and the part each has in the action, and in conducting and pursuing them throughout. Postures are either natural or artificial. *Natural* postures are such as nature seems to have had a view to in the mechanism in the body, or rather such as the ordinary actions and occasions of life lead us to exhibit while young, and while the joints, muscles, ligaments, &c. are flexible. *Artificial* postures are those which some extraordinary views, or studies, occasion us to learn; as those of dancing, fencing, &c. Such also are those of our balance and posture masters.

A painter would be strangely puzzled with the figure of Clark (a late famous posture-master in London) in a history-piece. This man we are told in the Phil. Transf. had such an absolute command of his muscles, &c. that he could disjoin almost his whole body; so that he imposed on the great surgeon Mullens, who looked upon him in such a miserable condition, he would not undertake his cure. Though a well-made man, he would appear with all the deformities imaginable; hunch-backed, pot-bellied, sharp-breasted, &c. He disjoined his arms, shoulders, legs, and thighs; and rendered himself such an object of pity, that he has frequently extorted money, in quality of a cripple, from the same company in which he had the minute before been in quality of a comrade. He would make his hips stand a considerable way out from his loins, and so high as to invade the place of his back. Yet his face was the most changeable part about him, and shewed more postures than all the rest. Of himself he could exhibit all the uncouth faces of a Quaker's meeting.

POT-ASHES are properly the lixivious ashes of certain vegetables, used in the making of glass and soap. Such are the ashes of the herb kali, called also salt-wort, glass weed, &c. from its great use in glass making. Pot-ashes are also called *cineres clavellati*, and make the basis of salt of tartar, and most of the lixivial salts, as our chymists sometimes manage them for cheapness. The English and Dutch made a considerable commerce of *pot-ashes*, which they bring from about the Black Sea; using great quantities thereof in the preparation of their cloths, &c. those ashes being found excellent for scouring.

POT-ASHES is also a denomination popularly applied to all kinds of wood ashes bought in all parts of the country, and mixed together, for the making green glass: or more generally denotes an

P O W

alkaline salt, of that kind called the vegetable alkali, obtained from most vegetables by burning or incineration. The art of reducing vegetables to this state is a very valuable one; the soap maker, fuller, scourer, dyer, and glass-man, as well as the chymist and apothecary, depending greatly on it in many particulars. The authors who are farther to be consulted in this case, are Glauber, in his Prosperity of Germany; but the chymical foundation of the whole appears in Boerhaave's Chymistry, and the papers of Stahl on this subject.

POTATOE, in botany. These roots came first from Ireland into Lancashire, where they are still very much cultivated. It was, however, 40 years after their introduction before they were much cultivated about London; and then they were considered as rarities, without any conception of the utility that might arise from bringing them into common use. At this time they were distinguished from the Spanish by the name of *Virginia potatoes*, or *battatas*, which is the Indian name of the Spanish sort.

At a meeting of the Royal Society, March 18th, 1662-3, a letter was read from Mr. Buckland, a Somerset gentleman, recommending the planting of potatoes in all parts of the kingdom to prevent famine. This was referred to a committee; and, in consequence of their report, Mr. Buckland had the thanks of the society; such members as had lands were intreated to plant them, and Mr. Evelyn was desired to mention the proposals at the close of his Sylva. Since that time the plant has been so universally cultivated, that it has become a considerable part of our food; and attempts have even been made to substitute the potatoe instead of bread, or to make bread from it. See the article BREAD.

A correspondent has favoured us with the following observations on feeding hogs with potatoes. "From an accurate experiment I made lately, I can venture to recommend baked potatoes as an excellent food for hogs. The pork produced by this food was equal to that from barley and beans: but at present I cannot exactly ascertain the comparative experiment with regard to expence; however, I am of opinion, that roasted potatoes, considering the improvement of the hogs, is as cheap a food, if not cheaper, than can be given them. I roasted my potatoes upon a kiln, similar to what is used by oat-meal shellers for drying their oats. The difference in expence between boiling and roasting the potatoes is prodigious, both with regard to the labour and fuel. A kiln that will cost 3l. will roast potatoes sufficient for the maintenance of more than 20 hogs; and one man will bestow all the necessary attendance upon them, and do other work besides. The action of the fire, by dissipating the crude juices that are contained in raw potatoes, reduces them into a state highly wholesome and nutritious. Boiling does this in part, but not so effectually. A potatoe roasted in the manner above described, partakes much of the nature of a chestnut, and perhaps is not greatly inferior to it. There is one remarkable property of a potatoe, that when planted in water, it shoots out a great number of fine white roots like threads into the water; but on none of them is there to be found the least appearance of a bulb; while on the other hand, the potatoes in that case always grow on the top." For the newest and most approved methods of cultivating potatoes, see the system of AGRICULTURE, Sect. XIII.

POTENT, or POTENCE, in heraldry, a term for a kind of a cross, whose ends all terminate like the head of a crutch.

POTENTIAL, in grammar, gives the denomination to one of the moods of verbs. The *potential* mood is the same, in form, with the subjunctive; but differs from it in this, that it hath always implied in it, either *possum*, *volo*, or *debeo*; as *roget*, that is, *rogare potest*, the man may ask. See the System, Part II. Chap. III. Art. V.

POTTERY, the art of making earthen pots and vessels; or the manufacture of earthen-ware. All kinds of *pottery* in general are made of clays or argillaceous earths; because these earths are capable of being kneaded, of easily receiving any forms, and of acquiring much solidity and hardness by exposure to the fire.

POWDER, in pharmacy, a dry medicine, well broken, either in a mortar, by grinding, or by some chymical operation.

Gun-Powder. See GUN-Powder.

POWER, *potentia*, in physics, a natural faculty of doing or suffering any thing. Mr. Locke explains the origin of our idea of power to the following effect: the mind being daily informed, by the sense, of the alterations of the simple ideas of things without, and reflecting on what passes within itself, and observing a constant change of its ideas, sometimes by the impressions of outward objects upon the senses, and sometimes by the determinations of its own choice; and concluding, from what it has so constantly observed to have been, that the like changes will for the future be made in the same things, by the same agents, and by the like ways; considers in one thing, the possibility of having any of its simple ideas changed; and in another, the possibility of making that change; and so comes by that idea which we call power. Thus we say, fire has a power to melt gold, and make it fluid; and gold has a power to be melted. Power, thus considered, is twofold; viz. as able to make, or able to receive, any change; the one may be called *active*, the other *passive power*. Of *passive power* all sensible things abundantly furnish us with ideas; nor have we of

*

G g g

active

P R A

active power fewer instances; since whatever change is observed, the mind must suppose a *power* somewhere able to make that change.

POWER, in mechanics, denotes a force, which being applied to a machine, tends to produce motion; whether it does actually produce it or not. See the *System*, Sect. III.

POX, in medicine, a disease, under which name there are several kinds: as *small-pox*, *French-pox*, *chicken-pox*, *swine-pox*, &c.

Small Pox, *variola*, is a contagious disease appearing on the surface of the skin, which it covers with pustules, or ulcerous eruptions, that leave eschars behind them. Or, it is a general eruption of particular pustules tending to suppuration, and attended with a fever. For description, causes, prognosis and cure, see the *System*, Genus 26.

Chicken Pox, a cutaneous disease frequent in children, wherein the skin is covered with pustules, like those of the *small-pox*, as to figure and magnitude; and only distinguishable therefrom, in that those of the *small-pox* appear with a redness and inflammation, and those of the *chicken-pox* whiter, resembling vesiculæ full of a serous humour; which, in three days time, burst, and dry away without any danger, and usually without any fever. See the *System of MEDICINE*, Genus 27.

French Pox, a contagious disease, contracted by a poisonous humour, usually in coition: and manifesting itself in ulcers and pains. For description, prognosis and cure, see the *System of MEDICINE*, Genus 59.

PRACTICE, in arithmetic, *PRACTICA Italica*, or *Italian* *rules*, certain compendious ways of working the rule of proportion, or golden rule; especially where the first term is 1, or unity.

They were thus called from their expediting of practice, and business; and because first introduced by the merchants and negotiants of Italy. For a full account of the different methods used in this branch, see the *System*, under the Article *RULE of PRACTICE*.

PRAGMATIC Sanction, in the civil law, is defined, by Hotoman, a rescript or answer of the sovereign; delivered, by advice of his council, to some college, order, or body of people, upon their consulting him in some case of their community. The word is formed from the Greek *πραγμα*, *negotium*, *business*. It is sometimes called absolutely, *pragmatic*, *το πραγματικον*. The like answer given to any particular person is called simply *rescript*, *rescriptum*. The term *pragmatic sanction* is chiefly used among the modern writers, for that famous ordonnance of Charles VII. of France, drawn up at Bourges, with the consent of the most eminent prelates and grandees of the nation assembled at that place, and published in 1438, containing a regulation of ecclesiastical discipline, conformable to the canons of the council by Basil; and since used by the Gallican church, as a barrier against the enterprises and encroachments of the church of Rome.

The scope of the *pragmatic sanction*, which consisted of twenty-three articles, was to regulate the form of elections made by the clergy, to restore to every church its privilege of choosing its bishop, and to every monastery that of electing its abbot or crier; to declare the collations to belong to ordinaries, the prevention alone reserved to establish prebends; to assign a third of the benefices to graduates; and to abolish reservations, annates, and other like grievances. The *pragmatic* of St. Lewis in 1268, consisting of six articles, was similar to this in its chief design. The edict of Bourges in 1438, was drawn up in concert with the fathers of the council of Basil; and the articles it contains were taken from the decrees of that council; though they were admitted by the Gallican church with certain modifications, which the nature of the times and the manners of the nation rendered expedient. See this edict published at large in *Hard. Concil. tom. viii. p. 1949*.

Pope Pius II. obtained an abrogation of this sanction from Louis XI. on which occasion the court of Rome, transported with joy, dragged the *pragmatic* through the streets, whipping it all the way, as Xerxes anciently did the Hellespont: and the king obtained for himself and his successors the title of *Most-Christian*. But the parliament opposed this abrogation with a great deal of vigour, and refused its consent to the last. Lewis also perceiving that he had been deluded into this measure by the treacherous insinuations of Geoffroy, bishop of Arras, whom the pope had bribed with a cardinal's cap, and large promises of a lucrative kind, took no sort of pains to have it executed, but published, on the contrary, new edicts against the pecuniary pretensions and extortions of the court of Rome. So that, in spite of all the efforts of Rome, the *sanction* still held in force, till the *concordat* held between pope Leo X. and Francis I. in 1517, when the *pragmatic sanction* was abolished and the king was invested with the privilege of nominating to bishoprics and vacant benefices. The parliament of Paris again opposed the innovation, and refused to confirm the concordat; and was not brought to give its consent at last, till after repeated orders of the king; together with a secret resolution taken always to judge conformably to the tenor of the *pragmatic sanction*.

PRAYER, in theology, a petition put up to God, either for the obtaining some future favour, or the returning of thanks for a past one. Divines distinguish three kinds of *prayer*: *Vocal*, which is clothed in words and sounds to be uttered with the mouth *Mental* which is only formed or conceived, in the mind, and not delivered

P R E

in words. *Ejaculatory*, which is a short, sudden flight, without study, order, or method. Mystic divines, again, distinguish *prayer* into *active* and *PASSIVE*. Among us, *prayer* is most frequently considered under the divisions of pre-conceived and extemporary. Under the first come all set forms, whether public or private, by which the mind is directed in the order, manner, expression, &c. of its petitions. The second is that where the mind is left to itself, its own conduct, both as to matter, manner, words, &c. The Romanists also prefer *prayers* to saints; the Virgin, the angel Gabriel, &c. See *SAINT*.

PREBEND, *præbenda*, the portion which a prebendary receives for his maintenance out of the estate of a cathedral, or collegiate church. The term *prebend* is usually confounded with *canonicate*, or *canonica*; yet there is a real difference. A *prebend* is properly a right which an ecclesiastic has in a cathedral or collegiate church, where he officiates, to receive certain ecclesiastical revenues, and to enjoy certain dues, either in money or in kind.

Prebends, are either *simple*, or with *dignity*. The latter are such as, beside their *prebends*, have some jurisdiction annexed to them. No person may hold more than one prebend in the same church; and if a prebendary accepteth of a deanry, his *prebend* is void by cession, the acceptance of a deanry being understood to be in the same church. So if he is made a bishop, the king presents to his *prebend*.

PREBENDARY, *præbendarius*, an ecclesiastic who enjoys a *PREBEND*. The difference between a prebendary and a canon is, that the former receives his portion or prebend in consideration of his officiating and serving in the church; but the latter without any such consideration, merely by his being received into the cathedral or college.

PRECEDENCE, **PRECEDENCY**, or **PRÆCEDENCY**, a place of honour which a person is entitled to. With regard to the order of *precedency*, it may be observed in general, that persons of every degree of honour or dignity take place according to the seniority of their creation and not of years, unless they are descended of the royal blood; in which case they have place of all others of the same degree. *Precedency* is either of *courtesy*, or *de jure*, of right. The former is that which is due to age, or estate, &c. which is regulated by custom and civility. For further particulars, see the close of the *system of PEERAGE*.

PRECIPITANT, *præcipitans*, in chemistry, a term applied to any liquor, which, being poured on a dissolution, separates what is there dissolved, and makes it *precipitate*, i. e. fall to the bottom of the vessel. Thus oil of tartar, and the volatile spirit of sal ammoniac, are *precipitants* with regard to the dissolution of gold in aqua regalis; and common water is a *precipitant* with regard to the dissolution of jalap in spirit of wine.

PRECIPITANT is also used in medicine for a remedy which separates and precipitates any heterogeneous matter contained in the mass of blood; and by this means abates any irregular fermentations, effervescences, or the like disorders, which the matter has excited. Among the number of *precipitants* are ranked hartshorn, crabs eyes, ivory, bezoard, barks of oak and guaiacum, iron, quinquina, chalk, &c.

PRECIPITATION, *præcipitatio*, a process in chymistry, which, in its most extensive sense, is applicable to all chymical decompositions made by an intermediate substance; or, to all operations in which two bodies are disunited by employing a third body, which has the property of uniting with one of these, and thereby of separating the other; so that every *precipitation* is effected by means of the *AFFINITY* of a precipitant, much stronger than that of a precipitate with the substance from which it is separated. In a more confined sense, *precipitation* is a kind of separation, whereby a body, dissolved and suspended in any menstruous liquor, is detached therefrom, and falls down to the bottom of the vessel. *Precipitation* is either *spontaneous* or *artificial*.

PRECIPITATION, in assaying, is the separation of any part of a compound body, while melting in the fire, or when cooling from fusion, from the rest of the mass, in such manner that it sinks to the bottom, while the remainder continues at top and makes the surface. The heavy part thus *precipitated* from the rest, is called the *regulus* of that body.

PRECISION, in oratory, denotes such a brevity as consists in saying nothing superfluous, and omitting nothing that is necessary. In this sense it is opposed to a tedious prolixity on the one hand, and an obscure conciseness on the other. See the *System*, Part III. Sect. II. Art. IV.

PREDESTINARIAN, a person who adheres to the doctrine of absolute predestination. St. Augustin is looked on as the founder of the sect of *Predestinarians*, he being the first of the fathers that seems to have asserted the doctrine in such express terms; though the *JANSENISTS* and other sects are still greatly divided about the real doctrine of St. Augustin, in this article, each interpreting him consistently with their own scheme. Father Sirmond contends for an ancient sect of *Predestinarians*, contemporary with St. Augustin himself, and who had their rise in Africa, in the monastery of Adrumetum, from a misunderstanding of St. Augustin's doctrine. Hence they were led into a notion, that God not only predestinated the wicked to eternal punishment, but also to the guilt and transgression for which they are punished; and that thus both the good and

and had actions of all men were determined from eternity by a divine decree, and fixed by an inevitable necessity. It is added, that the opinion spread thence throughout the Gauls, where one of them, a priest named Lucidus, was condemned by Faustus, bishop of Ruggio, and his sentence was confirmed by two councils. However, the existence of this *Predestinarian* sect has been denied by many learned men, particularly the president Mauguin, and considered as an invention of the SEMIPELAGIANS, designed to decry the followers of Augustin, by attributing to him unjustly this dangerous and pernicious error. Nor does it appear, though there might have been persons who embraced the *Predestinarian* opinion, that the abettors of them ever formed themselves into a sect. The doctrine was again broached in the ninth century, by Godeschalch, a Benedictine; who, as Hincmar, in a letter to pope Nicolas, says, maintained with the ancient *Predestinarians*, who had been already anathematized, that God *predestinated* some to eternal life, and others to eternal death; that God did not will all people to be saved; that Jesus Christ did not die for all, but only the elect, or those that are saved, &c. This doctrine was again condemned in a synod held at Mentz, A. D. 848, and by a council at Quiercy, A. D. 849, in consequence of which Godeschalch was treated with the utmost barbarity, and compelled to burn with his own hands the justification of his opinion, which he had presented to the council at Mentz. He was then cast into prison, where he died in the year 868 or 869, maintaining with his last breath the doctrine for which he had suffered.

The controversy was revived in the sixteenth century by Calvin, who maintained that the everlasting condition of mankind in a future world, was determined from all eternity; and that God, in *predestinating* from all eternity one part of mankind to everlasting happiness, and another to endless misery, was led to make that distinction by no other motive than his own good pleasure and free will. This opinion was, in a very short time, propagated through all the reformed churches, by the writings of Calvin, and by the ministry of his disciples, and, in some places, was inserted in the national creeds and confessions; and thus made a public article of faith. The unhappy controversy, which took its rise from this doctrine, was opened at Strasburgh, in the year 1560, by Jerome Zanchius, an Italian ecclesiastic, who was particularly attached to the sentiments of Calvin, and carried on in a manner as contributed very much to exasperate the passions and foment the discord of the contending parties. The *Predestinarian* opinions have been maintained by considerable numbers, both in popish and protestant countries: and in our own country, in particular, they have had many zealous advocates. We shall here observe, that they have undergone a kind of relaxation by those who have been denominated Baxterians, from the famous non-conformist minister, Mr. Richard Baxter, of the last century. The Baxterians have endeavoured to strike into a middle path between Calvinism and Arminianism, and to unite both these schemes. They profess to believe in the doctrines of election, effectual calling, and other tenets of Calvinism; and consequently suppose that a certain number determined upon in the divine counsels, will infallibly be saved. This they think necessary to secure the ends of Christ's interposition. But then, on the other hand, they reject the doctrine of reprobation, and admit, that our blessed Lord, in a certain sense, died for all; and that such a portion of grace is allotted to every man, as renders it his own fault if he does not attain to eternal happiness. If he improves the common grace given to all mankind, this will be followed by that special grace which will end in his final acceptance and salvation. Whether the Baxterians are of opinion, that any, besides the elect, will actually make such a right use of common grace, as to obtain the other, and, at length, come to heaven, we cannot assuredly say. There may possibly be a difference of sentiment upon the subject, according as they approach nearer to Calvinism or Arminianism. Kippis's Ed. of the *Biog. Brit. art. Baxter*.

PREDESTINATION, *predestinatio*, in theology, a judgment, or decree of God, whereby he has resolved, from all eternity, to save a certain number of persons, hence called elect or chosen. Others define *predestination*, a decree to give faith in Jesus Christ to a certain number of men, and to leave the rest to their own malice and hardness of heart, who being left in a state of impenitence, are said to be reprobated. According to the Calvinistical scheme, the reason of God's *predestinating* some to everlasting life is not founded in a foresight of their faith and obedience, considered as independent upon any communication of grace from him, but it is to be referred to his sovereign mercy and free grace; nevertheless it is also maintained on this scheme, that the means are decreed as well as the end, and that God purposes to save none but such as by his grace he shall prepare for salvation by sanctification.

The Remonstrants define *predestination* more laxly and generally, the decree of saving believers, and damning unbelievers. Some represent the election and *predestination* spoken of in Scripture, as relative only to nations, and not to particular persons. The greatest difficulties wherewith the modern theology is clogged, turn on the article of *predestination*: nothing has occasioned more disputes than this thorny subject, both the Romish and reformed churches are divided about it; the Lutherans speak of it with horror; the Calvinists contend for it with the greatest zeal; the Molinists

preach it down as a most dangerous doctrine; the Janseists assert it as an article of faith; the Arminians, Remonstrants, and Pelagians are all avowed enemies of *predestination*. Those strenuous patrons of Janseism the Portroyalists, teach, that God *predestinates* those who he foresees will co-operate with his grace to the end. Du Pin adds, that men do not fall into sin because not *predestinated*; but they are not *predestinated*, because God foresaw their sins. See ELECTION and REPROBATION.

PREDESTINATION is also used for a concatenation of second causes appointed by Providence; in virtue whereof things are brought to pass by a fatal necessity, contrary to all appearances, and in spite of all opposition. See FATE and NECESSITY. The Turks are great *Predestinarians*; they esteem the slightest accident predetermined, and on this account are much more daring in battle, and run greater risks of their lives than they would otherwise do.

PREDESTINATION, in general, signifies a decree of God, whereby, from all eternity, he ordained such a concatenation of causes as must produce every event by a kind of fatal necessity, and maugre all opposition.

The Scotists urge that all natural causes are of their own nature determined to a certain action; whence it should seem needless to cast in a new predetermination of God, e. gr. to fire, to make it warm the hand. For if an object be, by the course of divine Providence, applied to fire; what need a second application of the fire to make it warm the object applied thereto? since beings are not to be multiplied unnecessarily. And such predetermination some philosophers hold still less requisite to produce the acts of the will; at least, say they, the human mind must be allowed the common power and privilege of a second cause, and therefore be entitled to produce its own acts, as well as other strictly natural agents.

PREDICATE, *predicatum*, in logic, that part of a proposition which affirms or denies something of the subject. Thus, in *God made the world*; *made the world* is the predicate, and *God* is the subject. See the System, Part II. Sect. II.

PREDICTION, *prædictio*, divination, prophecy, or foretelling what is to come, either by divine revelation, by art and human invention, or by conjecture. See DIVINATION and PROPHECY.

PRE-EXISTENCE, a priority of being, or the being of one thing before another. Thus a cause, if not in time, is yet in nature, pre-existent to its effect. Thus God is pre-existent to the universe. Thus a human father is pre-existent to his son. The Peripatetics, though they maintained the eternity of the world, were likewise dogmatical in their opinion, that the universe was produced, actuated, and governed, by a sovereign intelligence. Embarrassed, however, with the difficulty, that causation seemed to imply previous existence, as no being could operate either production or change upon another till its own existence and powers of operation had first been realized, these profound and accurate philosophers exerted all their subtilty and learning to obviate an objection so formidable. Thus, in order to extricate their system, they had recourse to a distinction which equally shewed the extent of their genius and the depth of their erudition. They distinguished between priority in nature and priority in time. It is impossible, say they, to conceive the existence of the sun, for one indivisible instant prior to his emission of rays. When a seal is stamped upon wax, the impression must be strictly and coexistent with the impulse; thus the emanant act or exertion of Deity in producing, moving, and superintending the universe, must be one continued and unsuccessive energy. It is unnecessary to enter into the depth or minutiae of this controversy, since we are assured by the best of all authorities, that the world was created in time, from whence it follows, that even in the course of duration the existence of God must have been anterior to that of his works. The difficulty urged by them, and by other sceptical philosophers, that at whatever period of duration creative power began to be exerted, it must have passed an eternity prior to that point in supine indolence and inactivity; though not to be solved by human reason, is yet less formidable, because more easily conceivable, than the eternal coexistence of an effect with its cause. Previous to that distinguished æra in endless duration, when nature, at the Almighty fiat, emerged from nothing, we are entirely ignorant of the motives (if it may be so expressed) which might predispose infinite wisdom, power, and goodness, then, and not till then, to exert themselves in creating. But since, from all that we see of the divine energy and administration, nothing appears to be done without a sufficient reason, we have the best grounds to conclude that the same conduct prevails in those divine exertions, whose nature, manner, and adjuncts, are absolutely incomprehensible by our limited powers.

It is evident, that the Divine Nature, rich in its eternal and independent all sufficiency, could never feel any necessity which might be redressed or gratified by the existence or homage of external nature. The universe therefore must be formed for itself alone, and could only be the glorious result of unconstrained wisdom and voluntary goodness. Besides, there is no series of deductions more natural and congenial to the human mind, than to conclude, that what is eternal must be unproduced. That if it was produced, there must have been a period when it did not exist: if it was not produced it must be independent; if independent it must be self-existent; and if self-existent, it must be from eternity to eternity invested with powers sufficient for the maintenance and regulation of

of its own existence: so that not only the necessity, but perhaps even the possibility of a supreme Agent and wise Superintendent, acting upon nature, and animating or controlling her operations, is upon this hypothesis entirely superseded. But from the beauty, symmetry, and order, of nature, and from the number of final causes pursued in her progress and accomplished in its results, Aristotle and his followers were too wise not to perceive, and too ingenuous, not to acknowledge, the sacred vestiges, the conspicuous interpositions, of infinite wisdom, power, and goodness; hence his notion of an eternal world, though generally admitted among the sages of antiquity, was an incompatible or self-destructive opinion. The objections which have already been mentioned against a temporary creation might perhaps be obviated, if not annihilated, were it our present business to enter deeply into the nature of space and time.

But this disquisition requires a boldness and abstraction of thought, in which we might probably be followed by few, and relished by fewer readers. Such, however, as have courage, sagacity, and perseverance to penetrate and pursue their intricacies to their ultimate conclusions, will find their investigation cheered and enlightened by the philosophical essays of Dr. Isaac Watts, and by the chevalier Ramsay's principles of natural and revealed religion. Veracity likewise obliges us to add, that the speculations of Mr. Hume on this abstruse and arduous subject, had a greater tendency to dissipate its gloom than that philosopher himself could imagine. The pre-existence of the human soul to its corporeal vehicle had been from time immemorial a prevailing opinion among the Asiatic sages, and from them was perhaps transferred by Pythagoras to the philosophy of the Greeks; but his metempsychosis, or transmigration of souls, is too trivial to be seriously proposed or refuted. Nevertheless, from the sentiments of Socrates concerning the immortality of the soul, delivered in his last interview with his friends, it is obvious that the tenet of pre-existence was a doctrine of the Platonic school. If at any period of life, say these philosophers, you should examine a boy; of how many ideas, of what a number of principles, of what an extent of knowledge, will you find him possessed! these, without doubt, could neither be self-derived nor recently acquired. With what avidity and promptitude does he attain the knowledge of arts and sciences, which appear entirely new to him! these rapid and successful advances in knowledge can only be the effects of reminiscence, or of a fainter and more indistinct species of recollection. But in all the other operations of memory, we find retrospective impressions attending every object or idea which emerges to her view; nor does she ever suggest any thought, word, or action, without informing us, in a manner equally clear and evident, that those impressions have been made upon our senses, mind, or intellect, on some former occasion. Whoever contemplates her progress, will easily discover, that association is her most faithful and efficacious auxiliary; and that by joining impression with impression, idea with idea, circumstance with circumstance, in the order of time, of place, of similarity or dissimilarity, she is capacitated to accumulate her treasures and enlarge her province even to an indefinite extent. But when intuitive principles, or simple conclusions, are elicited from the puerile understanding, by a train of easy questions, properly arranged; where is the retrospective act of memory, by which the boy recognises those truths as have formerly been perceived in his mind? where are the crowds of concomitant, antecedent, or subsequent ideas, with which those recollections ought naturally to have been attended? In a word, where is the sense of personal identity, which seems absolutely inseparable from every act of memory? This hypothesis, therefore, will not support pre-existence. After the Christian religion had been considerably diffused, and warmly combated by its philosophical antagonists, the same doctrine was resumed and taught at Alexandria by Platonic proselytes, not only as a topic constituent of their master's philosophy, but as an answer to those formidable objections which had been deduced from the doctrine of original sin, and from the vices which stain, and from the calamities which disturb, human life: hence they strenuously asserted, that all the human race were either introduced to being prior to Adam, or pre-existent in his person; that they were not therefore represented by our first parents, but actually concurred in their crime, and participated their ruin.

The followers of Origen, and such as entertained the notion of pre-Adamites, might argue from the doctrine of pre-existence with some degree of plausibility. For the human beings introduced by them to the theatre of probation, had already attained the capacity or dignity of moral agents; as their crime therefore was voluntary; their punishment might be just. But those who believe the whole human race created in Adam to be only pre-existent in their germs or stamina, were even deprived of this miserable subterfuge; for in these homunculi we can neither suppose the moral nor rational constitution unfolded. Since, therefore, their degeneracy was not spontaneous, neither could their sufferings be equitable. Should it be said that the evil of original sin was penal, as extended to our first parents alone, and merely consequential as felt by their posterity, it will be admitted that the distinction between penal and consequential evil may be intelligible in human affairs, where other laws, assortments, and combinations than those which are simply and purely moral, take place. But that a moral government, at one of the most cardinal periods of its administra-

tion, should admit gratuitous or consequential evil, seems to us irreconcilable with the attributes and conduct of a wise and just legislator. Consequential evil, taken as such, is misery sustained without demerit; and cannot result from the procedure of wisdom, benignity and justice; but must flow from necessity, from ignorance, from cruelty, or from caprice, as its only possible sources. But even upon the supposition of those who pretend that man was mature in all his faculties before the commission of original sin, the objections against it will still remain in full force. For it is admitted by all, except the Samian sage, that the consciousness of personal identity, which was felt in pre-existence, is obliterated in a subsequent state of being.

Now it may be demanded, whether agents thus resuscitated for punishment have not the same right to murmur and complain as if they had been perfectly innocent, and only created for that dreadful catastrophe? It is upon this principle alone that the effects of punishment can be either exemplary, or disciplinary; for how is it possible, that the punishment of beings unconscious of a crime, should ever be reconciled either to the justice or beneficence of that intention with which their sufferings are inflicted? or how can others be supposed to become wise and virtuous by the example of those who are neither acquainted with the origin nor the tendency of their miseries, but have every reason to think themselves afflicted merely for the sake of afflicting. To us it seems clear, that the nature and rationale of original sin lie inscrutably retired in the bosom of Providence; nor can we, without unpardonable presumption and arrogance, form the most simple conclusion, or attempt the minutest discovery, either different from or extraneous to the clear and obvious sense of revelation. This sense indeed may with propriety be extracted from the whole, or from one passage collated with another; but independent of it, as reason has no premises, she can form no deductions. The boldness and temerity of philosophy, not satisfied with contemplating pre-existence as merely relative to human nature, has dared to try how far it was compatible with the glorious Persons of the sacred Trinity. The Arians, who allowed the subordinate divinity of our Saviour, believed him pre-existent to all time, and before all worlds; but the Socinians, who esteemed his nature as well as his person merely human, insisted that before his incarnation he was only pre-existent in the divine idea, not in nature or person. But when it is considered, that children do not begin to deduce instructions from nature and experience, at a period so late as we are apt to imagine; when it is admitted, that their progress, though insensible, may be much more rapid than we apprehend; when the opportunities of sense, the ardour of curiosity, the avidity of memory, and the activity of understanding, are remarked, we need not have recourse to a pre-existent state for our account of the knowledge which young minds discover. It may likewise be added, that moral agents can only be improved and cultivated by moral discipline. Such effects therefore of any state, whether happy or miserable, as merely mechanical, may be noxious or salutary to the patient, but can never enter into any moral œconomy as parts of its own administration. Pre-existence, therefore, whether rewarded or punished without the continued impression of personal identity, affords no solution of original sin.

PREFACE *præfatio*, formed from *præ* and *fari*; q. d. to speak before, an advertisement in the beginning of a book, to inform the reader of the design, order, method, &c. observed therein; of what is necessary to receive its full effect, and facilitate the understanding thereof. There is no part of writing that requires more art and address, or that fewer authors succeed in, than *prefaces*. Prefacing is, in effect, a particular species of writing, and has its peculiar character and taste to distinguish it from all others. It is neither argumentation, discourse, narration, nor apology.

PREGNANCY, the state of a woman when she has conceived, or is with child. The same state with a view to the bearing of the child in the womb, is called *gestation*. For a particular account of the disorders incidental to pregnant women, and the methods of treating them, see *System of Midwifery*, Part II. Sect. I. II. and III.

PREJUDICE, *præjudicium*, a false notion or opinion of any thing conceived, without a due previous examination thereof. Prejudice, q. d. pre-judgment, does not import a judgment merely as prior to another in respect of time, but as being prior thereto in respect to knowledge, or of sufficient attention to the thing; the preposition *præ* expressing an anticipation, not so much of time, as of knowledge and due attention.

PRELATE, from *prælatus*, *præ*, before, and *fero*, I bear, carry, an ecclesiastical superior, raised to some eminent and superior dignity of the church. Patriarchs, primates, archbishops, bishops, generals of religious orders, certain crossiered and mitred abbots, and even deans and archdeacons, are ranked among the number of prelates.

PRELATE of the Garter, is the first officer of that noble order, and is as ancient as the institution itself. William de Edynton, then bishop of Winchester, was the first prelate at the erection of the order; and it has been continued in that see ever since. It is an office of great honour, but has neither salary nor fees; only a convenient lodging allowed in Windsor-castle; and as oft as the prelate comes thither (by the sovereign's command), he is to have court-livery allowed for himself and servants. See **KNIGHTS of the GARTER**.

P R E

PRELIMINARY, or **PRÆLIMINARY**, formed from *præ*, before, and *limen*, threshold, something to be examined, dispatched or determined, before an affair can be treated of thoroughly, and to any purpose. Preliminaries of peace generally take up the greatest part of treaties. They consist in examining of powers, qualities of princes, ranks of ambassadors, &c.

PREMISES, **PREMISSÆ**, *præmissæ*, in logic, the two first propositions of a syllogism. When a syllogism is in form, the two premises being granted, the conclusion cannot be denied. See the System, Part III. Sect. IV.

PREMIUM, or **PRÆMIUM**, literally denotes a reward or recompence. Among merchants it is taken for that sum of money; viz. 8 or 10 per cent. &c. which is given to an insurer, for insuring the safe return of any ship or merchandize.

PREMIUM is also used in the money and paper-trade for what is given for a thing above *par*. Thus, lottery-tickets, &c. are said to bear so much, e. gr. 10 or 20s. premium, when they are sold for so much beyond the prime cost, at which the government issued them.

PREPARATION, in chemistry and pharmacy, is applied to the several manners of managing the *materia medica*, and of disposing it to serve the several purposes. There are various preparations of mercury, antimony, and other drugs, to purify them, sublimate, calcine, edulcorate, &c.

PREPARATIONS, in anatomy, the parts of animal bodies prepared and preserved for anatomical uses. The manner of preserving anatomical preparations, is either by drying them thoroughly in the air, or putting them into a proper liquor. In drying parts which are thick, when the weather is warm, care must be taken to prevent putrefaction, fly-blows, insects, &c. This is easily done by the use of a solution of corrosive sublimate in spirit of wine, in the proportion of two drams of sublimate to a pound of spirit: the part should be moistened with this liquor as it dries, and by this method the body of a child may be kept safe even in summer. Dried preparations are apt to crack and moulder away in keeping; to prevent this their surface should be covered with a thick varnish, repeated as often as occasion requires. Though several parts prepared dry are useful, yet others must be so managed as to be always flexible, and nearer a natural state. The difficulty has been to find a proper liquor for this purpose. Dr. Monro says, the best he knows is a well rectified colourless spirit of wine, to which is added a small quantity of the spirit of vitrol or nitre. When these are properly mixed, they neither change their colour nor the consistence of the parts, except where there are serous or mucous liquors contained in them. The brain, even of a young child, in this mixture, grows so firm as to admit of gentle handling, as do also the vitreous and crystalline humours of the eye. The liquor of the sebaceous glands and the semen are coagulated by this spirituous mixture; and it heightens the red colour of the injection of the blood vessels, so that after the part has been in it a little time, several vessels appear which were before invisible. If you will compare these effects with what Ruysch has said of his balsam, you will find the liquor above-mentioned to come very near to it.

The proportion of the spirits must be changed according to the part prepared. For the brain and humours of the eye, you must put two drams of spirit of nitre to one pound of spirit of wine. In preserving other parts which are harder, 30 or 40 drops of the acid will be sufficient; a larger quantity will make bones flexible, and even dissolve them. The part thus preserved should be always kept covered with the liquor: therefore great care should be taken to stop the mouth of the glass with a waxed cork and a bladder tied over it, to prevent the evaporation of the spirit; some of which notwithstanding all this care, will fly off; therefore fresh must be added as there is occasion. When the spirits change to a dark tincture, which will sometimes happen, they should be poured off, and fresh put in their room; but with somewhat less acid than at first. The glasses which contain the preparations should be of the finest sort, and pretty thick; for through such the parts may be seen very distinctly, and of a true colour, and the object will be so magnified as to show vessels in the glass which out of it were not to be seen.

As the glass when filled with the liquor has a certain focus, it is necessary to keep the preparation at a proper distance from the sides of it, which is easily done by little sticks suitably placed, or by suspending it by a thread in a proper situation. The operator should be cautious of putting his fingers in this liquor oftener than is absolutely necessary; because it brings on a numbness of the skin, which makes the fingers unfit for any nice operation. The best remedy for this is to wash them in water mixed with a few drops of oil of tartar per deliquium.

Dr. Christ. Jac. Trew prefers the rectified spirit of grain for preserving anatomical preparations to spirit of wine, or to compositions of alcohol, amber, camphor, &c. because these soon change into a brown colour, whereas the spirit from malt preserves its limpid appearance. When any part is to be preserved wet, wash it with water till it be no more tinctured. The water is next to be washed away with spirits, and then the preparation is to be put among spirits in a glass, the mouth of which is to be closely covered with a glass head, over which a wet bladder and leaf-tin are to be tied. *Com. Lit. Norimb. 1731, someß. 1. specim. 9.*

PREPOSITION, **PRÆPOSITIO**, in grammar, one of the parts

P R E

of speech or discourse. The *preposition* is an undeclinable particle, which yet serves to govern the nouns that follow it. Such are, *per*, *pro*, *propter*, *in*, *with*, *through*, *from*, *by*, &c. They are called *prepositions*, because *præpositæ*, placed before the nouns they govern. See the System, Part I. Chap. IV. Sect. IV.

PREPUCE, **PRÆPUTIUM**, in anatomy, the foreskin; a prolongation of the cutis of the penis, covering the glans or extremity of the yard. See the System, Part III. Sect. IV.

Dr. Drake observes, that nature does not seem more various in any part of her works than in the *prepuce*; for the figure and proportion whereof there does not seem any standard. Hence, probably, arose the necessity of circumcision, so generally practised throughout the oriental parts of the world: not out of a view to religion, but to cleanliness; and to prevent diseases, which a detention of the mucus of the *subpreputial* glans might breed in those hot countries. For even here, the same author adds, he has known some, who having large prepuces, called filbert-prepuces, have been frightened at the appearance of a mucus issuing out upon a mere plenitude from between the prepuce and the glans; which, it is probable, the great legislator of the Jews might have a view to in the first institution of circumcision. The skin of the prepuce is double; at the connection of the internal skin, to the other part, are several oval and roundish glandules, placed irregularly about the joining of the glans to the corpora cavernosa, and on the glans itself. Their use is to separate a liquor to render the agitation of the prepuce on the glans easy. When this liquor becomes rancid, as upon old age, or venereal contracts, it excoriates the glans and prepuce; and even sometimes contracts the latter, and renders it necessary to be divided, to afford a passage to the glans. See PHIMOSIS, and PARAPHIMOSIS.

PREROGATIVE, *prærogativa*, a privilege, or pre-eminence, which one person has over another.

Royal PREROGATIVE, that special pre-eminence which the king hath over and above all other persons, and out of the ordinary course of the common law, in right of his regal dignity. It signifies in its etymology (from *præ* and *roga*) something that is required or demanded before, or in preference to all others. And hence it follows, that it must be in its nature singular and eccentric; that it can only be applied to those rights and capacities which the king enjoys alone, in contradistinction to others, and not to those which he enjoys in common with any of his subjects: for if once any one prerogative of the crown could be held in common with the subject, it would cease to be a prerogative any longer. And therefore Finch lays it down as a maxim, that the prerogative is that law in case of the king, which is law in no case of the subject.

Prerogatives are either *direct* or *incidental*. The *direct* are such positive substantial parts of the royal character and authority, as are rooted in, and spring from, the king's political person, considered merely by itself, without reference to any other extrinsic circumstance; as, the right of sending ambassadors, of creating peers, and of making war or peace. But such prerogatives as are *incidental* bear always a relation to something else, distinct from the king's person; and are indeed only exceptions, in favour of the crown, to those general rules that are established for the rest of the community: such as that no costs shall be recovered against the king; that the king can never be a joint-tenant; and that his debt shall be preferred before a debt of any of his subjects.

These substantive or direct prerogatives may again be divided into three kinds: being such as regard, first, the king's royal character or dignity; secondly, his royal authority or power; and, lastly, his royal income. These are necessary, to secure reverence to his person, obedience to his commands, and an affluent supply for the ordinary expences of government; without all of which it is impossible to maintain the executive power in due independence and vigour. Yet, in every branch of this large and extensive dominion, our free constitution has interposed such seasonable checks and restrictions, as may curb it from trampling on those liberties which it was meant to secure and establish. The enormous weight of prerogative, if left to itself (as in arbitrary governments it is), spreads havoc and destruction among all the inferior movements: but, when balanced and bridled (as with us) by its proper counterpoise, timely and judiciously applied, its operations are then equable and regular; it invigorates the whole machine, and enables every part to answer the end of its construction.

I. Of the royal dignity. Under every monarchical establishment, it is necessary to distinguish the prince from his subjects, not only by the outward pomp and decorations of majesty, but also by ascribing to him certain qualities as inherent in his royal capacity, distinct from and superior to those of any other individual in the nation. For though a philosophical mind will (says Sir William Blackstone) consider the royal person merely as one man appointed by mutual consent to preside over many others, and will pay him that reverence and duty which the principles of society demand; yet the mass of mankind will be apt to grow insolent and refractory, if taught to consider their prince as a man of no greater perfection than themselves. The law therefore ascribes to the king, in his high political character, not only large powers and emoluments, which form his prerogative and revenue, but likewise certain attributes of a great and transcendent nature; by which the people are led to consider him in the light of a superior being; and

*

H h

to

to pay him that awful respect which may enable him with greater ease to carry on the business of government. This is what we understand by the royal dignity, the several branches of which we will now proceed to enumerate.

1. And, first, the law ascribes to the king the attribute of *sovereignty*, or pre-eminency. See SOVEREIGN.

2. "The law also, (according to Sir William Blackstone) ascribes to the king, in his political capacity, absolute *perfection*. 'The king can do no wrong.' Which ancient and fundamental maxim (says he) is not to be understood as if every thing transacted by the government was of course just and lawful; but means only two things. First, that whatever is exceptionable in the conduct of public affairs is not to be imputed to the king, nor is he answerable for it personally to his people: for this doctrine would totally destroy that constitutional independence of the crown which is necessary for the balance of power, in our free and active, and therefore compounded, constitution. And, secondly, it means that the prerogative of the crown extends not to do any injury; it is created for the benefit of the people, and therefore cannot be exerted to their prejudice.—'The king, moreover, (he observes), is not only incapable of *doing* wrong, but even of *thinking* wrong: he can never mean to do an improper thing: in him is no folly or weakness. And therefore, if the crown should be induced to grant any franchise or privilege to a subject contrary to reason, or in any wise prejudicial to the commonwealth or a private person, the law will not suppose the king to have meant either an unwise or an injurious action, but declares that the king was deceived in his grant; and thereupon such grant is rendered void, merely upon the foundation of fraud and deception, either by or upon those agents whom the crown has thought proper to employ. For the law will not cast an imputation on that magistrate whom it entrusts with the executive power, as if he was capable of intentionally disregarding his trust: but attributes to mere imposition (to which the most perfect of sub-lunary beings must still continue liable) those little inadvertencies, which, if charged on the will of the prince, might lessen him in the eyes of his subjects."

But this doctrine has been exposed as ridiculous and absurd, by Lord Abingdon, in his late *Dedication to the Collective Body of the People of England*. "Let us see (says he) how these maxims and their comments agree with the constitution, with nature, with reason, with common sense, with experience, with fact, with precedent, and with Sir William Blackstone himself; and whether, by the application of these rules of evidence thereto, it will not be found, that (from the want of attention to that important line of distinction which the constitution has drawn between the king of England and the crown of England) what was attributed to the monarchy has not been given to the monarch, what meant for the kingship conveyed to the king, what designed for the thing transferred to the person, what intended for theory applied to practice; and so in consequence, that whilst the premises (of the perfection of the monarchy) be true, the conclusion (that the king can do no wrong) be not false.

"And first, in reference to the constitution: to which if this matter be applied (meaning what it expresses, and if it do not, it is unworthy of notice) it is subversive of a principle in the constitution, upon which the preservation of the constitution depends; I mean the principle of *resistance*: a principle which, whilst no man will now venture to gainsay, Sir William Blackstone himself admits, 'is justifiable to the person of the prince, when the being of the state is endangered, and the public voice proclaims such resistance necessary; and thus, by such admission, both disproves the maxim, and oversets his own comment thereupon: for to say that 'the king can do no wrong,' and that 'he is incapable even of thinking wrong,' and then to admit that 'resistance to his person is justifiable,' are such jarring contradictions in themselves, that until reconciled, the necessity of argument is suspended.

"With respect then, in the next place, to the agreement of this maxim, and its comment, with nature, with reason, and with common sense, I should have thought myself sufficiently justified in appealing to every man's own reflection for decision, if I had not been made to understand that nature, reason, and common sense, had nothing to do with either. Sir William Blackstone says, 'That though a philosophical mind will consider the royal person merely as one man appointed by mutual consent to preside over others, and will pay him that reverence and duty which the principles of society demand, yet the mass of mankind will be apt to grow insolent and refractory if taught to consider their prince as a man of no greater perfection than themselves; and therefore the law ascribes to the king, in his high political character, certain attributes of a great and transcendent nature, by which the people are led to consider him in the light of a superior being, and to pay him that awful respect which may enable him with greater ease to carry on the business of government.' So that, in order to govern with greater ease, (which by the bye is mere assertion without any proof) it is necessary to deceive the mass of mankind, by making them believe, not only what a philosophical mind cannot believe, but what it is impossible for any mind to believe; and therefore, in the investigation of this subject, according to Sir William, neither nature, reason, nor common sense, can have any concern.

"It remains to examine in how much this maxim and its com-

ment agree with experience, with fact, with precedent, and with Sir William Blackstone himself. And here it is a matter of most curious speculation, to observe a maxim laid down, and which is intended for a rule of government, not only without a single case in support of it, but with a string of cases, that may be carried back to Egbert the first monarch of England, in direct opposition to the doctrine. Who is the man, that, reading the past history of this country will shew us any king that has done no wrong? Who is the reader that will not find, that all the wrongs and injuries which the free constitution of the country has hitherto suffered, have been solely derived from the arbitrary measures of our kings? And yet the mass of mankind are to look upon the king as a superior being; and the maxim, that 'the king can do no wrong,' is to remain as an article of belief. But without pushing this enquiry any further, let us see what encouragement Sir William Blackstone himself has given us for credulity. After stating the maxim, and presenting us with the most lively picture, 'of our sovereign lord thus all perfect and immortal,' what does he make this all perfection and immortality in the end to come to? His words are these: "For when king Charles's deluded brother attempted to enslave the nation (*no wrong this, to be sure*) 'he found it was beyond his power: the people both could, and did resist him; and in consequence of such resistance obliged him to quit his enterprise and his throne together.'"

The sum of all is this: That the Crown of England and the King of England are distinguishable, and not synonymous terms: that allegiance is due to the crown, and through the crown to the king: that the attributes of the crown are sovereignty, perfection, and perpetuity; but that it does not therefore follow, that the king can do no wrong. It is indeed to be admitted, that in high respect for the crown, high respect is also due to the wearer of that crown; that is, to the king: but the crown is to be preferred to the king, for the first veneration is due to the constitution. It is likewise to be supposed, that the king will do no wrong, and as, to prevent this, a privy council is appointed by the constitution to assist the king in the execution of the government; so if any wrong be done, 'these men,' as Montesquieu expresses it, 'may be examined and punished.' Except the parliament, which is the great council of the nation, the judges and the peers, who, being the hereditary counsellors of the crown, have not only a right, but are bound in *foro conscientia*, to advise the king for the public good, the constitution knows of no other counsel than the privy council. Any other council, like Clifford, Arlington, Buckingham, Ashley, Lauderdale, is, as the initial letters of these names express, a CABAL, and as such should be suppressed. Nat. Bacon, speaking of the loss of power in the grand council of lords, says, "The sense of state once contracted into a privy council, is soon recontracted into a cabinet-council, and last of all into a *favourite* or two; which many times brings damage to the public, and both themselves and kings into extreme precipices; partly for want of maturity, but principally through the providence of God over-ruling irregular courses to the hurt of such as walk in them." Pol. Disc. part 2. page 201.

"But if any future king shall think to screen these evil counsellors from the just vengeance of the people by becoming his own minister; and, in so doing, shall take for his sanction the attribute of perfection, shall trust to the deception of his being a superior being, and cloak himself under the maxim that *the king can do no wrong*; I say, in such a case, let the appeal already made to the constitution, to nature, to reason, to common sense, to experience, to fact, to precedent, and to Sir William Blackstone himself, suffice; and preclude the necessity of any further remarks from me." For experience, fact, and precedent, see the reigns of king John, Henry III. Edward II. Richard II. Char. I. and James II. See also *Mirror of Justice*; where it is said, "that this grand assembly (meaning the now parliament, or then Wittenagemotte) is to confer on the government of God's people, how they may be kept from sin, live in quiet, and have right done them, according to the customs and laws; and more especially of *wrong done by the king, queen, or their children*:" to which Nat. Bacon adds this note; "At this time *the king might do wrong*, &c. and so say Bracon and Fleta of the kings in their time." Disc. part 1. page 37. Lond. 1739.

To proceed now to other particulars: Blackstone observes, the law determines, that in the king can be no negligence, or *laches*; and therefore no delay will bar his right. *Nullum tempus occurrit regi*, is the standing maxim upon all occasions: for the law intends that the king is always busied for the public good, and therefore has not leisure to assert his right within the times limited to subjects. In the king also can be no stain or corruption of blood: for if the heir to the crown were attainted of treason or felony, and afterwards the crown should descend to him, this would purge the attainer *ipso facto*. And therefore, when Henry VII. who as earl of Richmond stood attainted, came to the crown, it was not thought necessary to pass an act of parliament to reverse this attainer; because, as lord Bacon, in his History of that Prince, informs us, it was agreed that the assumption of the crown had at once purged all attainders. Neither can the king, in judgment of law, as king, ever be a minor or under age; and therefore his royal grants and assents to acts of parliament are good, though he has not in his natural capacity attained the legal age of 21. By a statute indeed, 28 Hen.

Hen. VIII. c. 17. power was given to future kings to rescind and revoke all acts of parliament that should be made while they were under the age of 24: but this was repealed by the statute of 1 Edw. VI. c. 11. so far as related to that prince, and both statutes are declared to be determined by 24 Geo. II. c. 24. it hath also been usually thought prudent, when the heir apparent has been very young, to appoint a protector, guardian, or regent for a limited time; but the very necessity of such extraordinary provision is sufficient to demonstrate the truth of that maxim of common law, that in the king is no minority; and therefore he has no legal guardian. See REGENT.

3. A third attribute of the king's majesty is his *perpetuity*. The law ascribes to him, in his political capacity, an absolute immortality. The king never dies. Henry, Edward, or George may die: but the king survives them all. For immediately upon the decease of the reigning prince in his natural capacity, his kingship or imperial dignity, by act of law, without any *interregnum* or interval, is vested at once in his heir; who is, *eo instanti*, king to all intents and purposes. And so tender is the law of supposing even a possibility of his death, that his natural dissolution is generally called his *demise*, *dimissio regis vel coronæ*: an expression which signifies merely a transfer of property; for, as is observed in Plowden, when we say the demise of the crown, we mean only, that, in consequence of the dissolution of the king's body-natural from his body-politic, the kingdom is transferred or demised to his successor, and so the royal dignity remains perpetual. Thus, too, when Edward the fourth, in the tenth year of his reign, was driven from his throne for a few months by the house of Lancaster, this temporary transfer of his dignity was denominated his *demise*; and all process was held to be discontinued, as upon a natural death of the king.

II. We are next to consider those branches of the royal prerogative, which invest this our sovereign lord with a number of authorities and powers; in the exertion whereof consists the executive part of government. This is wisely placed in a single hand by the British constitution, for the sake of unanimity, strength, and dispatch. Were it placed in many hands, it would be subject to many wills: many wills, if disunited and drawing different ways, create weakness in a government; and to unite those several wills, and reduce them to one, is a work of more time and delay than the exigencies of state will afford. The king of England is therefore not only the chief, but properly the sole, magistrate of the nation; all others acting by commission from, and in due subordination to, him: in like manner as upon the great revolution in the Roman state, all the powers of the ancient magistracy of the commonwealth were concentrated in the new emperor; so that, as Gravina expresses it, *in ejus unius persona veteris rei publicæ vis atque majestas per cumulatas magistratum potestates exprimebatur*.

In the exertion of lawful prerogative the king is held to be absolute; that is, so far absolute that there is no legal authority that can either delay or resist him. He may reject what bills, may make what treaties, may coin what money, may create what peers, may pardon what offences, he pleases: unless where the constitution hath expressly, or by evident consequence, laid down some exception or boundary; declaring that thus far the prerogative shall go and no farther. For otherwise the power of the crown would indeed be but a name and a shadow, insufficient for the ends of government, if, where its jurisdiction is clearly established and allowed, any man or body of men were permitted to disobey it, in the ordinary course of law: we do not now speak of those extraordinary recourses to the first principles, which are necessary when the contracts of society are in danger of dissolution, and the law proves too weak a defence against the violence of fraud or oppression. And yet the want of attending to this obvious distinction has occasioned these doctrines, of absolute power in the prince and of national resistance by the people, to be much misunderstood and perverted, by the advocates for slavery on the one hand, and the demagogues of faction on the other. The former observing the absolute sovereignty and transcendent dominion of the crown laid down (as it certainly is) most strongly and emphatically in our law-books as well as our homilies, have denied that any case can be excepted from so general and positive a rule; forgetting how impossible it is, in any practical system of laws, to point out beforehand those eccentric remedies, which the sudden emergencies of national distress may dictate, and which that alone can justify. On the other hand, over-zealous republicans, feeling the absurdity of unlimited passive obedience, have fancifully (or sometimes factiously) gone over to the other extreme; and, because resistance is justifiable to the person of the prince when the being of the state is endangered, and the public voice proclaims such resistance necessary, they have therefore allowed to every individual the right of determining this expedition, and of employing private force to resist even private oppression. A doctrine productive of anarchy, and (in consequence) equally fatal to civil liberty as tyranny itself. For civil liberty, rightly understood, consists in protecting the rights of individuals by the united force of society: society cannot be maintained, and of course can exert no protection, without obedience to some sovereign power; and obedience is an empty name, if every individual has a right to decide how far he himself shall obey.

In the exertion, therefore, of those prerogatives which the law has given him, the king is irresistible and absolute, according to the

forms of the constitution. And yet, if the consequence of that exertion be manifestly to the grievance or dishonour of the kingdom, the parliament will call his advisers to a just and severe account. For prerogative, consisting (as Mr. Locke has well defined it) in the discretionary power of acting for the public good where the positive laws are silent, if that discretionary power be abused to the public detriment, such prerogative is exerted in an unconstitutional manner. Thus a king may make a treaty with a foreign state, which shall irrevocably bind the nation; and yet, when such treaties have been judged pernicious, impeachments have pursued those ministers by whose agency or advice they were concluded. The prerogatives of the crown (in the sense under which we are now considering them) respect either this nation's intercourse with foreign nations, or its own domestic government and civil polity. With regard to *foreign concerns*, the king is the delegate or representative of his people. It is impossible that the individuals of a state, in their collective capacity, can transact the affairs of that state with another community equally numerous as themselves. Unanimity must be wanting to their measures, and strength to the execution of their counsels. In the king therefore, as in a centre, all the rays of his people are united, and form by that union a consistency, splendor, and power, that make him feared and respected by foreign potentates; who would scruple to enter into any engagement, that must afterwards be revived and ratified by a popular assembly. What is done by the royal authority, with regard to foreign powers, is the act of the whole nation: what is done without the king's concurrence, is the act only of private men. And so far is this point carried by our law, that it hath been held, that should all the subjects of England make war with a king in league with the king of England, without the royal assent, such war is no breach of the league. And by the statute 2 Hen. V. c. 6. any subject committing acts of hostility upon any nation in league with the king, was declared to be guilty of high treason: and though that act was repealed by the statute 20 Hen. VI. c. 11. so far as relates to the making this offence high treason, yet still it remains a very great offence against the law of nations, and punishable by our laws, either capitally or otherwise, according to the circumstances of the case.

1. The king therefore, considered as the representative of his people, has the sole power of sending ambassadors to foreign states, and receiving ambassadors at home. 2. It is also the king's prerogative to make treaties, leagues, and alliances, with foreign states and princes. For it is, by the law of nations, essential to the goodness of a league, that it be made by the sovereign power; and then it is binding upon the whole community: and in Britain the sovereign power *quoad hoc*, is vested in the person of the king. Whatever contracts therefore he engages in, no other power in the kingdom can legally delay, resist, or annul. And yet, lest this plenitude of authority should be abused to the detriment of the public, the constitution (as was hinted before) hath here interposed a check, by the means of parliamentary impeachment, for the punishment of such ministers as, from criminal motives, advise or conclude any treaty, which shall afterwards be judged to derogate from the honour and interest of the nation. 3. Upon the same principle the king has also the sole prerogative of making war and peace. For it is held by all the writers on the law of nature and nations, that the right of making war, which by nature subsisted in every individual, is given up by all private persons that enter into society, and is vested in the sovereign power: and this right is given up, not only by individuals, but even by the entire body of people that are under the dominion of a sovereign. And wherever the right resides of beginning a national war, there also must reside the right of ending it, or the power of making peace. And the same check of parliamentary impeachment, for improper or inglorious conduct, in beginning, conducting, or concluding a national war, is in general sufficient to restrain the ministers of the crown from a wanton or injurious exertion of this great prerogative.

These are the principal prerogatives of the king respecting this nation's intercourse with foreign nations; in all of which he is considered as the delegate or representative of his people. But in domestic affairs, he is considered in a great variety of characters, and from thence there arises an abundant number of other prerogatives.

1. He is a constituent part of the supreme legislative power; and as such, has the prerogative of rejecting such provisions in parliament, as he judges improper to be passed. The expediency of which constitution has before been evinced at large under the article PARLIAMENT. 2. The king is considered, in the next place, as the generalissimo, or the first in military command, within the kingdom. The great end of society is to protect the weakness of individuals by the united strength of the community; and the principal use of government is to direct that united strength in the best and most effectual manner, to answer the end proposed. Monarchical government is allowed to be the best of any for this purpose: it follows therefore from the very end of its institution, that in a monarchy the military power must be trusted in the hands of the prince. In this capacity, therefore, of general of the kingdom, the king has the sole power of raising and regulating fleets and armies. The manner in which they are raised and regulated, is explained under the article Treatise on Military Affairs. We are now only to consider the prerogative of enlisting and of governing them: which indeed

deed was disputed and claimed, contrary to all reason and precedent, by the long parliament of king Charles I.; but upon the restoration of his son, was solemnly declared by the statute 13 Car. II. c. 6. to be in the king alone: for that the sole supreme government and command of the militia within all his majesty's realms and dominions, and of all forces by sea and land, and of all forts and places of strength, ever was and is the undoubted right of his Majesty, and his royal predecessors, kings and queens of England; and that both or either house of parliament cannot, nor ought to, pretend to the same.

This statute, it is obvious to observe, extends not only to fleets and armies, but also to forts and other places within the realm; the sole prerogative, as well of erecting, as manning and governing of which, belongs to the king, in his capacity of general of the kingdom: and all lands were formerly subject to a tax, for building of castles wherever the king thought proper. This was one of the three things, from contributing to the performance of which no lands were exempted, and therefore called by the Anglo-Saxons the *trinoda necessitas*: *sc. pontis reparatio, arcis constructio, et expeditio contra hostem*. And this they were called upon to do so often, that, as Sir Edward Coke from M. Paris assures us, there were in the time of Henry II. 1115 castles subsisting in England. The inconveniences of which, when granted out to private subjects, the lordly barons of those times, were severely felt by the whole kingdom; for, as William of Newburgh remarks in the reign of king Stephen, *erant in Anglia quodammodo tot reges, vel potius tyranni, quot domini castellorum*: but it was felt by none more sensibly than by two succeeding princes, king John and king Henry III. And therefore the greatest part of them being demolished in the barons' wars, the kings of after times have been very cautious of suffering them to be rebuilt in a fortified manner: and Sir Edward Coke lays it down that no subject can build a castle or house of strength im battled, or other fortrefs defensible, without the licence of the king; for the danger which might ensue, if every man at his pleasure might do it. It is partly upon the same, and partly upon a fiscal foundation, to secure his marine revenue, that the king has the prerogative of appointing ports and havens, or such places only for persons and merchandise to pass into and out of the realm, as he in his wisdom sees proper.

But though the king had a power of granting the franchise of havens and ports, yet he had not the power of resumption, or of narrowing and confining their limits when once established: but any person had a right to load or discharge his merchandise in any part of the haven: whereby the revenue of the custom was much impaired and diminished, by fraudulent landings in obscure and private corners. This occasioned the statutes of 1 Eliz. c. 11. and 13 and 14 Car. II. c. 11. § 14. which enable the crown by commission to ascertain the limits of all ports, and to assign proper wharfs and quays in each port, for the exclusive landing and loading of merchandise.

3°. Another capacity in which the king is considered in domestic affairs, is as the fountain of justice, and general conservator of the peace of the kingdom. See the article JUSTICE.

4°. The king is likewise the fountain of honour, of office, and of privilege: and this in a different sense from that wherein he is styled the *fountain of justice*; for here he is really the parent of them. See the articles JUSTICE.

5°. Another light in which the laws of England consider the king with regard to domestic concerns, is as the arbiter of commerce.

6°. The king is, lastly, considered by the laws of England as the head and supreme governor of the national church. To enter into the reasons upon which this prerogative is founded is matter rather of divinity than of law. We shall therefore only observe, that by statute 26 Hen. VIII. c. 1. (reciting that the king's majesty justly and rightfully is and ought to be the supreme head of the church of England; and so had been recognized by the clergy of that kingdom in their convocation) it is enacted, that the king shall be reputed the only supreme head on earth of the church of England; and shall have, annexed to the imperial crown of this realm, as well the title and stile thereof, as all jurisdictions, authorities, and commodities to the said dignity of supreme head of the church appertaining. And another statute to the same purport was made, 1 Eliz. c. 1. In virtue of this authority the king convenes, prorogues, restrains, regulates, and dissolves all ecclesiastical synods or convocations. This was an inherent prerogative of the crown long before the time of Hen. VIII. as appears by the statute 8 Hen. VI. c. 1. and the many authors, both lawyers and historians, vouched by Sir Edward Coke. So that the statute 25 Hen. VIII. c. 19. which restrains the convocation from making or putting in execution any canons repugnant to the king's prerogative, or the laws, customs, and statutes of the realms, was merely declaratory of the old common law; that part of it only being new, which makes the king's royal assent actually necessary to the validity of every canon. The convocation or ecclesiastical synod, in England, differs considerably in its constitution from the synods of other Christian kingdoms: those consisting wholly of bishops; whereas in England the convocation is the miniature of a parliament, wherein the archbishop presides with regal state; the upper house of bishops represents the house of lords; and the lower house, composed of representatives of the several dioceses at large, and of each particular

chapter therein, resembles the house of commons with its knights of the shire and burgesses. This constitution is said to be owing to the policy of Edward I. who thereby at one and the same time let in the inferior clergy to the privileges of forming ecclesiastical canons, (which before they had not), and also introduced a method of taxing ecclesiastical benefices, by consent of convocation.

From this prerogative also of being the head of the church, arises the king's right of nomination to vacant bishoprics, and certain other ecclesiastical preferments. As head of the church, the king is likewise the *dernier resort* in all ecclesiastical causes; an appeal lying ultimately to him in chancery from the sentence of every ecclesiastical judge; which right was restored to the crown by statute 25 Hen. VIII. c. 19.

III. The king's fiscal prerogatives, or such as regard his revenue. See the Article REVENUE.

PREROGATIVE COURT, an English court established for the trial of all testamentary causes, where the deceased hath left *bona notabilia* within two different dioceses. In which case the probate of wills belongs to the archbishop of the province, by way of special prerogative. And all causes relating to the wills, administrations, or legacies of such persons, are originally cognizable herein, before a judge appointed by the archbishop, called the *judge of the prerogative court*; from whom an appeal lies by statute 25 Hen. VIII. c. 19. to the king in chancery, instead of the pope as formerly.

PRESAGE, *presagium*, an augury, or sign of something to come. The Romans judged of future events by certain signs which their superstition, or the artifice of their priests had invented. Their most celebrated presages were founded on the flight of birds, or the entrails of victims. All night-birds passed for birds of ill-presage. See AUGURY.

PRESBYTÆ, persons whose eyes are too flat to refract the rays sufficiently, so that unless the object is at some distance, the rays coming from it will pass through the retina before their union, consequently vision is confused: old people are usually the subjects of this disease. In order to remedy, or at least to palliate this defect, the person should first use glasses which do not magnify, and from them pass gradually to more convex spectacles, which shorten the focus.

PRESBYTER, in the primitive Christian Church, an elder, one of the second order of ecclesiastics; the other two being bishops and deacons. See the articles BISHOP and DEACON.

Presbyter, or elder, is a word borrowed from the Greek translation of the old testament, where it commonly signifies ruler or governor; it being a note of office or dignity, not of age, and in this sense bishops are sometimes called *presbyters* in the New Testament. The presbyters might baptize, preach, consecrate, and administer the eucharist in the bishop's absence, or in his presence, if he authorized and deputed them: and the bishops did scarce any thing in the government of the church without their advice, consent, and amicable concurrence. The grand dispute between the followers of the Geneva and Roman discipline, is about the sameness and difference of presbyters and bishops at the time of the apostles.

PRESBYTERIANS, a denomination comprehending a very considerable number of persons in Great Britain; but very differently applied in England and Scotland. The English *presbyterians* do not materially differ from the independents with regard to church-government and discipline, and mode of worship; but they generally allow a greater latitude of religious sentiments, and communion in their churches. The appellation, in this restricted use of it, implies no attachment to the authority of synods, presbyteries, or ecclesiastical assemblies composed of deputies from different churches, any more than to episcopacy and the ecclesiastical hierarchy; and, therefore, according to its original use, it is improperly applied to many who are now distinguished by it, and who form a very respectable class of NONCONFORMISTS or protestant DISSENTERS in this kingdom. See INDEPENDENTS. But the *presbyterians*, properly so called, and with whom the former agree in some particulars, admit, in general, and allowing for that latitude of sentiment, which will ever be the result of unrestrained and liberal enquiry, the doctrinal articles of the church of England: their chief difference lies in the point of discipline, viz. who shall appoint the governors of the church, and what subordination there shall or shall not be between them. The *presbyterians* allow of no hierarchy, no subordination in the persons of their ministers; bishops and priests they maintain, in the times of the apostles, were the same; and therefore though they allow episcopacy, as now settled in the church of England, to be very ancient, yet they deny it to be *jure divino*. In lieu of a series of ministers one over another, in quality of priests, bishops, and archbishops, their polity consists of a series of assemblies or synods. Thus every minister is to be obedient to the classis under which he lives; and that class to a synod, provincial, classical, or oecumenical.

The power of ordination with them resides in a classis; and none are admitted to administer the sacrament but those ordained by the imposition of hands of other ministers. They make use of deacons to take care of their poor; and, in the government of the church, they call in lay-elders; whence their name; from the Greek *πρεσβυτερος*, signifying *senior elder*. See PRESBYTERY.

This is now the established discipline of the church of Scotland, where it was introduced as soon as it began to assume a regular form,

form, about the 1560. Calvin, whose decisions were received among the protestants of that age with incredible submission, was the patron and restorer of this scheme of ecclesiastical policy. The church of Geneva, formed under his eye, and by his direction, was esteemed the most perfect model of government; and Knox, who, during his residence in that city, had studied and admired it, warmly recommended it to the imitation of his countrymen. But on the first introduction of this system, he did not think it expedient to depart altogether from the ancient form; instead of bishops he proposed to establish ten or twelve superintendants in different parts of the kingdom, who were empowered to inspect the life and doctrine of the other clergy, to preside in the inferior judicatories of the church, and to perform several other parts of episcopal functions; their jurisdiction, however, extended to sacred things only; they claimed no seat in parliament, and pretended no right to the dignity or revenues of the former bishops. The number of the inferior clergy was, at this time, very small; and in a few places only were formed into regular classes or societies. In order to give greater strength and consistence to the presbyterian plan, Knox, with the assistance of his brethren, composed, in 1561, the first book of discipline, which contains the model or platform of the intended policy. However, though the general assembly in the year 1566 had approved of the Geneva discipline, the parliament did not confirm the votes of the assembly, nor formally deprive the bishops of their power; but all church affairs from that time were managed by presbyteries, and general assemblies. In the year 1574, they voted the bishops to be only pastors of one parish; in 1577 they ordained that all bishops should be called by their own names; and in the next year they voted the name of bishop to be a grievance. In 1580 the general assembly, with one voice, declared diocesan episcopacy to be unscriptural and unlawful. In the same year King James, with his family, and the whole nation, subscribed a confession of faith, with a solemn league and covenant annexed, obliging themselves to maintain and defend the protestant doctrine and presbyterian government. In the year 1584 the bishops were restored by parliament to some parts of their ancient dignity. In 1587, the king consented to an act to take away bishops lands, and annex them to the crown; and in 1590 it was ordained that all who bore office in the kirk, or should hereafter do so, should subscribe to the book of discipline. In 1592, all acts of parliament in favour of popery and episcopacy were annulled; and an act passed for establishing the presbyterian government, its general assemblies, provincial synods, presbyteries, and kirk sessions, with all the different branches of their discipline and jurisdiction, in the most ample manner. This act was again confirmed in 1593 and 1594. King James, during the latter years of his administration in Scotland, revived the name and office of bishops; but they possessed no ecclesiastical jurisdiction or pre-eminence; their revenues were inconsiderable, and they were scarce distinguished by any thing but by their seat in parliament, and by being the object of the clergy's jealousy, and the people's hatred. The king, delighted with the splendour and authority which the English bishops enjoyed, and eager to effect an union in ecclesiastical policy, resolved to bring both churches to an exact conformity with each other. Three Scotsmen were consecrated bishops at London, from whom their brethren were commanded to receive orders. Ceremonies unknown in Scotland were imposed; and though the clergy, less obsequious than the nobles, boldly opposed these innovations, James, long practised and well skilled in the arts of managing them, obtained at length their compliance. But Charles I. a superstitious prince, unacquainted with the genius of the Scots, imprudent and precipitate in all the measures he pursued in that kingdom, pressing too eagerly the reception of the English liturgy, and indiscreetly attempting a resumption of church-lands, kindled the flames of civil war; and the people being left at liberty to indulge their own wishes, the episcopal church was overturned, and the presbyterian government and discipline were re-established with new vigour. Together with monarchy, episcopacy was restored in Scotland. The aversion of the nation, however, was insurmountable, and it subsisted with difficulty. At the Revolution, the inclinations of the people were thought worthy the attention of the legislature, the presbyterian government was again established (see CONVENTION,) and being ratified by the UNION, is still maintained in that kingdom.

In the year 1648, an ordinance for more effectually settling the presbyterian government, without limitation of time, received the sanction of both houses, under the title of a form of church government, to be used in the churches of England and Ireland. Under the commonwealth, in 1649, the presbyterian government was declared by the house to be the established government: it continued though at a low ebb, under the protectorate of Oliver Cromwell, who was more favourably inclined to the Independents and to the Restoration of Charles II. an event in which the presbyterians and army, under the direction of general Monk, concurred. At this period episcopacy was re-established; the imprudent zeal of the presbyterians was forgotten, and they suffered in common with others who disapproved the hierarchy, and who scrupled conformity to the established articles of doctrine and discipline, till they were in some measure relieved by the act of Toleration.

PRESBYTERY, *presbyterium*, *ἐκκλησία*, an assembly of the order of presbyters, or priests, with lay-elders, for the exercise of No. 132.

church discipline. The kirk, or church, of Scotland, is divided into sixty-nine presbyteries, each consisting of a number of parishes, not exceeding twenty-four, nor less than twelve. The ministers of the parishes, with one ruling elder, chosen half-yearly, out of every *Kirk-session*, constitute a presbytery; who, meeting in the chief town whence the presbytery is denominated, choose a moderator, or, more properly a prolocutor, who must be a minister, half-yearly. They determine all appeals from kirk-session, i. e. from the several parochial assemblies; but can try nothing at the first instance cognizable before a kirk-session. They compose all differences between ministers and people; for which end they hold presbyterial visitations in each parish, where they examine the registers of the kirk-sessions, &c. They enquire into repairs of churches; see that the glebe, &c. suffer no dilapidations; appoint schools in the parishes; and see that the funds be not misapplied. They alone can exclude from the communion; license probationers; suspend, dispose, and, in effect, determine all ecclesiastical matters within their district. From the presbytery there lies an appeal, in all cases, to provincial Synods.

PRESCIENCE, in Theology, prevision, or foreknowledge; that knowledge which God has of things to come. The doctrine of predestination is founded on the prescience of God, and on the supposition of all futurity's being present to him. Human reason can scarce reconcile the prescience of God with the free-agency of man; hence some have been led to deny the divine prescience, and others to maintain the doctrine of NECESSITY.

PRESCRIPTION, *prescriptio*, in Law, a right or title acquired by use and time. Prescription is a sort of title introduced for insuring the property of effects in favour of persons who have possessed them a certain time; and to keep off any who would disquiet them, or recover the thing possessed, after the term fixed by the laws. In effect, however, the law of prescription does not punish the indolence of proprietors, but only interprets their silence for their consent; presuming, that a man who neglects to assert his right for a long series of years, gives it up.

PRESCRIPTION, in Medicine, the act or art of assigning a proper and adequate remedy to a disease, from an examination of the symptoms thereof and an acquaintance with the virtues and effects of the *materia medica*. To prescribe with judgment, elegance, &c. a competent knowledge of pharmacy, i. e. with the forms and preparations of medicine, is required. The merits of a bill, or prescription, consists in its being concise, pertinent, efficacious, and agreeable: in the best and most suitable materials being chosen; those assembled in the most judicious proportions, made up in the best and most convenient form, and applied in the justest dose; a due regard being still had to the non-naturals, regimen, intervals of application, &c. Sydenham particularly excelled in prescription.

PRESENCE, *presentia*, a term or relation, used in opposition to *absence*, and signifying the existence of a person in a certain place or the state of a person considered as co-existing with another. In this sense, an obligation is said to be passed in presence of a notary and witnesses; at the breaking open a seal of a minor, or an absent person, the presence of a substitute is necessary. The Roman catholics believe the real presence of Jesus Christ in the eucharist, both in body and soul. See TRANSUBSTANTIATION.

PRESENT, *presens*, in Grammar, the first tense, or inflexion of verbs; expressing the present, or that which now is. See the System, Part II. Chap. III. Art. V.

PRESENTATION, *presentatio*, in the canon Law, the act of a patron, nominating and offering his clerk to the bishop or collator, to be instituted in a benefice of his gift, which is void. See PATRONAGE.

PRESERVATIVE, *præservative*, in Medicine, a remedy taken by way of precaution, or to secure a man from a disease that threatens him. The principal preservatives, according to Boerhaave, are abstinence, quiet, drinking of warm water; and, after this, a gentle and continued motion till the first appearance of sweat; then a profuse sleeping, the body well covered. By such means, crasis humours are diluted, the vessels are relaxed, and noxious matter excreted. He adds, that the best defence against the force of external cold is to lessen the winter's cloathing late in the spring, and to increase the summer's cloathing soon in autumn. In time of plague, preservatives are very necessary against the contagion of the air, &c. For the various means of prevention, see the System of MEDICINE, Genus 25.

PRESIDENT, *præses*, an officer created, or elected, to preside over a company, or assembly; so called in contradistinction to the other members, who are termed residents. *Lord President of the Council* is a great officer of the crown, who has precedence next after the lord chancellor or lord treasurer; as ancient as the time of king John, when he was styled *consiliarius capitalis*. His office is, to attend on the king, to propose business at the council-table, and to report to the king the several transactions there. See COUNCIL.

PRESS, *prelum*, in the mechanic arts, a machine made of iron or wood, serving to squeeze or compress any body very close.

Printing-Press. See PRINTING.

Liberty of the Press. See LIBERTY.

PRESSURE of the Air. Most of the effects anciently ascribed to the fugavacui, are now accounted for from the weight and pressure

P R I

sure of the air. The pressure of the air on the surface of the earth is balanced by a column of water of the same base, and about thirty-five feet high; or of one of mercury, of about twenty-nine inches. The pressure of the air on every square inch on the surface of the earth, is computed to be about fifteen pounds averduupois. See the System of AEROLOGY, Definition I.

PRETER, or PRÆTERITÆT, *præteritus*, past, in Grammar, an inflection of verbs, expressing the tense, or time passed. See the System, Part II. Chap. III. Art. V.

PRIAPISM, Πριαπισμός, in Medicine, a continual and painful erection or intension of the virile member. The term is derived from Priapus, a heathen god, whom the poets and painters represent in a state of erection. As satyrs are usually painted after the same manner, the disease is also called *satyriasis*, or *satyriasmus*. Some, however, distinguish between the *satyriasis*, and *priapismus*, in that the latter is without any effusion, or desire of coition; but the former attended with both. The immediate cause of a *priapism* is the heat, pungency, or acrimony of the semen, accompanied with a convulsion of the muscles of the part, which, compressing the veins and cavernous bodies, prevent the return of the blood. The more remote causes are too hot, sharp, stimulating foods: cantharides are also found to produce the same effect, but with much more violence. There are instances of people, especially old men, who, making use of cantharides to enable them to satisfy their passions the better, have been seized with a *priapism*, which has been followed with universal convulsions, and even death. With regard to the *priapism*, cordee, and other distortions of the penis in the venereal disease, their treatment is the same with that of the *gonorrhœa*. When they prove very troublesome, the patient may take a few drops of laudanum at night, especially after the operation of a purgative through the day.

PRIAPUS, Πριαπός, a term sometimes applied to the genital parts of men; viz. the penis and testes. The name took its rise from Priapus, a fabulous deity, particularly adored at Lampascus, the place of his birth: he was usually represented naked, with a stern countenance, matted hair, and held a sickle in his hand, with a monstrous privy, for which he was exceedingly revered by the women; inasmuch that the scripture seems to tell us, king Aśa de-throned his mother Maachah, because she had consecrated a grove to Priapus, and presided at his sacrifices. The Roman poets in general seem to have looked on Priapus as a ridiculous god, and are all ready enough, either to despise or abuse him. Hor. lib. i. sat. 8. v. 3.

PRIEST, *sacerdos*, a person set apart for the performance of sacrifices, and other offices and ceremonies of religion. Thus the false gods and goddesses of the heathens had their priests; priests of Mars, of Bacchus, of Hercules, of Isis; and some of them their priestesses. See Pontifex, &c. The Jews had three orders, viz. *priest*, LEVITES, and NETHINIMS, who served in the temple; over whom the high-priest was chief.

PRIEST, *presbyter*, in the Christian Church, is a person invested with holy orders; in virtue whereof he has a power to preach, pray, administer the sacraments, &c. and in the Romish church, also, to bless, absolve, &c. By the canons, can. 34. a man must be twenty-four years of age before he can be admitted to the priesthood: anciently thirty years were required. And by 13 Eliz. chap. 12. none shall be made minister, i. e. priest, being under the age of four and twenty years; and in this case, there is no dispensation, as there is in that of a deacon: and unless he first bring to the bishop of the diocese a testimonial both of his honest life, and of his professing the doctrine expressed in the thirty-nine articles: nor unless he be able to answer, and render to the ordinary an account of his faith in Latin, according to the said articles, or have special gift or ability to be a preacher. And by the canon just cited, it is required, that he shall have taken some degree of school in either of the two universities, or at least be able to give an account of his faith in Latin, according to the thirty-nine articles; and also that he exhibit letters testimonial of his good life and conversation, under the seal of some college of Cambridge or Oxford, where before he remained, or of three or four grave ministers, together with the subscription and testimony of other credible persons, who have known his life and behaviour for the space of three years next before. Nor shall any bishop admit any person into sacred orders, who is not of his own diocese, except he be either of one of the universities of this realm, or except he shall bring letters dismissory from the bishop of whose diocese he is.

PRIMÆVIÆ, the first passages of the chyle; including the œsophagus, stomach, intestines, and their appendices. See System of ANATOMY, Part III. Sect. I. to VI.

PRIMARY Planet, a planet which revolves round the sun as a centre. Such as Saturn, Jupiter, Mars, the Earth, Venus, and Mercury; thus called in opposition to secondary planets, or satellites. See the System of ASTRONOMY, Sect. VIII.

PRIMATE, PRIMAS, an Archbishop, invested with a jurisdiction over other bishops. Those who are advocates for a strict ecclesiastical hierarchy, maintain a *primate* to be a dignitary who has several metropolitans under him; as a patriarch has several primates. Yet it is pretty evident from history, that primates were, at first, confounded with patriarchs: thus Socrates, enumerating ten patriarchs, does not make any distinction thereof from primates.

P R I

Thus also the division of England into two provinces, Canterbury and York, in 1152, gave occasion to the introduction of *primacies* among us; Canterbury, which was the metropolis before, thence giving the title of *primate of all England* to its prelate, though the archbishop of York still claims that of *primate of England*. And, accordingly, the first has some jurisdiction over all England, relating to administrations, &c. which the latter has only in his own province.

PRIMATES, in the Linnæan System, the first order of animals belonging to the class of Mammalia: the characters of which are that they are furnished with fore-teeth, or cutting teeth, four above and parallel; and that they have two pectoral teats. To this order pertain four genera, viz. *homo*, or man, *simia*, or ape, *lemur*, or maucuaço, and *vespertilio*, or bat. See MAMMALIA, under the Article SYSTEMATIC ARRANGEMENT.

PRIMITIVE, in Grammar, a root; or a word in a language, which is neither derived from any other language, nor compounded from any other words of the same. Thus God is a primitive; Godly, a derivative; God-like, a compound.

PRINCE, *princeps*, in Politics, a person invested with the supreme command of a state or country, independent of any superior.

PRINCE is also used for a person who is sovereign in his own territory; yet holds of some other, as his superior or lord, and pays homage or tribute to him. Thus all the *princes* of Germany are feudatories of the emperor; they are as absolute in their respective principalities as the emperor himself; yet are all bound in certain services to him.

PRINCE is also a title given to the issue of *princes*, or those of the royal family. In which sense they were called, formerly in France, *princes of the blood*; as partaking of the blood to which the sovereignty is appropriated: and not by any hereditary right, but as a patrimony substituted to all the royal race. In England, the king's children are called *sons and daughters of England*; the eldest son is created *prince of Wales*. The cadets, or younger, are created dukes or earls, with what title the king pleases. They have no appendages, as once in France; but only what the good pleasure of the king bestows on them. The sons are all by birth counsellors of state: and the daughters are styled *princesses*; to violate the eldest of which, unmarried, is at this day high treason. To all the king's children belongs the title of *royal highness*. All subjects are to kneel when admitted to kiss their hand; and at table, out of the king's presence, they are served on the knee. The youngest sons and daughters of the king, who are not in the line of succession, have precedence before all peers and public officers, as well ecclesiastical as temporal. 31 Hen. VIII. cap. 10.

PRINCE of Wales, the eldest son of England. He is born duke of Cornwall; and immediately intitled to all the rights, revenues, &c. belonging thereto; as being deemed in law at full age on his birth-day. He is afterwards created *prince of Wales*, and earl of Chester; the investiture whereof is performed by imposition of a cap of state, and a coronet, a verge of gold, and a ring. He holds the principality by patent granted him and his heirs, by the kings of England. The title and principality were first given by king Edw. I. to his eldest son: till that time the eldest son of England was called *lord prince*. While Normandy remained to the king of England, the eldest son was always styled duke of Normandy: since the union, his title of *Magna Britannia Princeps*. He is reputed, in law, the same person with the king: to imagine his death, or to violate his wife, is high-treason by stat. 25 Edw. III. His revenues, as duke of Cornwall, are computed at 14,000*l.* per annum. The revenues of the principality were estimated, three hundred and fifty years ago, at 4680*l.* per annum.

PRINCIPAL, in Law, is either the actor or absolute perpetrator of the crime, who is called a *principal* in the first degree; or he who is present, aiding and abetting the fact to be done, who is denominated a *principal* in the second degree. The presence of a *principal* need not always be an actual immediate standing by, within sight or hearing of the fact; but there may be also a constructive presence, as when one commits a robbery or murder, and another keeps watch or guard at some convenient distance. And this rule has also other exceptions; for, in case of murder by poisoning, a man may be a *principal* felon, by preparing and laying the poison, or giving it to another, (who is ignorant of its poisonous quality) for that purpose; and yet not administer it himself, nor be present when the very deed of poisoning is committed. And the same reasoning will hold, with regard to other murders committed in the absence of the murderer, by means which he had prepared before-hand, and which probably could not fail of their mischievous effect. As by laying a trap or pit-fall for another, whereby he is killed; letting out a wild beast, with an intent to do mischief; or exciting a madman to commit murder, so that death thereupon ensues: in every one of these cases the party offending is guilty of murder as a *principal* in the first degree. For he cannot be called an ACCESSORY, that necessarily pre-supposing a *principal*; and the poison, the pit-fall, the beast or the madman cannot be held *principals*, being only the instruments of death. As therefore he must be certainly guilty, either as *principal* or accessory, and cannot be so as accessory, it follows that he must be guilty as *principal*; and if *principal*, then in the first degree; for there is no other criminal

minimal, much less a superior in the guilt, whom he could aid, abet, or assist. Blackst. Com. book iv. cap. 3.

PRINCIPLE, *principium*, a term frequently used for the cause, source, or origin of any thing. In which sense we say, the *principles of thinking, of willing, &c.* In physics, we must ever have recourse to a first principle, which is God.

PRINCIPLE, in general, is used for the cause, source, or origin of any thing.

PRINCIPLE, in human nature. See **DISPOSITION**.

INFLAMMABLE PRINCIPLE. See **PHLOGISTON**.

PRINCIPLES, in Chymistry, are the first and simplest parts whereof natural bodies are compounded, and into which they are again resolvable by fire, &c. These are more properly, as well as more commonly, called **ELEMENTS**. See the **ART. ELEMENT**, and the **SYSTEM OF CHYMISTRY**, Part I. throughout.

PRINCIPLES, in Physics, are often confounded with elements, or the first and simplest parts whereof natural bodies are compounded, and into which they are again resolvable by the force of fire.

PRINTER, a person who composes and takes impressions from moveable characters ranged in order, by means of ink, and a press.

PRINTING, the art of taking impressions from characters or figures moveable or immovable, on paper, linen, silk, &c. There are three kinds of printing: the one from moveable letters, for books; another from copper-plates, for pictures; and the last from blocks, in which the representation of birds, flowers, &c. are cut, for printing calicoes, linen, &c. The first is called *common* or *letter-press* printing; the second, *rolling-press* printing; and the last, *calico*, &c. printing. The principle difference between the three consists in this, that the first is cast in relievō, in distinct pieces, the second engraven in creux; and the third cut in relievō, and generally stamped, by placing the block upon the materials to be printed, and striking upon the back of it.

LETTER PRESS PRINTING. Of the above branches, this is the most curious, and deserves the most particular notice: for to it are owing chiefly our deliverance from ignorance and error, the progress of learning, the revival of the sciences, and numberless improvements in arts, which, without this noble invention would have been either lost to mankind, or confined to the knowledge of a few.

History of PRINTING. Some writers have ascribed the origin of this art to the East, and affixed a very early period to its invention; particularly P. Jovius (*Hist. lib. xiv. p. 226.* ed. Florent. 1550, from whom Osorius and many others have embraced the same opinion. But these have evidently confounded the European mode of printing, with the *engraved tablets*, which to this day are used in China. The invention of these tablets have been ascribed by many writers even to an earlier period than the commencement of the Christian æra; but is with more probability assigned, by the very accurate Phil. Couplet, to the year 930. The *Historia Sinenfis* of Abdalla, written in Persic in 1317, speaks of it as an art in very common use. MEZEMAN, vol. i. p. 16, 218, 219. vol. ii. p. 186. N. The honour of having given rise to the European method has been claimed by the cities of Haerlem, Mentz, and Strasbourg. And to each of these it may be ascribed in a qualified sense, as they made improvements upon one another.

The first testimony of the inventor is that recorded by Hadrian Junius, in his *Batavia*, page 253, ed. Lugd. Bat. 1588; which, though it has been rejected by many, is of undoubted authority. Junius had the relation from two reputable men; Nicolaus Galius, who was his schoolmaster; and Quitinus Taleusius, his intimate and correspondent. He ascribes to Laurentius, the son of John, (Æditus or Custos, of the cathedral at Harleim, at that time a respectable office) upon the testimony of Cornelius, some time a servant to Laurentius, and afterwards book-binder to the cathedral, an office which had before been performed by Franciscan friars. His narrative was thus: "That walking in a wood near the city (as the citizens of opulence used to do), he began first to cut some letters upon the rind of a beach-tree: which, for fancy sake, being impressed on paper, he printed one or two lines, as a specimen for his grand-children (the sons of his daughter) to follow. This having happily succeeded, he meditated greater things, as he was a man of ingenuity and judgment; and first of all, with his son-in-law, Thomas Peter, who, by the way, left three sons, who all attained the consular dignity) invented a more glutinous writing-ink, because he found the common ink sunk and spread; and then formed whole pages of wood, with letters cut upon them, A new invention never fails to engage curiosity. And when a commodity never before seen excited purchasers, to the advantage of the inventor; the admiration of the art increased, dependents were enlarged, and workmen multiplied, the first calamitous incident! Among these was one John, whether, as we suspect, he had ominously the name of *Fauftus*, unfaithful and unlucky to his master, or whether it was really a person of that name, we shall not much inquire; being unwilling to molest the silent shades, who suffer from a consciousness of their past actions in this life. This man, bound by oath to keep the secret of printing, when he thought he had learned the art of joining the letters, the method of casting the types, and other things of that nature; taking the most convenient time that was possible, on Christmas-eve, when every one was customarily

employed in lustral sacrifices, seizes the collection of types, and all the implements his master had got together, and, with one accomplice, marches off to Amsterdam, thence to Cologne, and at last settled at Mentz, as an asylum of security, where he might go to work with the tools he had stolen. It is certain, that in a year's time, viz. in 1442, the *Doctrinale* of Alexander Gallus, which was a grammar much used at that time, together with the *Tracts* of Peter of Spain, came forth there, from the same types as Laurentius had made use of at Harleim."

Some authors relate that Fauftus having printed off a considerable number of copies of the Bible, to imitate those which were commonly sold in MS, Fust undertook the sale of them at Paris, where the art of printing was then unknown. As he sold his printed copies for 60 crowns, while the scribes demanded 500, this created universal astonishment; but when he produced copies as fast as they were wanted, and lowered the price to 30 crowns, all Paris was agitated. The uniformity of the copies increased the wonder; informations were given into the police against him as a magician; his lodgings were searched; and a great number of copies being found, they were seized: the red ink, with which they were embellished, were said to be his blood; it was seriously adjudged that he was in league with the devil; and if he had not fled, most probably he would have shared the fate of those, whom ignorant and superstitious judges condemned, in those days, for witchcraft; from thence arose the origin of the story of the Devil and Dr. Fauftus.

The letters were at first *wooden*, and are said to be afterwards exchanged for *metal* types; from which the wine-pots were formed, remaining in the time of Junius. According to tradition, printing was carried on in the same house long after the time of Laurentius; those pots might therefore be formed from the waste metal of the printing-house, after the use of *fusile types* became universal. But Laurentius seems to have carried the art no farther than *separate wooden types*. What is a remarkable confirmation of this, Henry Spiechel, who wrote, in the 16th century, a Dutch poem, intituled *Herspiegel*, expresses himself thus: "Thou first, Laurentius, to supply the defect of wooden tablets, adaptedst *wooden types*, and afterwards didst connect them with a thread, to imitate writing. A treacherous servant surreptitiously obtained the honour of the discovery. But truth itself, though destitute of common and wide spread fame; Truth, I say, still remains." No mention in the poem of *metal types*; a circumstance which, had he been robbed of such, as well as of *wooden* ones, would scarcely have been passed over in silence. When Laurentius first advised his rough specimen of the art, can only be guessed at. He died in 1440, after having published the *Speculum Belgicum*, and two editions of *Donatus*, all with different *wooden types*; which it is probable (considering the difficulties he had to encounter, and the many artists whom he must necessarily have had occasion to consult) cost him some years to execute; so that the first essay might be about 1430, which nearly agree with Petrus Scriverius, who says the invention was about 10 or 12 years before 1440.

Some of Laurentius's types were stolen from him by one of his servants, John GEINSFLEICH, senior, who fled therewith to MENTZ. Having introduced the art from Harleim into this his native city, he set with all diligence to carry it on; and published in 1442, ALEXANDRI GALLI *Doctrinale*, and PETRI HISPANI *Trasatus*; two works, which, being small, best suited his circumstances; and for which, being much used in the schools, he might reasonably expect a profitable sale. They were executed with *wooden types*, cut after the model of those he had stolen. In 1443 he hired the house Zum Jungen, and was assisted with money by FUST, a wealthy person, who, in return, had a share of the business; and about the same time John Maidenbachus was admitted a partner, as were some others whose names are not transmitted to our times; and in 1444 they were joined by GUTENBERG, who for that purpose quitted Strasbourg. Wooden types being found not sufficiently durable, and not answering expectation in other respects, the two brothers first invented *cut metal types*. But while these were preparing, which must have been a work of time, several works were printed, both on *wooden separate types* and on *wooden blocks*, which were well adapted to small books of frequent use, such as the *Tabula Alphabetica*, the *Catholicon*, *Donati Grammatica*, and the *Conseptionalia*.

From the abovementioned printers in conjunction, after many smaller essays, the Bible was published in 1450, with *large cut metal types*. And it is no wonder, considering the immense labour this work cost, that it should be seven or eight years in completing. Gutenberg, by the pecuniary assistance of Conrad Humery syndic of Mentz, and others, opened another office in the same city; whence appeared, in 1460, without the printer's name, the *Catholicon Jo. de Janua*, with a pompous colophon in praise of its beauty, and ascribing the honour of the invention to the city of Mentz. It was a very handsome book, though inferior to the Pfalter which had been published in 1457, by Fust and Schoeffer. Both the Pfalter and *Catholicon* were printed on *cut metal types*. It may not be improper to observe here, that as the Pfalter is the earliest book which is known to have a genuine date, it became a common practice after that publication, for printers to claim their own performances, by adding their names to them. The progress of the art has been thus traced through its *second period*, the invention of *cut metal types*. But

But the honour of completing the discovery is due to PETER SCHOEFFER de Gernsheim.

An ample testimony, in favour of Schoeffer, is given by Jo. Frid. Faustus of Alschaffenburgh, from papers preserved in his family: "Peter Schoeffer of Gernsheim, perceiving his master Fust's design, and being himself ardently desirous to improve the art, found out (by the good providence of God) the method of cutting (*incidendi*) the characters in a *matrix*, that the letters might easily be singly cast, instead of being cut. He privately cut *matrices* for the whole alphabet; and when he showed his master the letters cast from those matrices, Fust was so pleased with the contrivance, that he promised Peter to give him his only daughter, Christiana, in marriage; a promise which he soon after performed. But there were as many difficulties at first with these letters, as there had been before with wooden ones; the metal being too soft to support the force of the impression: but this defect was soon remedied, by mixing the metal with a substance which sufficiently hardened it." Fust and Schoeffer concealed this new improvement, by administering an oath of secrecy to all whom they intrusted, till the year 1462; when, by the dispersion of their servants into different countries, at the sacking of Mentz by the archbishop Adolphus, the invention was publicly divulged.

The first book printed with these improved types was *Durandi Rationale*, in 1459; at which time, however, they seem to have had only one size of cast letters, all the larger characters which occur being cut types, as appears plainly by an inspection of the book. From this time to 1466, Fust and Schoeffer continued to print a considerable number of books; particularly two famous editions of Tully's Offices. In their earliest books, they printed more copies on vellum than on paper, which was the case both of their Bibles and Tully's Offices. This, however, was soon inverted; and paper introduced for the greatest part of their impressions: a few only being printed on vellum, for curiosities, and for the purpose of being illuminated.

With regard to the claim of STRASBURG: It has been already mentioned, that Gutenberg was engaged in that city in different employments; and, among others, in endeavouring to attain the art of printing. That these endeavours were unsuccessful is plain, from an authentic judicial decree of the senate of Strasburg, in 1439, after the death of Andrew Drizehen. But there are many other proofs that Gutenberg and his partners were never able to bring the art to perfection. As to the cities, Harleim and Mentz, the disputes between them seem easily cleared up, from the two-fold invention of printing above-mentioned: the first with *separate wooden types* at Harleim, by Laurentius, about 1430, and after continued by his family; the other with *metal types*, first cut, and afterwards cast, which was invented at Mentz, but not used in Holland till brought thither by Theodoric Martens at Aloft about 1472. From this period printing made a rapid progress in most of the principal towns of Europe. In 1490, it reached Constantinople; and, according to Mr. Palmer, p. 281, &c. it was extended by the middle of the next century, to Africa and America. It was introduced into Russia, about 1560; but, from motives either of policy or superstition, it was speedily suppressed by the ruling powers; and, even under the late enlightened emperors, has scarcely emerged from its obscurity. That it was early practised in the inhospitable regions of Iceland, we have the respectable authority of Mr. Byrant: "Arngrim Jonas was born amidst the snows of Iceland; yet as much prejudiced in favour of his country as those who are natives of a happier climate. This is visible in his *Crymogæa*; but more particularly in his *Anatome Bleskiniana*, I have in my possession this curious little treatise, written in Latin by him in his own country, and printed *Typis Holensibus in Islandia Boreali*, anno 1612. *Hola* is placed in some maps within the Arctic circle, and is certainly not far removed from it. I believe, it is the farthest north of any place, where arts and sciences have ever resided." Observations and Inquiries relating to various parts of Ancient History, 1767, p. 277.

Introduction of PRINTING into BRITAIN. It was a constant opinion, delivered down by our historians, as hath been observed by Dr. Middleton, that the Art of Printing was introduced and first practised in England by William Caxton, a mercer and citizen of London, who, by his travels abroad, and a residence of many years in Holland, Flanders, and Germany, in the affairs of trade, had an opportunity of informing himself of the whole method and process of the art; and by the encouragement of the great, and particularly of the abbot of Westminster, first set up a press in that abbey, and began to print books soon after the year 1471. This was the tradition of our writers; till a book, which had scarce been observed before the Restoration, was then taken notice of by the curious, with the date of its impression, from Oxford, anno 1468, and was considered immediately as a clear proof and monument of the exercise of printing in that university several years before Caxton began to deal in it.

This book, which is in the public library at Cambridge, is a small volume of 41 leaves in 4to, with this title: *Expositio Sancti Jeronimi in Simbolum Apostolorum ad Papam Laurentium*: and at the end, *Explicit expositio, &c. Impressa Oxonie, & finita Anno Domini M.CCCC.LXVIII. XVII die Decembris*. The appearance of this book has robbed Caxton of a glory that he had long pos-

essed, of being the author of printing to this kingdom; and Oxford, ever since carried the honour of the first press. The only difficulty was, to account for the silence of history in an event so memorable, and the want of any memorial in the university itself concerning the establishment of a new art amongst them of such use and benefit to learning. But this likewise has been cleared up, by the discovery of a record, which had lain obscure and unknown at Lambeth-house, in the Register of the See of Canterbury; and gives a narrative of the whole transactions, drawn up at the very time. An account of this record was first published in a thin quarto volume, in English; with this title: "The Original and Growth of Printing, collected out of History, and the Records of this Kingdom: wherein is also demonstrated, that Printing appertaineth to the Prerogative Royal, and is a Flower of the Crown of England. By Richard Atkyns, esq. Whitehall, April the 25, 1664. By order and appointment of the right honourable Mr. Secretary Morrice, let this be printed. Tho. Rycaut. London: Printed by John Streater, for the author. 1664." 4to.

It sets forth in short "That as soon as the art of printing made some noise in Europe, Thomas Bouchier, archbishop of Canterbury, moved the then king (Henry VI.) to use all possible means for procuring a printing-mould (for so it was then called) to be brought into this kingdom. The king (a good man, and much given to works of this nature) readily hearkened to the motion; and taking private advice how to effect his design, concluded it could not be brought about without great secrecy, and a considerable sum of money given to such person or persons as would draw off some of the workmen of Harleim in Holland, where John Gutenberg had newly invented it, and was himself personally at work. It was resolved, that less than 1000 merks would not produce the desired effect; towards which sum the said archbishop presented the king 300 merks. The money being now prepared, the management of the design was committed to Mr. Robert Turnour, who was then master of the robes to the king, and a person most in favour with him of any of his condition. Mr. Turnour took to his assistance Mr. Caxton, a citizen of good abilities, who traded much into Holland, which was a creditable pretence, as well for his going, as stay in the Low Countries. Mr. Turnour was in disguise (his beard and hair shaven quite off); but Mr. Caxton appeared known and public. They, having received the said sum of 1000 merks, went first to Amsterdam, then to Leyden, not daring to enter Harleim itself; for the town was very jealous, having imprisoned and apprehended divers persons who came from other parts for the same purpose. They staid till they had spent the whole thousand merks in gifts and expences; so as the king was fain to send 500 merks more, Mr. Turnour having written to the king that he had almost done his work; a bargain (as he said) being struck betwixt him and two Hollanders, for bringing off one of the under-workmen, whose name was *Frederick Corfellis* (or rather *Corfellis*), who one night stole from his fellows in disguise into a vessel prepared before for that purpose; and so, the wind favouring the design, brought him safe to London. It was not thought so prudent to set him on work at London: but by the archbishop's means (who had been vice-chancellor, and afterwards chancellor of the university of Oxon) Corfellis was carried with a guard to Oxon; which guard constantly watched to prevent Corfellis from any possible escape, till he had made good his promise in teaching them how to print. So that at Oxford printing was first set up in England, which was before there was any printing-press or printer in France, Spain, Italy, or Germany (except the city of Mentz), which claims seniority, as to printing, even of Harleim itself, calling her city, *Urbem Moguntinam artis typographicae inventricem primam*, though it is known to be otherwise; that city gaining the art by the brother of one of the workmen of Harleim, who had learnt it at home of his brother, and after set up for himself at Mentz. This press at Oxon was at least ten years before there was any printing in Europe, except at Harleim and Mentz, where it was but new-born. This press at Oxford was afterwards found inconvenient to be the sole printing-place of England; as being too far from London and the sea. Wherefore the king set up a press at St. Alban's, and another in the city of Westminster, where they printed several books of *divinity and physic*: for the king (for reasons best known to himself and council) permitted then no law books to be printed; nor did any printer exercise this art, but only such as were the king's sworn servants; the king himself buying the price and emolument for printing books.—By this means the art grew so famous, that anno primo Rich. III. c. 9. when an act of parliament was made for restraint of aliens from using any handicrafts here (except as servants to natives), a special proviso was inserted, that strangers might bring in printed or written books to sell at their pleasure, and exercise the art of printing here, notwithstanding that act: so that in that space of 40 and 50 years, by the indulgence of Edward IV. Edward V. Richard III. Henry VII. and Henry VIII. the English proved so good proficients in printing, and grew so numerous, as to furnish the kingdom with books; and so skilful, as to print them as well as any beyond the seas; as appears by the act 25 Henry VIII. c. 15. which abrogates the said proviso for that reason. And as it was further enacted in the said statute, that if any person bought foreign books bound, he should

pay 6s. 8d. per book. And [it was further provided and enacted, that in case the said printers or sellers of books were unreasonable in their prices, they should be moderated by the lord chancellor, lord treasurer, the two lords chief justices, or any two of them: who also had power to fine them 3s. 4d. for every book whose price should be enhanced. But when they were by charter incorporated with bookbinders, booksellers, and founders of letters, 3 & 4 Philip and Mary, and called *The Company of Stationers*—they resisted the power that gave them life, &c.—Queen Elizabeth, the first year of her reign, grants by patent the privilege of sole printing all books that touch or concern the common laws of England, to Tottel a servant to her majesty, who kept it entire to his death; after him, to one Yell Weirt, another servant to her majesty; after him, to Weight and Norton; and after them, king James granted the same privilege to More, one of the signet; which grant continues to this day, &c.

From the authority of this record, all our later writers declare Corfellis to be the first printer in England; as Mr. Anthony Wood, the learned Mr. Maillaire, Palmer, and one John Bagford, an industrious man, who had published proposals for an History of Printing, (Phil. Transf. for April, 1707). But Dr. Middleton has called in question the authenticity of this account, and has urged several objections to it, with a view of supporting Caxton's title to the precedence with respect to the introduction of the art into this country. Atkins, who by his manner of writing seems to have been a bold and vain man, might possibly be the inventor: for he had an interest in imposing it upon the world, in order to confirm the argument of his book, that printing was of the prerogative royal, in opposition to the *Company of Stationers*, with whom he was engaged in an expensive suit of law, in defence of the king's patents, under which he claimed some exclusive powers of printing. For he tells us, p. 3. "That upon considering the thing, he could not but think that a public person, more eminent than a mercer, and a public purse, must needs be concerned in so public a good: and the more he considered, the more inquisitive he was to find out the truth. So that he had formed his hypothesis before he had found his record; which he published, he says, as a friend to truth; not to suffer one man to be entitled to the worthy achievements of another; and as a friend to himself, not to lose one of his best arguments of entitling the king to his art." But, if Atkins was not himself the contriver, he was imposed upon at least by some more crafty; who imagined that his interest in the cause, and the warmth that he had shewed in prosecuting it, would induce him to swallow for genuine whatever was offered of the kind."

It may be asked by way of reply, is it likely that Mr. Atkins would dare to forge a record, to be laid before the king and council, and which his adversaries, with whom he was at law, could disprove?—He says, he received this history from a person of honour, who was sometime keeper of the Lambeth Library. It was easy to have confuted this evidence, if it was false, when he published it, April 25, 1664. John Bagford (who was born in England, 1651, and might know Mr. Atkins, who died in 1677), in his History of Printing at Oxford, blames those who doubted of the authenticity of the Lambeth MS.; and tells us that he knew Sir John Birkenhead had an authentic copy of it, when in 1665 [which Bagford by some mistake calls 1664, and is followed in it by Meerman] he was appointed by the house of commons to draw up a bill relating to the exercise of that art. This is confirmed by the Journals of that house, Friday October 27, 1665, Vol. VIII. p. 622, where it is ordered that this Sir John Birkenhead should carry the bill on that head to the house of lords, for their consent. The act was agreed to in the upper house on Tuesday October 31, and received the royal assent on the same day: immediately after which, the parliament was prorogued. See *Journals of the House of Lords*, Vol. XI. p. 700. It is probable then, that, after Mr. Atkins had published his book in April, 1664, the parliament thought proper, the next year, to enquire into the right of the king's prerogative; and that Sir John Birkenhead took care to inspect the original, then in the custody of archbishop Sheldon; and, finding it not sufficient to prove what Mr. Atkins had cited for, made no report of the MS. to the house; but only moved, that the former law should be renewed. The MS. was probably never returned to the proper keeper of it; but was afterwards burnt in the fire of London, September 13, 1666. That printing was practised at Oxford, was a prevailing opinion long before Atkins. Bryan Tyne, in his *Apologia pro Antiquitate Academiae Oxoniensis*, published 1608, tells us, it is so delivered down in ancient writings; having heard, probably, of this Lambeth MS. And king Charles I. in his letters patent to the University of Oxford, March 5, in the eleventh of his reign, 1635, mentions printing as brought to Oxford from abroad. As to what is objected, "that it is not likely that the press should undergo a ten or eleven years sleep, viz. from 1468 to 1479," it is probably urged without a foundation. Corfellis might print several books without date or name of the place, as Ulric Zell did at Cologne, from 1407 to 1473, and from that time to 1494. Corfellis's name, it may be said, appears not in any of his publications; but neither does that of Joannes Peterhemius. See MEERMAN, Vol. I. p. 34; Vol. II. p. 21—27, &c.

Further, the famous Shakespeare, who was born in 1564, and died 1616, in the Second Part of Henry VI. act iv. sc. 7. introduced the rebel John Cade, thus upbraiding Lord Treasurer Say:

"Thou hast most traitorously corrupted the youth of the realm, in creating a grammar-school: and whereas, before, our forefathers had no other book but the score and the tally, thou hast caused printing to be used; and, contrary to the king, his crown, and dignity, thou hast built a paper-mill." Whence now had Shakespeare this accusation against lord Say? We are told in the Poetical Register, vol. ii. p. 231. ed. Lond. 1724, that it was from Fabian, Pol. Vergel, Hall, Hollingshed, Grafton, Stow, Speed, &c. But not one of these ascribes printing to the reign of Henry VI. On the contrary, Stow, in his Annals, printed at London 1560, p. 686, gives it expressly to William Caxton, 1471. "The noble science of Printing was about this time found in Germany at Magunce, by one John Guthumburgus, a knight. One Conradus an Almaine brought it into Rome; William Caxton, of London, mercer, brought it into England about the year 1471, and first practised the same in the Abbie of St. Peter at Westminster; after which time it was likewise practised in the Abbies of St. Augustine at Canterbury, Saint Alban's, and other monasteries of England." What then shall we say, that the above is an anachronism arbitrarily put into the mouth of an ignorant fellow out of Shakespeare's head? We might believe so, but that we have the record of Mr. Atkins confirming the fame in King Charles II's time. Shall we say, that Mr. Atkins borrowed the story from Shakespeare, and published it with some improvements of money laid out by Henry VI. from whence it might be received by Charles II. as a prerogative of the crown? But this is improbable, since Shakespeare makes Lord Treasurer Say the instrument of importing it, of whom Mr. Atkins mentions not a word. Another difference there will be between Shakespeare and the Lambeth MS; the poet placing it before 1449, in which year Lord Say was beheaded; the MS. between 1454 and 1459, when Bouchier was archbishop. We must say then, that lord Say first laid the scheme, and sent some one to Harleim, though without success; but after some years it was attempted happily by Bouchier. And we must conclude, that as the generality of writers have overlooked the invention of printing at Harleim with wooden types, and have ascribed it to Mentz, where metal types were first made use of: so in England they have passed by Corfellis, (or the first Oxford Printer, whoever he was, who printed with wooden types at Oxford, and only mentioned Caxton as the original artist who printed with metal types at Westminster. [See MEERMAN, vol. ii. 7, 8.]) It is strange, that the learned commentators on our great dramatic poet, who are so minutely particular upon less important occasions, should, every one of them, Dr. Johnson excepted, pass by this curious passage, leaving it entirely unnoticed. And how has Dr. Johnson trifled, by lightly remarking, "that Shakespeare is a little too early with this accusation!" The great critic had undertaken to decipher obsolete words, and investigate unintelligible phrases; but never, perhaps, bestowed a thought on Caxton or Corfellis, on Mr. Atkins or the authenticity of the Lambeth Record. But, independent of the record altogether, the book stands firm, as a monument of the exercise of printing in Oxford, six years older than any book of Caxton's with a date.

Our first printers, in those days of ignorance, met with but small encouragement; they printed but few books, and but few copies of those books. In after times, when the same books were reprinted more correctly, those first editions, which were not as yet become curiosities, were put to common uses. This is the reason that we have so few remains of our first printers. We have only four books of Theodorice Rood, who seems by his own verses to have been a very celebrated printer. Of John Lettou-William de Machlinia, and the school-master of St. Alban's, we have scarce any remains. If this be considered, it will not appear impossible that our printer should have followed his business from 1468 to 1479, and yet Time have destroyed his intermediate works. But, 2dly, We may account still another way for this distance of time, without altering the date. The Civil wars broke out in 1469: this might probably oblige our Oxford printer to shut up his press; and both himself and his readers be otherwise engaged. If this were the case, he might not return to his work again till 1479; and the next year, not meeting with that encouragement he deserved, he might remove to some other country with his types.

Dr. Middleton concludes with apologizing for his "spending so much pains on an argument so inconsiderable, to which he was led by his zeal to do a piece of justice to the memory of our worthy countryman William Caxton; nor suffer him to be robbed of the glory, so clearly due to him, of having first imported into this kingdom an art of great use and benefit to mankind: a kind of merit, that, in the sense of all nations, gives the best title to true praise, and the best claim to be commemorated with honour to posterity." The fact, however, against which he contends, but which it seems impossible to overturn, does by no means derogate from the honour of Caxton, who, as has been shown, was the first person in England that practised the art of printing *fusile types*, and consequently the first who brought it to perfection; whereas Corfellis printed with separate cut types in wood, being the only method which he had learned at Harleim. Into this detail, therefore we have been led, not so much by the importance of the question, as on account of several anecdotes connected with it, which seemed equally calculated to satisfy curiosity and afford entertainment. Caxton had

*

K k k

becn

been bred very reputably in the way of trade, and served an apprenticeship to one Robert Large, a mercer; who, after having been sheriff and lord mayor of London, died, in the year 1441, and left, by will, as may be seen in the prerogative office, xxiiii merks to his apprentice William Caxton: a considerable legacy in those days, and an early testimonial of his good character and integrity. From the time of his master's death, he spent the following thirty years beyond sea, in the business of merchandize: where, in the year 1464, we find him employed by Edward IV. in a public and honourable negotiation, jointly with one Richard Whitehill, esq; to transact and conclude a treaty of commerce between the king and his brother-in-law the duke of Burgundy, to whom Flanders belonged. The commission styles them, *ambassadors, procuratores, nuncios, & deputatos speciales*; and gives to both or either of them full power to treat, &c.

Whoever turns over his printed works, must contract a respect for him, and be convinced that he preserved the same character through life, of an honest, modest man; greatly industrious to do good to his country, to the best of his abilities, by spreading among the people such books as he thought useful to religion and good manners, which were chiefly translated from the French. The novelty and usefulness of his art recommended him to the special notice and favour of the great; under whose protection, and at whose expence, the greatest part of his works were published. Some of them are addressed to king Edward IV. his brother the duke of Clarence, and their sister the dutches of Burgundy; in whose service and pay he lived many years before he began to print, as he often acknowledges with great gratitude. He printed likewise for the use, and by the expresse order of Henry VII. his son prince Arthur, and many of the principle nobility and gentry of that age. It has been generally asserted and believed, that all his books were printed in the abbey of Westminster; yet we have no assurance of it from himself, nor any mention of the place before the year 1477: so that he had been printing several years, without telling us where. There is no clear account left of Caxton's age: but he was certainly very old, and probably above four-score at the time of his death. In the year 1471 he complained of the infirmities of age creeping upon him, and feebling his body; yet he lived 23 years after, and pursued his business, with extraordinary diligence, in the abbey of Westminster, till the year 1494, in which he died; not in the year following, as all who write of him affirm. This appears from some verses at the end of a book, called, "Hilton's Scale of Perfection," printed in the same year:

" Infynite laud with thankynges many folde
I yeld to God me focouryng with his grace
This boke to fynyshe which that ye beholde
Scale of Perfection calde in every place
Whereof th'au^rtor Walter Hilton was
And Wynkyn de Worde this hath sett in print
In William Caxtons hows so fylle the cafe,
God rest his soule. In joy ther mot it flynt.

Impressus anno salutis MCCCCLXXXiiii."

Though he had printed for the use of Edward IV. and Henry VII. yet there appears no ground for the notion which Palmer takes up, that the first printers, and particularly Caxton, were sworn servants and printers to the crown; for Caxton, as far as can be observed, gives not the least hint of any such character or title: though it seems to have been instituted not long after his death: for of his two principal workmen, Richard Pynson, and Wynkyn de Worde, the one was made printer to the king, the other to the king's mother the Lady Margaret.

Different CHARACTERS when first used in PRINTING. Before 1465, the uniform character was the old Gothic, or German; whence our Black was afterwards formed. But in that year an edition of Lactantius was printed in a kind of Semi-Gothic, of great elegance, and approaching nearly to the present Roman type; which last was first used at Rome in 1467, and soon after brought to great perfection in Italy, particularly by Jenson. Towards the end of the 5th century, Aldus invented the Italic character which is now in use, called, from his name, Aldine, or Curfivus. This sort of letter he contrived, to prevent the great number of abbreviations that were then in use.

Of the first GREEK PRINTING. The first essays in Greek that can be discovered are a few sentences which occur in the edition of *Tulley's Offices*, 1465, at Mentz; but these were miserably incorrect and barbarous, if we may judge from the specimens Mr. Maittaire has given us, of which the following is one:

Описата на картата на мн. татитица.

In the same year, 1465, was published an edition of *Laetanzius's Institutes*, printed in *monasterio Sublacensi*, in the kingdom of Naples, in which the quotations from the Greek authors are printed in a very neat Greek letter. They seem to have had but a very small quantity of Greek types in the monastery; for, in the first part of the work, whenever a long sentence occurred, a blank was left, that it might be written in with a pen; after the middle of the work, however, all the Greek that occurs is printed.

The first printers who settled at Rome were Conrad Sweynheim and Arnold Pannartz, who introduced the present Roman type, in 1466, in Cicero's *Epistolæ Familiares*: in 1469 they printed a beautiful edition of Aulus Gellius, with the Greek quotations in a fair

character, without accents or spirits, and with very few abbreviations. The first whole book that is yet known is the Greek Grammar of Constantine Lascaris, in quarto, revised by Demetrius Cretenfis, and printed by Dionysius Palavifinus, at Milan, 1476. In 1481, the Greek Pfalter was printed here, with a Latin translation, in folio; as was Æsop's Fables in quarto. Venice soon followed the example of Milan; and in 1486 were published in that city the Greek Pfalter and the Batra Chomyomachia, the former by Alexander, and latter by Laonicus, both natives of Crete. They were printed in a very uncommon character; the latter of them with accents and spirits, and also with scholia. In 1488, however, all former publications in this language were eclipsed by a fine edition of Homer's Works at Florence, in folio, printed by Demetrius, a native of Crete. Thus printing (says Mr. Maittaire, p. 185.) seems to have attained its *ακμην* of perfection, after having exhibited most beautiful specimens of Latin, Greek, and Hebrew. In 1493, a fine edition of Isocrates was printed at Milan, in folio, by Henry German and Sebastian ex Pantremulo. All the above works are prior in time to those of Aldus, who has been erroneously supposed to be the first Greek printer: the beauty, however, correctness, and number of his editions, place him in a much higher rank than his predecessors; and his characters in general were more elegant than any before used. He was born in 1445, and died in 1515. Though the noble Greek books of Aldus had raised an universal desire of reviving that tongue, the French were backward in introducing it. The only pieces printed by them were some quotations, so wretchedly performed, that they were rather to be guessed at than read; in a character very rude and uncouth, and without accents. But Francis Tissard introduced the study of this language at Paris, by his Βιβλος η γνησιωτατη, in 1507; and that branch of printing was afterwards successfully practised by Henry, Robert, and Henry Stephens.

The earliest edition of the whole Bible was, strictly speaking, the Complutenian Polyglott of cardinal Ximenes; but as that edition, though finished in 1517, was not published till 1522, the Venetian Septuagint of 1518 may properly be called the first edition of the whole Greek Bible; Erasmus having published the New Testament only, at Basil, in 1516.

Of the first HEBREW PRINTING. A very satisfactory account of this branch of printing is thus given by Dr. Kennicott, in his *Annual Accounts of the Collation of Hebrew MSS.* p. 112. "The method which seems to have been originally observed, in printing the Hebrew Bible, was just what might have been expected: 1. The Pentateuch, in 1482. 2. The Prior Prophets, in 1484. 3. The Posterior Prophets, in 1486. 4. The Hagiographia, in 1487. And after the four great parts had been thus printed separately (each with a comment), the whole text (without a comment) was printed in one volume in 1488: and the text continued to be printed, as in these first editions, so in several others for 20 or 30 years, without marginal *Keri* or *Mafora*, and with greater arguments to the more ancient Mss. till, about the year 1520, some of the Jews adopted *later* Mss. and the *Mafora*; which absurd preference has obtained ever since." Thus much for the ancient edition given by Jews. In 1642, a Hebrew Bible was printed at Mantua, under the care of the most learned Jews in Italy. This Bible had not been heard of among the Christians in this country, nor perhaps in any other; though the nature of it is very extraordinary. The text indeed is nearly the same with that in other modern editions; but at the bottom of each page are various readings, amounting in the whole to above 2000, and many of them of great consequence, collected from manuscripts, printed editions, copies of the Talmud, and the works of the most renowned Rabbies. And in one of the notes is this remark:—"That in several passages of the Hebrew Bible the differences are so many and so great, that they know not which to fix upon as the true readings." We cannot quit this subject without observing, on Dr. Kennicott's authority, that as the first printed Bibles are more correct than the later ones; so the variations between the first edition, printed in 1488, and the edition of Vander Hooght, in 1705, at Amsterdam, in 2 vols. 8vo. amount, upon the whole, to above 1200. The method of printing is very complex, nor could the reader form an adequate idea of it but by seeing the workmen engaged in their several departments.

Chinese PRINTING. There are three opinions as to the antiquity of the Chinese printing; one fixing it three hundred years before Christ; another nine hundred years after him; and a third carrying it still farther back, and making it coeval with that mighty empire; though, it must be allowed, the last is much the least probable of the three. The manner of printing we have already limited to be very different from that which now obtains among the Europeans; it is true it has some advantage over our's in correctness, and the beauty of the character; but, in other respects, it comes far short, the single advantage of moveable characters making more than amends for all that is urged against us by some zealous advocates for this oriental printing.

Books are printed in China from wooden planks, or blocks, cut like those used in printing of calicoes, paper, cards, &c. among us. As to their paper it is inferior to our's; it is made of the inner bark or rind of a kind of ruffles, beat up with water into a pulp or paste, and formed in moulds, much like our's. The advantages of the Chinese printing consists in this, that they are not obliged to take

off the whole edition at once, but print their books as they need them; that the blocks are easily retouched, and made to serve again, and that there needs no corrector of the press. Its disadvantages are, that a large room will scarcely hold all the blocks of a moderate volume; that the colour of the ink easily fades; and that the paper is apt to tear, and is subject to worms: whence it is, that so few ancient books are seen in China.

Rolling-press PRINTING, is employed in taking off prints or impressions from copper-plates engraved or etched. It differs, as we have before observed, from *letter printing*, in that the marks and characters, whose impressions are to be taken, in the former case, are indented, or cut inwards; and in the latter are in relieve, or stand out. This art is said to be as ancient as the year 1460, and to owe its origin to Finiguerra, a Florentine goldsmith; who, casting a piece of engraven plate in melted brimstone, found the exact print of the engraving left in the cold brimstone, marked with black licked out of the strokes by the liquid sulphur. Some years after, the invention of etching was discovered, which was soon after made use of by Parmeggiano. Mr. Walpole observes, that it was not till Raphael had formed Marc Antonio, that engraving placed itself with dignity by the side of painting. See **ENGRAVING** and **ETCHING**.

When the art reached England does not certainly appear. Mr. Chambers, on the authority of Mr. Bagford, (see Phil. Transf. N° 310, p. 2397, or Abr. vol. v. part ii. p. 20.) erroneously said, that it was first brought from Antwerp, by Speed, in the reign of James I. whereas we had it in some degree almost as soon as printing; the printers themselves using small plates for their devices and rebuses. Caxton's *Golden Legend*, printed in 1473, has in the beginning a group of saints, and many other cuts disposed through the body of the work. The second edition of his *Game of Chesse*, and *Le Morte de Arthur*, had also cuts. Wynkyn de Worde, Caxton's successor, prefixed to his title of the Statutes, in the seventh year of Henry VII. or 1491, a plate with the king's arms, crests, &c. a copy of which is given in the *Life of Wynkyn*, by Mr. Ames, in his *Typographical Antiquities*, p. 79. The same printer exhibited several books adorned with cuts, some of which are particularly described by his biographer, p. 87, 88, 89, &c.

The subsequent printers continued to ornament their books with wooden cuts. One considerable work, published by John Raftell, called the *Pastyme of the People*, and Raftell's *Chronicle*, was distinguished by prints of such uncommon merit for that age, as to have been ascribed to Holbein. Grafton's *Chronicle*, printed in 1569, contained many heads, as of William the Conqueror, Henry VIII. queen Elizabeth, &c. and many more are recorded by Ames. But though portraits were used in books, Mr. Walpole observes, that he can find no trace of single prints being wrought off in that age. Those which composed part of the collection of Henry VIII. were probably the productions of foreign artists. The first book that appeared with cuts from copper-plates, or at least the first that Mr. Ames had observed, was the *Birth of Man-kind*, otherwise called the *Woman's Book*, dedicated to queen Catharine, and published by Thomas Raynalde in 1540, with many small copper cuts, without any name. See Ames, *ubi supra*, p. 35, 46, 60, and 219. Walpole's *Catalogue of Engravers*, &c. 4to.

PRISM, in Dioptrics, is a glass in form of a triangular prism, much used in experiments about the nature of light and colours. The phenomena and use of the prism arise from its separating the rays of light in their passage through it.

PRIVATEERS, are a kind of private men of war, the persons concerned wherein administer at their own costs a part of a war, by fitting out these ships of force, and providing them with all military stores; and they have instead of pay, leave to keep what they take from the enemy, allowing the admiral his share, &c. Privateers may not attempt any thing against the laws of nations; as to assault an enemy in a port or haven, under the protection of any prince or republic, whether he be friend, ally, or neuter; for the peace of such places must be inviolably kept; therefore, by a treaty made by king William and the States of Holland, before a commission shall be granted to any privateer, the commander is to give security, if the ship be not above 150 tons, in £.1500, and if the ship exceeds that burden, in £.3000, that they will make satisfaction for all damages which they shall commit in their courses at sea, contrary to the treaties with that state, on pain of forfeiting their commissions; and the ship is made liable. Besides these private commissions, there are special commissions for privateers, granted to commanders of ships, &c. who take pay; who are under a marine discipline; and if they do not obey their orders, may be punished with death: and the wars in later ages have given occasion to princes to issue these commissions, to annoy the enemies in their commerce, and hinder such supplies as might strengthen them or lengthen out the war; and likewise to prevent the separation of ships of greater force from their fleets or squadrons. Ships taken by privateers, were to be divided into five parts: four parts whereof to go to the persons interested in the privateer, and the fifth to his Majesty: and as a further encouragement, privateers, &c. destroying any French man of war or privateer, shall receive, for every piece of ordnance in the ship so taken, £.10 reward, &c. By a particular statute lately made, the lord admiral, or commissioners of the admiralty, may grant commissions to commanders of privateers, for taking

ships, &c. which being adjudged prizes, and the tenth part paid to the admiral, &c. wholly belong to the owners of the privateers and the captors, in proportions agreed on between themselves.

PRIVATIVE, in Grammar, a participle, which, prefixed to a word, changes it into a contrary sense. Thus, among the Greeks, the α is used as a *privative*; as in *atheos*, *atheists*, *acephalous*, &c. The Latins have their *privative* in: as *incurribilis*, *indeclinabilis*, &c. The English, French, &c. on occasion, borrow both the Latin and Greek *privatives*.

PRIVILEGE, in Law, some peculiar benefit granted to certain persons or places, contrary to the usual course of the law. Privileges are said to be *personal* or *real*. *Personal* privileges are such as are extended to peers, ambassadors, members of parliament, and of the convocation, &c. See **AMBASSADOR**, **PARLIAMENT**, **ARREST**. A *real* privilege is that granted to some particular place; as the king's palace, the courts at Westminster, the universities, &c.

PRIVY COUNCIL, called by way of eminence, *the COUNCIL*, a council of state, held by the king with his counsellors, to concert matters for the public service, and for the honour and safety of the realm. See **COUNCIL**.

PRIVY SEAL, a seal which the king uses, previously to such grants, &c. as are afterwards to pass the great seal. Yet the privy seal is sometimes used in matters of less consequence, which do not acquire the great SEAL. See the Article **LORD PRIVY SEAL**.

PRIZE, in marine affairs, a vessel taken at sea from the enemies of a state, or from pirates; and that either by a man of war, a privateer, &c. having a commission for that purpose. Vessels are looked on as prizes, if they fight under any other standard than that of the state from which they have their commission; if they have no charter-party, invoice, or bill of lading aboard; if loaded with effects belonging to the king's enemies, or with contraband goods. In ships of war, the prizes are to be divided among the officers, seamen, &c. as his majesty shall appoint by proclamation; but among privateers, the division is according to the agreement between the owners. By stat. 13. Geo. II. c. 4; judges and officers, failing of their duty in respect to the condemnation of prizes, forfeit £.500, with full costs of suit; one moiety to the king, and the other to the informer.

PROBABILITY of an Event, in the Doctrine of Chances, is greater or less according to the number of chances by which it may happen compared with the whole number of chances by which it may either happen or fail. See **EXPECTATION**, **GAMING**, and the **System of ANNUITIES**.

PROBABILITY, in Reasoning, verisimilitude; or an appearance of truth. To define it philosophically, probability is the appearance of the agreement or disagreement of two things by the intervention of proofs, whose connection is not constant and immutable, or is not perceived to be so; but is, or appears, for the most part, to be so; so as to suffice to induce the mind to judge the proposition to be true or false, rather than the contrary. That proposition, then, is probable, for which there are arguments and proofs to make it pass, or be received for true. The entertainment the mind gives to this sort of propositions, is called belief, assent, or opinion. Probability, then, being to supply the defect of our knowledge, is always conversant about propositions whereof we have no certainty, but only some inducements to receive them for true; and this probability relates either to matter of fact, which falling under observation, are capable of human testimony, or to things which, being beyond the discovery of our senses, are not capable of any such testimony; called matters of speculation.

PROBABILITY, in Poetry, denotes the appearance of truth in the fable or action of a poem. There are four kinds of actions: for a thing may be either only true or only probable; or true and probable at the same time; or neither the one, nor the other. These four kinds of actions are shared between four arts: history takes the first, still keeping to truth, without regard to probability. Epic and dramatic poetry have the second, and still prefer probability, though false, to an improbability though true. Thus the death of Dido, who killed herself on being deserted by Æneas, though false in itself, is a fitter subject for a poem, than the action of Sampson, or the Maid of Orleans.

PROBATE of a Will or Testament, in Law, is the exhibiting and proving a will and testament, before the ecclesiastical judges delegated by the bishop, who is ordinary of the place where the party dies.

PROBLEM, *Προβλημα*, in Logic, a doubtful question; or a proposition that neither appears absolutely true, nor false; but which is probable on both sides, and may be asserted either in the negative or affirmative, with equal evidence. Thus, that the moon and planets are inhabited by animals in some respect like us, is a problem: that the fixed stars are all suns, and each the centre of a several system of planets and comets, is a problem.

PROBLEM is also a proposition expressing some natural effect, proposed in order to a discovery of its apparent cause. Such are the problems of Aristotle. A logical or dialectical problem, say the learned, consists of two parts; a *subject*, or subject-matter, about which the doubt is raised: and a *predicate* or attribute, which is the thing doubted whether it be true of the subject or not. See the **System of LOGIC**. Part II. Sect. II.

PROBLEM, in Geometry, denotes a proposition wherein some operation

PRO

operation or construction, is required; as to divide a line, to make an angle, to draw a circle through three points not in a right line, &c. See the System, Sect. V.

PROBLEM, in Algebra, is a question or proposition which requires some unknown truth to be investigated or discovered; and the truth of the discovery demonstrated. In this sense it is a problem, to find a *theorem*. Algebra is defined to be the art of resolving all problems that are resolvable. See the System, Sect. VII.

PROBOSCIS, *πρόβος*, in Natural History, the trunk or snout of an elephant, and of some other animals. The proboscis is a member issuing out of the middle of the forehead, serving instead of a hand; and having a little appendix fastened to the hand thereof, in form of a finger. By the proboscis the she elephant, it is said, sucks herself; and by the same conveys the milk to her young. All quadrupeds have the length of their neck equal to that of their feet, the elephant alone excepted; in which the shortness of the neck is compensated by the length of the proboscis. The microscope shews us a little trunk or proboscis in flies and gnats, by means whereof they suck the blood of animals, or liquors, for their food.

PROCELLARIA, in Ornithology; a genus of birds belonging to the order of Anseres. The beak is somewhat compressed, and without teeth; the mandibles are equal, the superior one being crooked at the point; the feet are palmated, the hind claw being feeble, without any toe. There are six species, the principal of which are the following: 1. The cinerea, or fulmar. The size of this bird is rather superior to that of the common gull. These birds feed on the blubber or fat of whales, &c. which being soon convertible into oil, supplies them constantly with means of defence, as well as provision for their young, which they cast up into their mouth. They are likewise said to feed on sorrel, which they use to qualify the unctuous diet they live on. This species inhabits the isle of St. Kilda; makes its appearance there in November, and continues the whole year, except September and October; it lays a large, white, and very brittle egg; and the young are hatched the middle of June. No bird is of such use to the islanders as this; the fulmar supplies them with oil for their lamps, down for their beds, a delicacy for their tables, a balm for their wounds, and a medicine for their distempers. The fulmar is also a certain prognosticator of the change of the wind; if it comes to land no west wind is expected for some time; and the contrary when it returns and keeps at sea. The whole genus of petrels have a peculiar faculty of spouting from their bills, to a considerable distance, a large quantity of pure oil; which they do, by way of defence, into the face of any that attempts to take them: so that they are, for the sake of this panacea, seized by surprise; as this oil is subservient to the abovementioned medical uses. Martin tells us, it has been used in London and Edinburgh with success in rheumatic cases. Frederic Martens, who had an opportunity of seeing vast numbers of these birds at Spitzbergen, observes that they are very bold, and resort after the whale-fishers in great flocks, and that, when a whale is taken, they will, in spite of all endeavours, light on it and pick out large lumps of fat, even when the animal is alive: That the whales are often discovered at sea by the multitudes of malle-mukes flying; and that when one of the former are wounded, prodigious multitudes immediately follow its bloody track. He adds, that it is a most gluttonous bird, eating till it is forced to disgorge itself. 2. The puffinus, or shear water, is 15 inches in length; the breadth 31; the weight 17 ounces. These birds are found in the Isle of Man; and, as Mr. Ray supposes, in the Scilly isles: great numbers are killed by the person who farms the isle: they are salted and barrelled; and when they are boiled, are eaten with potatoes. During the day they keep at sea, fishing; and towards evening return to their young; whom they feed, by discharging the contents of their stomachs into their mouths; which by that time is turned into oil: by reason of the backward situation of their legs, they sit quite erect. They quit the isle in the latter end of August, or beginning of September; and from accounts lately received from navigators, we have reason to imagine, that, like the storm-finch, they are dispersed over the whole Atlantic ocean. This species inhabits also the Orkney Isles, where it makes its nest in holes on the earth near the shelves of the rocks and headlands: it is called there the lyre; and is much valued both on account of its being a food, and for its feathers. The inhabitants take and salt them in August for winter provisions, when they boil them with cabbage. They also take the old ones in March; but they are then poor, and not so well tasted as the young. For representation see Plate V. Genus 90.

PROCESSION denotes a ceremony in the Romish church, consisting in a formal march of the clergy in their robes, and the people after them, putting up prayers, singing hymns, &c. and in this manner making a visit to some church or other holy place. There are general processions of all the people in Jubilees, and the same often in public calamities. The processions of the holy sacrament are very solemn. They have also processions, frequently, around the church, at the salutations, &c. in the mass. Anciently, among us, there were, in each parish, customary processions of the parish-priest, the patron of the church, with the chief flag, or holy banner, attended by the other parishioners, each Ascension week; to take a circuit round the limits of the parish, and pray for a

blessing on the fruits of the earth. Of which custom there still remains a shadow in that annual *perambulation*, still called processioning; though the order and devotion of the ancient processions be almost lost.

PROCLAMATION, *PROCLAMATIO*, an instrument dispatched by the king, with the advice of his privy-council, whereby the people are advertised of something which his majesty thinks fit for them to know; and whereby they are sometimes required to do, or not to do, certain things. By the statute 31 Hen. VIII. cap. 8. it was enacted, that the king's proclamation should have the force of acts of parliament, a statute, says judge Blackstone, which was calculated to introduce the most despotic tyranny, and which must have proved fatal to the liberties of this kingdom, had it not been happily repealed in the minority of his successor. Stat. 1. Edw. VI. cap. 12. Comm. book i. p. 271.

PROCTORS in the Common, are persons skilled in the civil and ecclesiastical laws, who exhibit their proxies, and make themselves parties for their clients, to draw up acts and pleadings, produce witnesses, prepare causes for sentences, and attend the advocates with the proceedings. They are about fifty in number; are admitted by the archbishop's fiat: and wear black robes, and hoods lined with white furs.

PROCTORS in the University, are two officers chosen from among the students, to see good orders and exercises daily performed there.

PRODIGALITY, is a term, the meaning and application of which are well known. We shall, therefore, under this head, only take occasion to observe, that, by the Roman law, if a man by notorious prodigality was in danger of waiving his estate, he was looked upon as *non compos*, and committed to the care of curators, or tutors, by the prætor. And by the laws of Solon, such prodigals were branded with perpetual infamy.

PRODUCT, in Arithmetic and Geometry, the factum of two numbers, or the quantity arising from, or produced by, the multiplication of two or more numbers, lines, &c. into one another. Thus, if 6 be multiplied by 8, the *product* is 48. See the Systems.

PRODUCTION. See GENERATION, and PROPAGATION.

PROFANE, a term applied, in general, to all persons who have not the sacred character; and all things which do not belong to the service of religion. In this sense, Xenophon, Seneca, &c. are profane authors. The heathen priests, pontiffs, &c. also pass with us for profane.

PROFANENESS denotes a disrespect paid to the name of God, and to things and persons consecrated to him. By the last statute against profane and common swearing and cursing, 19 Geo. II. cap. 21. which repeals all former ones, every labourer, sailor, or soldier, shall forfeit 1s. for every profane oath or curse; every other person under the degree of a gentleman 2s. and every gentleman, or person of superior rank, 5s. to the poor of the parish; and on a second conviction, double; and for every subsequent conviction, treble the sum first forfeited, with all charges of conviction; and in default of payment shall be sent to the house of correction for ten days. Any justice of the peace may convict upon his own hearing, or the testimony of one witness; and any constable or peace officer, upon his own hearing, may secure any offender, and carry him before a justice, and there convict him. If the justice omits his duty, he forfeits 5l. and the constable 40s. And the act is to be read in all parish churches and public chapels, the Sunday after every quarter day, on the pain of 5l. to be levied by warrant from any justice.

PROFESSOR, in the Universities, a person who teaches, or lectures, publicly, some art or science, in a chair established for that purpose. The *professors*, in foreign universities teach the arts, and have their classes of pupils; those in our universities only read public lectures in term-time. Of *professors* we have a great number, some denominated from the arts they profess, as *casuistical professor*, *Hebrew professor*, *physic professor*, *divinity professor*, &c. Others, from those who founded the *professorship*, or assigned a revenue for the support of the *professor*.

PROFILE, in Architecture, the figure or draught of a building, fortification, or the like; wherein are expressed the several heights, widths, and thickneses, such as they would appear were the building cut down perpendicularly from the roof to the foundation. Whence the *profile* is also called the *section*, sometimes the *orthographical section*: and by Vitruvius, also the *sciagraphy*. *Profile*, in this sense, amounts to the same with *elevation*; and stands opposed to a plan, or *ichnography*. See the System of PERSPECTIVE.

PROFILE, in Sculpture and Painting. A head, a portrait, &c. are said to be in *profile*, when they are represented sideways, or in a side-view. As, when in portrait, there is but one side of the face, one eye, one cheek, and nothing of the other.

PROGNOSTIC, *prognosis*, in Medicine, a judgment of the event either of health, or of a disease; as, whether it shall end in life or death; be long or short; mild or malignant, &c. taken from certain symptoms thereof. For the prognosis of diseases most commonly incidental to the human species, see the System of MEDICINE throughout.

PROJECTILES, are such bodies as, being put in a violent motion by any great force, are then cast off or let go from the place where they received their quantity of motion; as a stone thrown from a sling, an arrow from a bow, a bullet from a gun, &c.

PRO

PROJECTILES.

THE doctrine of projectiles is either theoretical, or practical. The former explains upon mathematical, mechanical, and philosophical principles; the laws and properties of bodies in motion. The latter consists chiefly in experiments; and is usually styled gunnery. To this belongs the art of charging, directing, and exploding fire-arms, as cannons, mortars, muskets, &c. to the best advantage.

The theory, therefore, more properly belongs to this part of our work; but that we may be as systematic as possible, we have chosen to treat of each in this treatise, beginning with the theoretical part.

PART I.

THEORY OF PROJECTILES.

It is usually taken for granted, by writers on projectiles, that the force of gravity near the earth's surface is every where the same, and acts in parallel directions; and that the effect of the air's resistance upon very heavy bodies, such as bombs and cannon-balls, is too small to be taken into consideration. It is obvious, that the error arising from the supposition of gravity's acting uniformly, and in parallel lines, must be exceeding small; because even the greatest distance of a projectile above the surface of the earth, is inconsiderable in comparison of the distance from the centre to which the gravitation tends. But then, on the other hand, it is certain, that the resistance of the air to very swift motions, is much greater than it has been commonly represented. Nevertheless, (in the application of this doctrine to gunnery), if the amplitude of the projection, answering to one given elevation, be first found by experiment, the amplitudes in all other cases, where the elevations and velocities do not very much differ from the first, may be determined, to a sufficient degree of exactness, from the foregoing hypothesis: because, in all such cases, the effects of the resistance will be nearly as the amplitudes themselves; and were they accurately so, the proportions of the amplitudes, at different elevations, would then be the very same as in vacuo. Now, in order to form a clear idea of the subject here proposed, the path of every projectile is to be considered as depending on two different forces: that is to say, on the impellent force, whereby the motion is first begun, (and would be continued in a right line,) and on the force of gravity, by which the projectile, during the whole time of its flight, is continually urged downwards, and made to deviate more and more from its first direction.

But before we enter further into this subject it will be necessary to explain the terms used in this art; the chief of which are contained in the following DEFINITIONS:

1. *Random, or Amplitude*, is the distance to which a ball is shot from a mortar or gun, and is measured upon the plane of projection.
2. *Elevation* is the angle to which the axis of the gun is raised above the plane of projection.
3. *Altitude* is the height a ball acquires above the plane of projection, or the highest point of its tract.
4. *Plane of Projection* is a plane passing between the cannon or musket, and the object to be fired at; or it is a plane on which both the cannon and object are supposed to be situated.
5. *Charge* is the quantity of powder and ball proper for any gun.

PROPOSITION, the motion of a projectile (abstracting from the air's resistance, and supposing the force of gravity to be uniform) is in the curve of a parabola. For let the line GRF, (fig. 50, in the Plate of Miscellaneous Mathematics,) be the line in which the projectile is directed, and in which, by the laws of motion, it would perpetually move equal spaces in equal times, were it not deflected downwards by the force of gravity. Let GB be the horizontal line, and GC a perpendicular thereto: then the line GRF being divided into equal parts, answering to equal spaces of time, let the descents of the projectile be laid down in lines parallel to GC, proportioned as the squares of the lines GS, GR, GL, GF; or as the squares of the times from S to T, from R to V, from L to X, and from F to B; and draw the lines TH, VD, XY, BC, parallel to GF; then will the points T, V, X, B, be in the curve described by the projectile, which is a parabola; for the parts of the descent GH, GD, GY, GC (= ST, RV, LX, FB, respectively) being as the squares of the times; that is, as the squares of the ordinates HT, DV, XY, BC = GS, GR, GL, GF, the spaces measured in those times, and there being no other curve but the parabola, whose parts of the diameter are as the squares of the ordinates; it follows, that the curve described by a projectile is a parabola and no other: and saying as RV, the descent in any time: GR or VD the direct motion in the same time :: VD : a third proportional called the parameter of the parabola to the diameter GC, which is always the same in projectiles cast with the same velocity; and the velocity being defined by the number of feet cast in a second of time, the parameter will be found by dividing the square of the velocity by 16, the fall of a body in the same time.

For the more easy comprehending of this demonstration, our readers are referred to what has been delivered under the article MOTION, and in the treatise of Conic Sections given in the System of GEOMETRY.

Hence, by means of the parabola, the several requisites in the art of gunnery are readily computed, except inasmuch as the same are affected by the air's resistance, which causes the ball to move in a curve of the hyperbolic kind, whereof one of the asymptotes is parallel to the line of projection, and the other is perpendicular to the horizon; but as it is wholly impracticable, if not almost impossible,

on account of its intricacy, to solve the different cases by means of an hyperbola, and as the calculations derived from the parabola are on the contrary so exceeding easy; the parabolic method is therefore the only one that has been brought into general use, except such particular corrections as different artists have found necessary to introduce along with it from their own experience. I shall therefore, in what follows, give the rules of calculation according to the parabolic theory; and shew how accurate tables may be constructed from experiments, to solve every case with correctness and expedition.

PROBLEM I. The random or horizontal projection at any elevation being given to find the random at any other elevation.

THEOREM. The horizontal randoms made with the same velocity at different elevations, are as the sines of the double angle of elevation.

EXAMPLE. Suppose the random at 20 degrees elevation be found by experiment to be 3058 feet, required the random at 62 degrees elevation? The proportion will be as sine of 40° :: 3058 :: sine (124° or) 56° : 3944 feet, the answer.

COR. The greatest random is at the elevation of 45°, and is equal to the latus rectum of the parabola.

SCHOLIUM. It is observed however, that the greatest random is not at quite 45° elevation in the air, but on account of resistance is diminished to about 44°.

PROBLEM II. The greatest random being given to find the random at any given elevation.

EXAMPLE. Let the greatest random be 5080 feet, required the random at the elevation of 25°?

SOLUTION. As sine of 90° (double elevation at the greatest random) is to 5080, so is sine of 50° (double of 25°) to 3892, the answer.

PROB. III. Having the random and elevation of the piece given to find the elevation proper for hitting a mark at a given distance.

EXAMPLE. Suppose the random 4900 feet, and elevation 42°, required the elevation with the same charge of powder to hit a mark at the distance of 3320 feet?

SOLUTION. As 4900 is to sine of 84° (double 42°) so is 3320, to sine of 45°. 36' or 134°, 24'; the half is 22°. 48', or 97°, 12'; at either of which elevations the mark will be hit.

N.B. The two last problems are but the converse of the first, the solutions being deduced from the same theorem.

PROB. IV. Having the greatest random on any horizontal plane, to find the greatest random on an inclined plane.

THEOREM II. The projections or randoms made on different planes with the same velocity, are in the complicate ratio of the sines of the angles which the lines of direction make with the plane and zenith; and the squares of the sines of the planes elevations reciprocally. And the greatest randoms on different planes are as the versed sines of angles between the plane and zenith directly, and the versed sines of double these angles reciprocally, either for ascents or descents: or rather thus, the randoms are reciprocally as the versed sines of the supplements of the angles between the plane and zenith.

EXAMPLE. Suppose the greatest horizontal random 3990 feet, what is the greatest random on a plane elevated, or depressed 9 degrees?

1. For the ascent. Here $\frac{\text{ver. sine } 90^\circ}{\text{ver. sine } 180^\circ} = \frac{1}{2}$, and therefore as $\frac{\text{ver. sine } 810}{\text{ver. sine } 1620}$ so is 3990 to $\frac{2 \times \text{ver. sine } 810 \times 3990}{\text{ver. sine } 1620} = 3450$ feet, the answer when the plane is elevated; or as vers. 99°: 3990 :: radius : 3450, same as before.

2. For the descent. The random sought will be $\frac{2 \times \text{ver. sine } 99^\circ \times 3990}{\text{ver. sine } 198^\circ} = 4730$, the answer, when the plane is depressed; or as versed sine 82° is to 3990, so is radius to 4730, same as above.

COR. The greatest random on an inclined plane, is when the line of direction bisects the angle between the zenith and the plane, and the randoms are equal which are made at equal distances above and below this line.

PROB. V. Having the greatest horizontal random, to find the elevation to hit an object with the least force, the height and distance being given.

RULE. The angle of elevation is found thus: as distance is to radius, so is the altitude of the object to the tangent of its elevation. But this elevation may more easily be had by observation.

COR. To hit an object with the least force, the line of direction must bisect the angle between the zenith and the object.

PROB. VI. The velocity in feet, and the elevation being given to find the horizontal random. In order to solve this, let $f = 16$. 1 feet; $A =$ sine of double the angle of elevation, $v =$ the velocity, $r =$ radius, or sine of 90°.—Then the horizontal random will be equal to $\frac{v^2 A}{2f \times \text{rad.}}$ or as $2f \times \text{rad.} : v^2 :: A$ to the horizontal random.

EXAMPLE. Let the elevation be 30°, and the velocity = 350 feet, per second.

Then as $32.2 \times \text{rad.} : 350^2 :: \text{sine } 60^\circ : 3295$ feet, the answer.

COR. The elevations being the same, the horizontal randoms are as the squares of the velocities.

PROJECTILES.

PROB. VII. Having the random made with a certain charge of powder at a given elevation, to find the charge of powder for any other random with the same elevation.

THEOREM III. The charges of powder will be nearly as the randoms.

EXAMPLE. If 8lb. of powder throw a ball 4010 feet, how much powder will throw it 5700 feet?

As 4010 ft. : 8lb. :: 5700 ft. : 11.3lb. the answer, which will be pretty exact, supposing all the powder not to fire instantaneously, but in a gradual manner, so as to be all fired when the ball is at the mouth of the gun; but if all the charge is supposed to be fired instantaneously, the answer when greater than the given charge will be something too little, and when less than the given charge will be something too great.

PROB. VIII. The height of the perpendicular projection being given, to find the height of the shot at any other elevation.

THEOREM IV. The altitudes of projections are as the versed sines of the double angles of elevation, when the velocities are the same, and as the squares of the velocities when the elevations are the same; viz. in the compound ratio of both.

EXAMP. Let the height of the perpendicular projection be 3420 feet, what is the height when the elevation is 35° ? Here, as vers. 180° : 3420 :: vers. 70° : 1125, the altitude required.

COR. The perpendicular projection is the greatest altitude.

PROB. IX. Given the height of the perpendicular projection, and the elevation, to find the random.

RULE. As radius, is to the height of the perpendicular projection, so is the sine of twice the elevation to half the random.

EXAMP. Let the perpendicular projection be 3420 feet, and the elevation 35° required the random? As rad. : 3420 :: sine 70° : 3214 = $\frac{1}{2}$ the random, which doubled gives 6428 the random sought.

COR. The perpendicular projection is half the greatest random, but owing to the resistance of the air, it is found to be something more than half the greatest random.

PROB. X. The random and elevation being given to find the height of the shot.

RULE. As radius is to the tangent of the elevation, so is $\frac{1}{2}$ the random to the height of the projection.

EXAMP. Let the random be 6428, and elevation 35° ; then as radius : tangent 35° :: $\frac{1}{2}$ rand. 1607 to 1125, the height required.

PROB. XI. The random and height of the shot being given to find the height of the perpendicular projection.

RULE. Let $d = \frac{1}{2}$ the random, $h =$ height of the projection, then $h + \frac{dd}{b} =$ height of the perpendicular projection.

EXAMP. Suppose the random to be 6428, height 1125: then by the above rule $\frac{1607^2}{1125} + 1125 = 3420$, the height of the perpendicular projection required.

PROB. XII. Given the elevation, and random to find the time of flight.

RULE. The times of flight are as the sines of the angles of elevation; or thus, as radius : tangent elevation :: random to Q;

and $\sqrt{\frac{Q}{f}}$ = time in seconds, f being = 16.1 feet.

Besides the arithmetical calculations here given, the several problems may be solved geometrically after this manner: Let AB (fig. 51.) the perpendicular projection. About AB describe the semicircle ACD. Make AK = $\frac{1}{2}$ AB, which will be the greatest random. Let AH, be any other random, and make AE = $\frac{1}{2}$ AH, and erect EC perpendicular to AH to cut the semicircle in C; and draw ACD. Make AF = $\frac{1}{2}$ AH, and raise FD perpendicular to AH. Bisect FD, Fd, in G. and g, which will be the vertices of two parabolas passing through AH, and touching the lines AD and Ad, whose parameters are 4BL, and 4Bl. Therefore if EAC, EAc be two elevations, so that CR = cR, the projections made in these two directions will describe these parabolas, and both pass through H: and if AI = $\frac{1}{2}$ AK, and IR touch the circle in R, AR will be 90° , and the projection made along AR will pass through the point K. So then AGH, AgH, will be the paths of the projectiles in direction AC or Ac, and whose velocity is that required of falling through BA. And the angle ACB or AcB is always a right angle. Also the height of the parabolas will be FG = EC or AL, and Fg = Ec or Al, being the versed sines of twice the elevation. And the time of ascent and descent in AB, to the time in the parabola AGH (or AgH) is as AB to AC or (Ac). Likewise CL (l) is the sine of twice the elevation = $\frac{1}{2}$ of the random. These geometrical constructions, with a knowledge of the laws of motion and conic sections, also furnish means for demonstrating the several theorems and rules used in calculation.

The Method for constructing Tables for solving accurately the Common Problems of Gunnery by Inspection.

In order to this there must be a competent number of experiments made with all sorts of guns at all elevations. Thus take any gun of which you know the proper charge and elevate it to 5° ,

fire it off, and measure the random, which set down; then elevate it to $10^\circ, 15^\circ, 20^\circ, 25^\circ$, &c. as far as 90° , and find the random to each elevation. One shot, however, for each cannot be relied on, but several should be made, at each degree of elevation, and a mean random taken; and this must not only be done for one sort of guns, but the same must be done for guns of all sizes; and their respective sizes with the several degrees of elevation, and randoms must be inserted in tables for use, and then all the common cases in gunnery may be resolved from the tables by inspection, or at least by help of a short proportion, in a more accurate manner than from the theory, seeing that the tables are made from actual experiments, they include the air's resistance, and every other consideration of allowance.

PART II. PRACTICAL PROJECTILES.

The practical part of this treatise, termed Gunnery, consists chiefly in directing the piece in such a manner as always to hit the object, against which it is directed, and must be attained by a train of actual experience. It is however supposed the following maxims from Mr. Benjamin Robins, who was employed a long time in this art, may be worthy of insertion.

1. In any piece of artillery, the greater the quantity of powder it is charged with, the greater will be the velocity of the bullet.

2. If two pieces of the same bore, but of different lengths, are fired with the same charge of powder, the longer will impel the bullet with a greater celerity than the shorter.

3. If two pieces of artillery, different in weight, and formed of different metals, have yet their cylinders of equal bores and equal lengths; then, with like charges of powder and like bullets, they will each of them discharge their shot with nearly the same degree of celerity.

4. The ranges of pieces at a given elevation are no just measures of the velocity of the shot; for the same piece fired successively at an invariable elevation, with the powder, bullet, and every other circumstance, as nearly the same as possible, will yet range to very different distances.

5. The greatest part of that uncertainty in the ranges of pieces which is described in the preceding maxim, can only arise from the resistance of the air.

6. The resistance of the air acts upon projectiles in a twofold manner: for it opposes their motion, and by that means continually diminishes their celerity; and it besides diverts them from the regular tract they would otherwise follow; whence arise those deviations and inflections already treated of.

7. That action of the air by which it retards the motion of projectiles, though much neglected by writers on artillery, is yet, in many instances, of an immense force; and hence the motion of these resisted bodies is totally different from what it would otherwise be.

8. This retarding force of the air acts with different degrees of violence, according as the projectile moves with greater or lesser velocity; and the resistances observe this law, That to a velocity which is double another, the resistance within certain limits is fourfold; to a triple velocity, ninefold; and so on.

9. But this proportion between the resistances to two different velocities, does not hold, if one of the velocities be less than that of 1200 feet in a second, and the other greater; for in that case the resistance to the greater velocity is near three times as much as it would come out by a comparison with the smaller, according to the law explained in the last maxim.

10. To the extraordinary power exerted by the resistance of the air it is owing, that when two pieces, of different bores, are discharged at the same elevation, the piece of the largest bore usually ranges farthest, provided they are both fired with fit bullets, and the customary allotment of powder.

11. The greatest part of military projectiles will, at the time of their discharge, acquire a whirling motion round their axis, by rubbing against the inside of their respective pieces; and this whirling motion will cause them to strike the air very differently from what they would do had they no other than a progressive motion. By this means it will happen, that the resistance of the air will not always be directly opposed to their flight; but will frequently act in a line oblique to their course, and will thereby force them to deviate from the regular tract they would otherwise describe; and this is the true cause of the irregularities described in maxim 4.

12. From the sudden trebling the quantity of the air's resistance, when the projectile moves swifter than at the rate of 1200 feet in a second (as hath been explained in maxim 9), it follows, that whatever be the regular range of a bullet discharged with this last mentioned velocity, that range will be but little increased, how much soever the velocity of the bullet may be still farther augmented by greater charges of powder.

13. If the same piece of cannon be successively fired, at an invariable elevation, but with various charges of powder, the greatest charge being the whole weight of the bullet in powder, and the least not less than the fifth part of that weight; then, if the elevation be not less than eight or ten degrees, it will be found, that some of the ranges, with the least charge, will exceed some of those with the greatest.

PROJECTILES.

14. If two pieces of cannon of the same bore, but of different lengths, are successively fired at the same elevation with the same charge of powder; then it will frequently happen that some of the ranges with the shorter piece will exceed some of those with the longer.

15. In distant cannonadings, the advantages arising from long pieces and large charges of powder are but of little moment.

16. In firing against troops with grape shot, it will be found, that charges of powder much less than those generally used are the most advantageous.

17. The principal operations in which large charges of powder appear to be more efficacious than small ones, are the ruining of parapets, the dismounting of batteries covered by stout merlons, or battering in breach; for, in all these cases, if the object be but little removed from the piece, every increase of velocity will increase the penetration of the bullet.

18. Whatever operations are to be performed by artillery, the least charges of powder, with which they can be effected, are always to be preferred.

19. Hence then, the proper charge of any piece of artillery is not that allotment of powder which will communicate the greatest velocity to the bullet (as most practitioners formerly maintained); nor is it to be determined by an invariable proportion of its weight to the weight of the ball: but, on the contrary, it is such a quantity of powder as will produce the least velocity for the purpose in hand; and, instead of bearing always a fixed ratio to the weight of the ball, it must be different according to the different business which is to be performed.

20. No field piece ought at any time to be loaded with more than $\frac{1}{10}$, or at the utmost $\frac{1}{8}$, of the weight of its bullet in powder: nor should the charge of any battering piece exceed $\frac{1}{4}$ of the weight of its bullet.

ART. I. Description and Use of rifled Barrels.

The greatest irregularities in the motion of bullets are, owing to the whirling motion on their axis, acquired by the friction against the sides of the piece. The best method hitherto known of preventing these is by the use of pieces with rifled barrels. These pieces have the insides of their cylinders cut with a number of spiral channels: so that it is in reality a female screw, varying from the common screws only in this that its threads or rifles are less deflected, and approach more to a right line; it being usual for the threads with which the rifled barrel is indented, to take little more than one turn in its whole length. The numbers of these threads are different in each barrel according to the size of the piece and the fancy of the workman; and in like manner the depth to which they are cut is not regulated by any invariable rule.

The usual method of charging these pieces is this; When the proper quantity of powder is put down, a leaden bullet is taken, a small mallet larger than the bore of the piece was before the rifles were cut; and this bullet being laid on the mouth of the piece, and consequently too large to go down of itself, it is forced by a strong rammer, impelled by a mallet, and by repeated blows is driven home to the powder; and the softness of the lead giving way to the violence with which the bullet is impelled, that zone of the bullet, which is contiguous to the piece varies its arcular form, and takes the shape of the inside of the barrel; so that it becomes part of a male screw, exactly answering to the indents of the rifle.

"It must be observed, however, that though the bullet impelled from a rifle-barrelled piece keeps for a time to its regular track with sufficient nicety; yet if its flight be so far extended that the track becomes considerably incurvated, it will then undergo considerable deflections." The best remedy for this defect, is the making use of bullets of an egg-like form instead of spherical ones.

ART. II. Of Mr. Robin's Method of determining by Experiments the Velocity which any Ball moves with at any Distance of the Piece it is discharged from.

This he effects by means of an iron pendulum, having a broad part at the bottom, covered with a thick piece of wood fastened to the iron by screws: then having three poles joined together by their tops, and spreading at bottom, such as are commonly used in weighing and lifting heavy bodies, and called by workmen triangles, on two of these poles, towards their tops, are screwed on sockets, on which the pendulum is hung by means of a cross piece, which becomes its axis of suspension, and on which it ought to vibrate with great freedom. Something lower than the bottom of the pendulum there should be a brace, joining the two poles to which the pendulum is suspended, and to this brace there is fastened a contrivance, made with two edges of steel, something in the manner of a drawing pen; the strength with which these edges press on each other, being diminished or increased at pleasure by means of a screw. To the bottom of the pendulum should be fastened a narrow ribbon, which, passing between the steel edge, may hang loosely down, by means of an opening cut in the lower piece of steel.

The instrument being thus fitted, if the weight of the pendulum, the respective distances of its centre of gravity, and of its centre of oscillation from its axis of suspension be known, it may from thence be found what motion will be communicated to this pendulum, by the percussion of a body of a known weight, moving

with a known degree of velocity, and striking it in a given point; that is, if the pendulum be supposed at rest before the percussion, it will be known what vibration it ought to make in consequence of such a blow; and if the pendulum being at rest is struck by a body of a known weight, and the vibration which the body makes after the blow is known, the velocity of the striking body may from thence be determined.

Now the extent of the vibration made by the pendulum may be measured by the ribbon: for if the pressure of the steel edges on the ribbon be regulated by the screw, so as to be free and easy, though with a minute resistance to prevent its slipping of itself, then setting the pendulum at rest, let the part of the ribbon between the pendulum and the steel edges be drawn straight, but not strained; and fixing a pin in the part of the ribbon contiguous to the edges, the pendulum swinging back by the impulse of the ball, will draw out the ribbon to the just extent of its vibration, which will be determined by the interval on the ribbon between the edges and the place of the pin. The computation by which the velocity of the ball is determined from the vibration of the pendulum after the stroke, is founded on this principle of mechanics: that if a body in motion strikes on another at rest, and they are not separated after the stroke, but move on with one common motion, then that common motion is equal to the motion which the first body moved before the stroke; whence if that common motion, and the masses of the two bodies are known, the motion of the first body before the stroke is thence determined. On this principle it follows that the velocity of a bullet may be diminished in any given ratio by its being made to impinge on a body of weight properly proportioned to it; and hereby the most violent motions, which would otherwise escape our examination, are easily determined by the retarded motions which have a given relation to them.

It is to be observed that the length to which the ribbon is drawn is always near the chord of the arch described by the ascent; it being so placed as to differ insensibly from those chords which most frequently occur, and these chords are known to be in the proportion of the velocities of the pendulum acquired from the strokes. Hence it follows that the proportions between the lengths of ribbon, drawn out at different times, will be the same with that of the velocities or the impinging bullets. Now from Mr. Robins's computations, the velocity of a bullet whose weight was $\frac{1}{16}$ of a pound, was 1641 feet in a second of time, when the chord of the arch described by the ascent of the pendulum was $17\frac{1}{2}$ inches; therefore, by the proportion of any other lengths of ribbon drawn out by a percussion to $17\frac{1}{2}$, the proportion of the velocity with which the bullets impinge, to the known velocity of 1641 feet in 1 second will be determined.

ART. III. Of the Resistance of the Air to the Motion of the Bullets.

"With regard to the resistance of the air, which so remarkably affects all military projectiles, it is necessary to premise, that the greatest part of authors have established it as a certain rule, that, while the same body moves in the same medium, it is always resisted in the duplicate proportion of its velocity; that is, if the resisted body move in one part of its track with three times the velocity with which it moved in some other part, then its resistance to the great velocity will be nine times the resistance to the lesser. If the velocity in one place be four times greater than in another, the resistance of the fluid will be 16 times greater in the first, than in the second, &c. This rule, however, though pretty near the truth when the velocities are confined within certain limits, is excessively erroneous when applied to military projectiles, where such resistances often occur as could scarcely be effected, on the commonly received principles, even by a triple augmentation of its density. By means of the machine already described, (says Mr. Robins) I have it in my power to determine the velocity with which a ball moves in any part of its track, provided I can direct the piece in such a manner as to cause the bullet to impinge on the pendulum place in that part: and therefore, charging a musket-barrel three times successively with a leaden ball $\frac{1}{4}$ of an inch in diameter, and about half its weight of powder; and taking such precautions in weighing of the powder, and placing it, that I was assured, by many previous trials, that the velocity of the ball could not differ by 20 feet in a second from its medium quantity; I fired it against the pendulum placed at 25, 75, and 125 feet distance from the mouth of the piece respectively; and I found that it impinged against the pendulum, in the first case, with a velocity of 1670 feet in a second; in the second case with a velocity of 1550 feet in a second; and in the third case, with a velocity of 1425 feet in a second; so that, in passing through 50 feet of air, the bullet lost a velocity of 120 or 125 feet in a second; and the time of its passing through that space being about $\frac{1}{16}$ and $\frac{1}{10}$ of a second, the medium quantity of resistance must, in these instances, have been about 120 times the weight of a ball; which (as the ball was nearly $\frac{1}{16}$ of a pound) amounts to about 10lb. avoirdupoise.

"Now, if a computation be made, according to the method laid down for compressed fluids in the 38th proposition of Newton's Principia, supposing the weight of water to that of air as 850 to 1, it will be found, that the resistance to a globe of $\frac{1}{4}$ of an inch diameter, moving with a velocity of about 1600 feet in a second, will not, on these principles, amount to any more than 4 $\frac{1}{2}$ lb. avoirdupoise; whence, as we know that the rules contained in that proposition

PROJECTILES.

position are very accurate with regard to slow motions, we may hence conclude, that the resistance of the air in slow motions is less than that in swift motions, in the ratio of $4\frac{1}{2}$ to 10; a proportion between that of 1 to 2, and 1 to 3.

Again, I charged the same piece a number of times with equal quantities of powder, and balls of the same weight, taking all possible care to give to every shot an equal velocity; and, firing three times against the pendulum placed only 25 feet from the mouth of the piece, the medium of the velocities with which the ball impinged was nearly that of 1690 feet in a second: then removing the piece 175 feet from the pendulum, I found, taking the medium of five shots, that the velocity with which the ball impinged at this distance, was 1300 feet in a second: whence the ball in passing through 150 feet of air, lost a velocity of about 390 feet in a second; and the resistance computed from these numbers, comes out something more than in the preceding instance, it amounting here to between 11 and 12 pounds avoirdupoise; whence, according to these experiments, the resisting power of the air to swift motions is greater than to slow ones, in a ratio, which approaches nearer to that of 3 to 1 than in the preceding experiments.

Having thus examined the resistance to a velocity of 1700 feet in a second, I next examined the resistance to smaller velocities: and for this purpose, I charged the same barrel with balls of the same diameter, but with less powder, and placing the pendulum at 25 feet distant from the piece, I fired against it five times with an equal charge each time: the medium velocity with which the ball impinged, was that of 1180 feet in a second; then, removing the pendulum to the distance of 250 feet, the medium velocity of five shots, made at this distance, was that of 950 feet in a second: whence the ball, in passing through 225 feet of air, lost a velocity of 230 feet in a second; and as it passed through that interval in about $\frac{2}{3}$ ths of a second, the resistance to the middle velocity will come out to be near $33\frac{1}{2}$ times the gravity of the ball, or 2lb. 10 oz. avoirdupoise. Now, the resistance to the same velocity, according to the laws observed in slower motions, amounts to $\frac{1}{7}$ of the same quantity; whence in a velocity of 1065 feet in a second, the resisting power of the air is augmented in no greater a proportion than that of 7 to 11; whereas we have seen in the former experiments, that to still greater degrees of velocity the augmentation approached very near the ratio of one to three.

But farther, I fired three shots of the same size and weight with those already mentioned, over a large piece of water; so that their dropping into the water being very discernable, both the distance and time of their flight might be accurately ascertained. Each shot was discharged with a velocity of 400 feet in a second; and I had satisfied myself by many previous trials of the same charge with the pendulum, that I could rely on this velocity to 10 feet in a second. The first shot flew 313 yards in four seconds and a quarter, the second flew 319 yards in four seconds, and the third 373 yards in five seconds and an half. According to the theory of resistance established for slow motions, the first shot ought to have spent no more than 3.2 seconds in its flight, the second 3.28, and the third 4 seconds: whence it is evident that every shot was retarded considerably more than it ought to have been, had that theory taken place in its motion; consequently the resistance of the air is very sensibly increased, even in such a small velocity as that of 400 feet in a second.

From the computations and experiments already mentioned, it plainly appears, that a leaden ball of $\frac{3}{4}$ of an inch diameter, and weighing nearly $1\frac{1}{2}$ oz. avoirdupoise, if it be fired from a barrel of 45 inches in length, with half its weight of powder, will issue from that piece with a velocity which, if it were uniformly continued, would carry it near 1700 feet in a second. If, instead of a leaden ball, an iron one, of an equal diameter, was placed in the same situation in the same piece; and was impelled by an equal quantity of powder, the velocity of such an iron bullet would be greater than that of the leaden one in the subduplicate ratio of the specific gravities of lead and iron; and supposing that ratio to be as three to two, and computing on the principles already laid down, it will appear, that an iron bullet of 24lb. weight, shot from a piece of ten feet in length, with 16lb. of powder, will acquire from the explosion a velocity which, if uniformly continued, would carry it nearly 1650 feet in a second.

ART. IV. The Method of pointing Guns so as to strike distant Objects.

This depends on two things, viz. 1. Tracing on the outside of a piece, a visual line parallel to the axis, which is called *disparting*, and is performed by taking half the difference of the diameters of the muzzle and base-ring, and setting it perpendicularly on the muzzle-ring directly over the centre; for then a line which passes from that point in the base-ring, which is directly over the centre of the piece, to the extremity of the distance thus placed on the muzzle-ring, will, when the piece is truly bored, be parallel to its axis. 2. The other operation is the determining the allowance to be made in distant shot for the incurvation of the flight of the bullet: this is greater or less (*ceteris paribus*) according to the different charges of powder made use of. Mr. Robins has determined, that such a charge as produces a velocity between 1100 and 1200 feet in a second, is in many cases the most eligible: supposing, therefore, that the piece is loaded with such a charge; in this case, if

the shot were not retarded by the resistance of the air, the range corresponding to one degree of this piece might be reckoned 450 yards, to two degrees 900, to three degrees 1350, &c. since independently of the air's resistance, the ranges at different elevations would be nearly in proportion to these angles, at least as far as eight or ten degrees. But the resistance of the air will occasion a considerable alteration; because, by diminishing the velocity of the bullet, it will render its tract more incurvated than it would otherwise be, and diminish its range: and the smaller the shot the greater would be the diminution. The following table will serve to show the angles of elevation corresponding in different pieces to different distances, and will save the labour of computation.

Actual Range in Yards	Angle of Elevation.				
	24 lb	12 lb	9 lb	6 lb	3 lb
1400	4 12	4 30	4 45	5 0	5 57
1200	3 26	3 40	3 50	4 0	4 30
1000	2 45	2 54	3 0	3 7	3 30
800	2 6	2 10	2 13	2 20	2 30
600	1 30	1 32	1 34	1 36	1 44
500	1 13	1 15	1 17	1 19	1 23
400	58	58 $\frac{1}{2}$	59	1 0 $\frac{1}{2}$	1 3
300	43	43	43	44	43
200	27 $\frac{3}{4}$	28 $\frac{1}{4}$	28 $\frac{1}{2}$	28 $\frac{1}{2}$	29 $\frac{1}{2}$
100	14	14	14 $\frac{1}{2}$	14 $\frac{1}{2}$	15

By this table, when the distance of the object is known, the angle, by which the axis of the piece ought to be elevated above the usual line, will be readily determined; and when this angle is known, the piece may be directed or pointed, by measuring the length of it from the middle of the base-ring to the middle of the muzzle-ring, and computing the tangent of the given angle of elevation to that radius, which may be readily done by a table of tangents.

ART. V. To determine the Lengths of Guns answering to any given Charge.

From some experiments with six 24 pounders, nearly of the same weight, whose lengths were 10.5, 10, 9, 5.9, 8.5, and 8 feet, charged alike, and elevated to $7^{\circ}12'$, made by general Armstrong at Woolwich, in 1736, it has been inferred, that 9.5 was the best length for a 24 pounder: but it does not appear what the charge was; and besides, if the charge, supposed to be half the weight of the bullet, had been more or less, the lengths which carried the shot farthest would likewise have been more or less: so that allowing this length to be the best for that charge, it does not follow that it will remain so when the charge is either increased or diminished, or when the weight of the metal is changed. But since these experiments were made, it has been found that eight pounds of powder are sufficient for a 24 pounder, when it is to make a breach; and therefore it remains to be determined, what is the best length for that charge.

With a view to this subject, Mr. Muller has calculated the following table, in which the numbers at the top express the lengths of the pieces in diameters of their shot; the first vertical column expresses the charges in respect to the weight of the shots; and the other numbers in the same horizontal lines, express the distances in feet moved over, by the velocities of the shot uniformly continued in a second of time.

TABLE OF VELOCITIES.

	12	15	18	21	24	27	30	36
$\frac{1}{4}$	1043	1052	1058	1063	1066	1068	1071	1074
$\frac{2}{3}$	1186	1200	1210	1217	1222	1224	1229	1234
$\frac{1}{2}$	1406	1434	1452	1465	1475	1482	1488	1497
	1568	1613	1641	1692	1677	1688	1698	1711

N.B. The diameter of a nine pound shot, which is four inches, and expresses the height of the charge when it is a quarter of the weight of the shot, &c. was used in the calculation of this table. From this table it is inferred, 1. That if the charge is but a quarter of the shot's weight, the difference between the velocities, when the length is 12 and 15 diameters, is only nine feet in a second; and the differences between the other velocities decrease, as the length increases; and, therefore, as the difference between the velocities, when the piece is 15 and 36 diameters, is only twenty-two feet in a second, it follows, that when the pieces are charged with one quarter of the shot's weight, the length from 12 to 15 is the best in that case. 2. When the charge is one third of the shot's weight, it appears in the same manner, that the length from 15 to 18 diameters is the best. And, 3. When the charge is one half of the shot's weight, the length ought to be from 18 to 21 diameters; and when the charge is two thirds of the shot's weight, the length should be from 21 to 24 diameters: and these lengths, says Mr. Muller, are conformable to practice: for the present light field-pieces are some 12, and others 15 diameters long, and their charge

PROJECTILES.

charge is one-fourth of the shot's weight; and the heavy twenty-four pounders are commonly from 21 to 24 diameters long, and their proper charge is esteemed to be two-thirds of the shot's weight. The following tables exhibit the dimensions of all sorts of brass and iron guns, as established by the Board of Ordnance.

TABLE I.

Nature.	Pouder.	Length.		Weight.	Calibre of the Gun.		Diameter of the Shot.
		ft.	in.	c. qr. lb.	Inches.	Inches.	
BRASS GUNS.	Heavy.	42	9 6	61 0 0	7.3	6.68	
		24	9 6	52 0 0	5.83	5.54	
		12	9 0	29 0 0	4.63	4.4	
		9	9 0	26 0 0	4.21	4.0	
		6	8 0	19 0 0	3.66	3.48	
	Medi.	3	7 0	11 2 0	2.91	2.77	
		1 1/2	6 0	5 2 0	2.31	2.2	
		24	8 0	40 1 21	5.83	5.54	
		12	6 6	21 0 14	4.63	4.4	
		6	5 0	10 1 0	3.66	3.48	
Light.		24	5 6	16 1 12	5.83	5.54	
		12	5 0	8 3 18	4.63	4.4	
		6	4 6	4 3 14	3.66	3.48	
		3	3 6	2 3 4	2.91	2.77	

TABLE II.

IRON GUNS.		42	9 6	65 0 0	7.3	6.68	
		32	9 6	55 0 0	6.42	6.1	
		24	9 6	49 0 0	5.83	5.54	
		24	9 6	47 2 0	5.83	5.54	
		18	9 0	40 0 0	5.29	5.3	
		12	9 0	32 2 0	4.63	4.4	
		12	8 6	31 2 0	4.63	4.4	
		12	7 6	29 1 0	4.63	4.4	
		9	9 0	29 0 0	4.21	4	
		9	8 6	27 2 0	4.21	4	
		9	8 0	26 2 0	4.21	4	
		9	7 6	24 2 0	4.21	4	
		9	7 0	23 0 0	4.21	4	
		6	9 0	24 0 0	3.66	3.48	
		6	8 6	23 0 0	3.66	3.48	
		6	8 0	22 0 0	3.66	3.48	
		6	7 6	20 2 0	3.66	3.48	
		6	7 0	19 0 0	3.66	3.48	
		6	6 6	18 0 0	3.66	3.48	
		6	6 0	16 2 0	3.66	3.48	
		4	6 0	12 1 0	3.21	3.4	
		4	5 6	11 1 0	3.21	3.4	
		3	4 6	7 1 0	2.21	2.77	
		1 1/2	3 0	7 1 25	1.58	1.52	

The requisite charges for all the different pieces, on all occasions, both in garrison and in field, appear from the following Table.

TABLE III.

Proof.	Service.		Salut.		Ricochet.		Diameter of		Length of cart.	
	Brass	Iron	Brass	Iron	Salut.	Ricochet.	Guns.	Shot	Proof.	Service
lb. oz. lb. oz.	lb. oz. lb. oz.	lb. oz. lb. oz.	lb. oz. lb. oz.	lb. oz. lb. oz.	lb. oz. lb. oz.	lb. oz. lb. oz.	pts. in.	pts. in.	pts. in.	pts. in.
42 31 8 25	14	12	10 4 4	7	7 0 18	6 68 4	26 94	17 79		
32 26 12 21	8	10 10	9 4 8	2 12	6 4 10	6 105 26	3 16	25		
24 21 18	8	8	6 2	5 8 24	5 54 7	25 58	14 78			
18 18	15	6	8	4 8 1 12	5 29 2	5 04 0	2 49 2	13 46		
12 12	4	4	3 1 6	4 6 23	4 40 3	23 24	11 72			
9 9	3	3	2 5 1 4	4 200	4 03 8	21 26	10 63			
6 6	2 8	2 8	2 1	3 66 8	3 40 8	18 7	9 35			
4 4	1 6	1 8	1 4	12 3 204	3 00 3	16 43	8 12			
3 3	1	1	12 8	2 9 13	2 77 5	14 84	7 42			
1 1/2 1 8	1 8	8 1 8	6 4	2 03 1	2 02 0	11 76	5 88			
1 1	1	5	5	4 2 1/2	2 01 9	1 92 3	8 35	3 18		

ART. VI. Of the Nature, Composition, and Force of Gunpowder. Gunpowder is a mixture of charcoal, brimstone, and nitre. The proportion of these is different in different authors: powder made for government is composed of ten pounds of brimstone, fifteen pounds of charcoal, and seventy-five pounds of nitre. Powder made for the use of merchants has less nitre, and more charcoal. At first gunpowder was made like fine flour, but afterwards made into lumps, which was found to fire quicker than the flour powder. To burn it, it must be put through two or three sieves; the powder must be first moistened and reduced to a sort of paste, and put into the first sieve, which has large holes: it is broke in pieces by a

piece of wood; and it passes through the sieve while it is working. The next sieve, which is smaller, retains the corns, but lets the dust go through: the corns passed through this second sieve, are retained at the third sieve, with still smaller holes: the powder which only goes through one sieve is used by great guns, and called cannon powder. The smaller sort, which passes through two sieves, is used by small guns, and named pistol powder: to glaze the powder, or make it shine, they shake it in a cask that has had black-lead in it. The sudden firing of gunpowder is owing to the nitre; and the vehement explosion arises from the great quantity of air which it contains. The force of fired gunpowder is the elasticity or pressure of the fluid produced by firing it; and is the same as the elastic force of so much air compressed into the same space with the gunpowder.

Mr. Robins, from experiments related in his new principles of gunnery, having concluded, that the force of fired gunpowder, at the instant of its explosion, is the same as that of an elastic fluid of a thousand times the density of the common air, and that the elasticity of this fluid, like that of air, is proportionable to its density, proposes the following problem.

The dimensions of any piece of artillery, the density of its ball, and the quantity of its charge being given, to determine the velocity which the ball will acquire from the explosion, supposing the elasticity or force of the powder at the first instant of its firing to be given. In the solution of this problem he assumes the two following principles: 1. That the action of the powder on the bullet ceases as soon as the bullet is got out of the piece. 2. That all the powder of the charge is fired, and converted into an elastic fluid, before the bullet is sensibly moved from its place. These assumptions, and the conclusions before mentioned, make the action of fired gunpowder to be entirely similar to that of air condensed a thousand times; and from thence it will not be difficult to determine the velocity of the ball arising from the explosion; for the force of the fired powder diminishing in proportion to its expansion, and ceasing when the ball is out of the piece, the total action of the powder may be represented by the area of the curve, the base of which represents the space through which the ball is accelerated; and the ordinates to which, represent the force of the powder at every point of that space: and these ordinates being in reciprocal proportion to their distance from the breech of the gun, because when the spaces occupied by the fired powder are as 1, 2, 3, 4, &c. the force of the powder, or the ordinates representing it, will be as 1, 1/2, 1/3, 1/4, &c. it appears that the curve will be a common hyperbola, and that the area intercepted between it, its asymptote, and the two ordinates, representing the force of the powder at the first explosion, and at the muzzle of the piece, will represent the total action of the powder on the ball: but if the ball were urged through the same space, by an uniform force equal to its gravity, the total action of this force would be represented by a rectangle, the base of which would be the base of the curve or intercepted portion of the asymptote before mentioned, and the height of which would represent the uniform force of gravity. Hence the square of the velocity of the ball, resulting from the action of the gunpowder, will be to the square of the velocity, resulting from the action of gravity, as the area of the hyperbolic space is to the area of the rectangle: but the velocity of the ball resulting from gravity is given, being the velocity it would acquire from a height equal to the space through which the powder accelerates it; and the proportion between the hyperbolic space and the rectangle is also given from the analogy of hyperbolic spaces and logarithms; therefore the velocity of the ball arising from the action of the fired gunpowder will be given.

ART. VII. Dr. Hutton's Experiments on the Velocity of Cannon-balls

In the 68th volume of the Phil. Trans. Dr. Hutton hath recited a number of experiments made on cannon carrying balls from one to three pounds weight. His machine for discovering the velocities of these balls was the same with that of Mr. Robins, only of a larger size. His charges of powder were two, four, and eight ounces; and the results of 15 experiments which seem to have been the most accurate, are as follow:

Velocity with two ounces.	Velocity with four ounces.	Velocity with eight ounces.
702 feet in 1"	1068 feet in 1"	1419 feet in 1"
682	1020	1352
695	948	1443
703	973	1300
725	957	1412
53507	54966	56986

Mean velocities 701

993

1397

In another course, the mean velocities, with the same charges of powder, were 613, 873, 1162. "The mean velocities of the balls in the first course of experiments," says Dr. Hutton, "with two, four, and eight ounces of powder, are as the numbers 1, 1.414, and 1.993; but the sub-duplicate ratio of the weights (two, four, and eight) give the numbers 1, 1.414, and 2, to which the others are sufficiently near. It is obvious, however, that the greatest difference lies in the last number, which answers to the greatest velocity. It will still be a little more in defect if we make the allowance for the weights of the balls; for the mean weights of the balls with the two and four ounces is 18 1/2 ounces, but of the eight ounces

M m m

it

PROJECTILES.

it is $18\frac{1}{2}$; diminishing, therefore, the number 1.993 in the reciprocal sub-duplicate ratio of $18\frac{1}{2}$ to $18\frac{1}{4}$, it becomes 1.985, which falls short of the number 2 by .015, or the 133d part of itself. A similar defect was observed in the other course of experiments; and both are owing to three evident causes, viz. 1. The less length of cylinder through which the ball was impelled; for with the eight-ounce charge, it lay three or four inches nearer to the muzzle of the piece than with the others. 2. The greater quantity of elastic fluid which escaped in this case than in the others by the windage. This happens from its moving with a greater velocity; in consequence of which, a greater quantity escapes by the vent and windage than in smaller velocities. 3. The greater quantity of powder blown out unfired in this case than in that of the lesser velocities; for the ball which was impelled with the greater velocity, would be sooner out of the piece than the others, and the more so as it had a less length of the bore to move through; and if powder fire in time, which cannot be denied, though indeed that time is manifestly very short, a greater quantity of it must remain unfired when the ball with the greater velocity issues from the piece, than when that which has the less velocity goes out, and still the more so as the bulk of powder which was at first to be inflamed in the one case so much exceeded that in the others.

Let us now compare the corresponding velocities in both cases. In the one they are, 701, 993, 1397; in the other, 613, 873, 1162. Now the ratio of the first two numbers, or the velocities with two ounces of powder, is that of 1 to 1.436, the ratio of the next two is that of 1 to 1.375, and the ratio of the last is that of 1 to 1.2022. But the mean weight of the shot for two and four ounces of powder, was $28\frac{1}{2}$ ounces in the first course, and $18\frac{1}{4}$ in this; and for eight ounces of powder, it was $28\frac{1}{2}$ in the first, and $18\frac{1}{2}$ in this. Taking, therefore, the reciprocal sub-duplicate ratios of these weights of shot, we obtain the ratio of 1 to 1.224 for that of the balls which were fired with two ounces and four ounces of powder, and the ratio of 1 to 1.241 for the balls which were fired with eight ounces. But the real ratios above found are not greatly different from these; and the variation of the actual velocities from this law of the weights of shot, inclines the same way in both courses of experiments. We may now collect into one view the principal inferences that have resulted from these experiments.

1. "It is evident from them, that powder fires almost instantaneously.
2. "The velocities communicated to balls or shot of the same weight with different quantities of powder, are nearly in the sub-duplicate ratio of these quantities; a very small variation in defect taking place when the quantities of powder become great.
3. "When shot of different weights are fired with the same quantity of powder, the velocities communicated to them are nearly in the reciprocal sub-duplicate ratio of their weights.
4. "Shot which are of different weights, and impelled by different quantities of powder, acquire velocities which are directly as the square roots of the quantities of powder, and inversely as the square roots of the weights of the shot nearly. The velocities of bullets being thus found, the ranges may be determined by the rules laid down in the following article:—

ART. VIII. Mr. Robins's Method of finding the Ranges of Bullets.

1. Till the velocity of the projectile surpasses that of 110 feet in a second, the resistance may be reckoned, according to Sir Isaac Newton's theory, in the duplicate proportion of the velocity, and its mean quantity may be reckoned about half an ounce avoirdupois on a 12lb. shot, moving with a velocity of about 25 or 26 feet in a second, but if the velocity be greater than that of 1100 or 1200 feet in a second, the resistance becomes affected by another cause, not noticed by former writers, and that is the air's elasticity, which takes place when the velocity of the moving body becomes considerably greater than that by which the air presses into vacuum. Having, therefore, first ascertained this velocity, which we shall suppose to be 1200 feet in a second, it is plain, that if a body moves with a velocity of 1800 feet in a second, it must compress the air before it; because the fluid hath neither time to expand itself in order to fill the vacuum left behind the moving body, nor to rush in by its gravity. This compression it will resist by its elastic power, which thus becomes a new source of resistance, increasing, without any limit, in proportion to the velocity of the moving body. If, now, we suppose the moving body to set out with a velocity of 2400 feet in a second, it is plain, that there is not only a vacuum left behind the body, but the air before it is compressed into half its natural space. The loss of motion in the projectile, therefore, is now very considerable. It first loses 15 pounds on every square inch of surface, on account of the deficiency of the moving power of the air behind it; then it loses 15 pounds more on account of the resistance of the air before it; again it loses 15 pounds on account of the elasticity of the compressed air; and lastly, another 15 pounds on account of the vacuum behind, which takes off the weight of the atmosphere, that would have been equivalent to one-half of the elasticity of the air before it. The whole resistance thereof upon every square inch of surface moving with this velocity is 60 pounds, besides that which arises from the power tending to preserve the general state of the atmosphere, and which increases in the duplicate proportion of the velocity as already mentioned. If the body is supposed to move with a velocity of 4800 feet in a second, the resist-

ance from the air's elasticity will then be quadrupled, or amount to 60 pounds on the square inch of surface; which, added to the other causes, produces a resistance of 105 pounds upon the square inch; and thus would the resistance from the elasticity of the air go on continually increasing, till at last the motion of the projectile would be as effectually stopped, as if it were fired against a wall. This obstacle, therefore, we are to consider as really insuperable by any art whatever; and therefore it is not advisable to use larger charges of powder than what will project the shot with a velocity of 1200 feet in a second.

Mr. Robins having advanced these grounds, he says, that if the motion of a projectile on the hypothesis of a resistance in the duplicate ratio of the velocity, be truly and generally assigned, the actual motions of resisted bodies may be thereby determined, notwithstanding the increased resistances in the great velocities. Mr. Robins then proceeds as follows:

"The distance to which any projectile would range in vacuum on the horizontal plane at 45° elevation, I call the potential range of that projectile; the distance to which the projectile would range in vacuo on the horizontal plane at any angle different from 45° , I call the potential range of the projectile at that angle; and the distance to which the projectile really ranges, I shall call its actual range."

"If the velocity with which a projectile begins to move is known, its potential range, and its potential range, at any given angle, are easily determined from the common theory of projectiles; or more generally, if either its original velocity, its potential range, or its potential range, at a given angle, are known, the other two are easily found out. To facilitate the computation of resisted bodies, it is necessary, in the consideration of each resisted body, to assign a certain quantity, which I shall denominate F, adapted to the resistance of that particular projectile. To find this quantity F to any projectile given, we may proceed thus: first find with what velocity the projectile must move, so that its resistance may be equal to its gravity. Then the height, from whence a body must descend in a vacuum to acquire this velocity, is the magnitude of F sought. But the simplest way of finding this quantity F to any shell or bullet is this: If it be of solid iron, multiply its diameter measured in inches by 300, the product will be the magnitude of F expressed in yards. If, instead of a solid iron bullet, it is a shell or a bullet of some other substance; then, as the specific gravity of iron is to the specific gravity of the shell or bullet given, so is the F corresponding to an iron bullet of the same diameter, to the proper F for the shell or bullet given. The quantity F being thus assigned, the necessary computations of these resisted motions may be dispatched by the three following propositions, always remembering that these propositions proceed on the hypothesis of the resistance being in the duplicate proportion of the velocity of the resisted body. How to apply this principle, when the velocity is so great as to have its resistance augmented beyond this rate, shall be shewn in a corollary to be annexed to the first proposition."

Actual ranges expressed in F.	Corresponding potential ranges expressed in F.	Actual ranges expressed in F.	Corresponding potential ranges expressed in F.	Actual ranges expressed in F.	Corresponding potential ranges expressed in F.
0.01	0.0100	1.5	2.6422	3.5	13.2536
0.02	0.0201	1.55	2.7890	3.6	13.8238
0.04	0.0405	1.6	2.9413	3.65	14.4195
0.06	0.0612	1.65	3.0994	3.7	15.0377
0.08	0.0822	1.7	3.2635	3.75	15.6814
0.1	0.1034	1.75	3.4338	3.8	16.3517
0.12	0.1249	1.8	3.6107	3.85	17.0497
0.14	0.1468	1.85	3.7944	3.9	17.7768
0.15	0.1578	1.9	3.9851	3.95	18.5341
0.2	0.2140	1.95	4.1833	4.0	19.3229
0.25	0.2722	2.	4.3890	4.05	20.1440
0.3	0.3324	2.05	4.6028	4.1	21.0006
0.35	0.3947	2.1	4.8249	4.15	21.8925
0.4	0.4591	2.15	5.0557	4.2	22.8218
0.45	0.5258	2.2	5.2955	4.25	23.7901
0.5	0.5949	2.25	5.5446	4.3	24.7991
0.55	0.6664	2.3	5.8036	4.35	25.8506
0.6	0.7404	2.35	6.0728	4.4	26.9465
0.65	0.8170	2.4	6.3526	4.45	28.0887
0.7	0.8964	2.45	6.6435	4.5	29.2792
0.75	0.9787	2.5	6.9460	4.55	30.5202
0.8	1.0638	2.55	7.2605	4.6	31.8138
0.85	1.1521	2.6	7.5875	4.65	33.1625
0.9	1.2436	2.65	7.9276	4.7	34.5680
0.95	1.3383	2.7	8.2813	4.75	36.0346
1.0	1.4366	2.75	8.6492	4.8	37.5632
1.05	1.5384	2.8	9.0319	4.85	39.1571
1.1	1.6439	2.85	9.4300	4.9	40.8193
1.15	1.7534	2.9	9.8442	4.95	42.5527
1.2	1.8669	2.95	10.2752	5.0	44.3600
1.25	1.9845	3.0	10.7237		
1.3	2.1066	3.05	11.1904		
1.35	2.2332	3.1	11.6761		
1.4	2.3646	3.15	12.1816		
1.45	2.5008	3.2	12.7078		

PROJECTILES.

"PROP. I. Given, the actual range of a given shell, or bullet, at any small angle not exceeding 8° or 10° , to determine its potential range, and consequently its potential random and original velocity?

"SOL. Let the actual range given be divided by the F corresponding to the given projectile, and find the quote in the first column of the preceding Table. Then the corresponding number in the second column multiplied into F , will be the potential range fought; and thence, by the methods already explained, the potential random, and the original velocity of the projectile is given.

"EXAM. An 18-pounder, the diameter of whose shot is about 5 inches, when loaded with 21b. of powder, ranged at an elevation of 30° 30', to the distance of 975 yards.

"The F corresponding to this bullet is 1500 yards, and the quote of the actual range by this number is 65; corresponding to which, in the second column, is 817; whence, 817 F , or 1225 yards, is the potential range fought; and this augmented in the ratio of the sine of twice the angle of elevation to the radius, gives 10050 yards for the potential random; whence it will be found, that the velocity of this projectile was that of 984 feet in a second, which is found by multiplying the feet in the potential random, by $32\frac{1}{2}$ feet, and extracting the square root.

"COR. I. If the converse of this proposition be desired; that is, if the potential range in a small angle be given, and thence the actual range be fought; this may be solved with the same facility by the same table. For if the given potential range be divided by its correspondent F , then opposite to the quote fought in the second column, there will be found in the first column a number, which, multiplied into F , will give the actual range required. And from hence it follows, that, if the actual range be given at one angle, it may be found at every other angle not exceeding 8° or 10° .

"COR. II. If the actual range at a given small angle be given, and another actual range be given, to which the angle is fought, this will be determined by finding the potential ranges corresponding to the two given actual ranges: then the angle corresponding to one of these potential ranges being known, the angle corresponding to the other, will be found by the common theory of projectiles.

"COR. III. If the potential random deduced from the actual range by this proposition exceeds 13000 yards; then the original velocity of the projectile was so great as to be affected by the treble resistance described above; and consequently the real potential random will be greater than what is here determined. However, in this case, the true potential random may be thus nearly assigned. Take a 4th continued proportional to 13000 yards, and the potential random found by this proposition, and the 4th proportional thus found may be assumed for the true potential random fought. In like manner, when the true potential random is given greater than 13000 yards, we must take two mean proportionals between 13000 and this random (the operations directed in this corollary are best performed by the table of logarithms;) and the first of these mean proportionals must be assumed instead of the random given, in every operation described in these propositions and corollaries. And this method will nearly allow for the increased resistance in large velocities, the difference only amounting to a few minutes in the angle of direction of the projected body, which, provided that angle exceeds two or three degrees, is usually scarce worth attending to. Of this process take the following example:

"A 24-pounder, fired with 12 pounds of powder, when elevated at 7° 15', ranged about 2500 yards. Here the F being near 1700 yards, the quote to be fought in the first column is 147, to which the number corresponding in the second column is 2,556; whence the potential range is near 4350 yards, and the potential random thence resulting 17400. But this being more than 13,000, we must, to get the true potential random, take a 4th continued proportional to 13000 and 17400; and this 4th proportional, which is about 13000 yards, is to be esteemed the true potential random fought; whence the velocity is nearly that of 1730 feet in a second.

"SCHOLIUM. This proposition is confined to small angles, not exceeding 8° or 10° . In all possible cases of practice, this approximation, thus limited, will not differ from the most rigorous solution by so much as what will often intervene from the variation of the density of the atmosphere in a few hours' time; so that the errors of the approximation are much short of other inevitable errors, which arise from the nature of this subject.

"PROP. II. Given the actual range of a given shell, or bullet, at any angle not exceeding 45° , to determine its potential range at the same angle; and thence its potential random and original velocity.

"SOL. Diminish the F corresponding to the shell, or bullet, given in the proportion of the radius to the cosine of $\frac{1}{2}$ of the angle of elevation. Then, by means of the preceding table, operate with this reduced F in the same manner as is prescribed in the solution of the last proposition, and the result will be the potential range fought; whence the potential random, and the original velocity, are easily determined.

"EXAM. A mortar for sea-service, charged with 30lb. of powder, has sometimes thrown its shell, of 12 $\frac{1}{2}$ inches diameter, and of 231b. weight, to the distance of 2 miles, or 5450 yards. This at an elevation of 45° .

"The F to this shell, if it were solid, is 3825 yards; but as the shell is only $\frac{1}{4}$ of a solid globe, the true F is no more than 3060

yards. This, diminished in the ratio of the radius to the cosine of $\frac{1}{2}$ of the angle of elevation, becomes 2544. The quote of the potential range by this diminished F is 1,384; which, fought in the first column of the preceding table, gives 2,280 for the corresponding number in the second column; and this, multiplied into the reduced F , produces 5800 yards for the potential range fought, which, as the angle of elevation was 45° , is also the potential random: and hence the original velocity of this shell appears to be that of about 748 feet in a second.

"COR. The converse of this proposition, that is, the determination of the actual range from the potential range given, is easily deduced from hence by means of the quote of the potential range divided by the reduced F ; for this quote, searched out in the second column, will give a corresponding number in the first column, which, multiplied into the reduced F , will be the actual range fought. Also, if the potential random of a projectile be given, or its actual range at a given angle of elevation; its actual range at any other angle of elevation, not greater than 45° , may hence be known. For the potential random will assign the potential range at any given angle: and thence, by the method of this corollary, the actual range may be found.

"EXAM. A fit musquet-bullet, fired from a piece of the standard dimensions, with $\frac{1}{4}$ of its weight in good powder, acquires a velocity of near 900 feet in a second: that is, it has a potential random of near 8400 yards. If, now, the actual range of this bullet at 15° was fought, we must proceed thus:

"From the given potential random, it follows, that the potential range at 15° is 4200 yards; the diameter of the bullet is $\frac{1}{4}$ of an inch; and thence, as it is of lead, its proper F is 337.5 yards, which, reduced in the ratio of the radius to the cosine of $\frac{1}{2}$ of 15° , becomes 351 yards. The quote of 4200 by this number, is 12,7 nearly; which, being fought in the second column, gives 3,2 nearly for the corresponding number in the first column; and this multiplied into 351 yards (the reduced F) makes 1059 yards for the actual range fought.

"EXAM. II. The same bullet, fired with its whole weight in powder, acquires a velocity of about 2100 feet in a second, to which there corresponds a potential random of about 45700 yards. But this number greatly exceeding 13,000 yards, it must be reduced by the method described in the third corollary of the first proposition, when it becomes 19700 yards. If, now, the actual range of this bullet 15° was required, we shall from hence find that the potential range at 15° is 9850 yards; which, divided by the reduced F of the last example, gives for a quote 2975; and thence following the steps prescribed above, the actual range of this bullet comes out 1396 yards, exceeding the former range by no more than 337 yards; whereas the difference between the two potential ranges is above ten miles. Of such prodigious efficacy is the resistance of the air, which hath been hitherto treated as two insignificant a power to be attended to in laying down the theory of projectiles!

"SCHOL. I must here observe, that as the density of the atmosphere perpetually varies, increasing and diminishing often by $\frac{1}{8}$ part, and sometimes more, in a few hours; for that reason I have not been over rigorous in forming these rules, but have considered them as sufficiently exact when the errors of the approximation do not exceed the inequalities which would take place by a change of $\frac{1}{8}$ part in the density of the atmosphere. With this restriction, the rules of this proposition may be safely applied in all possible cases of practice. That is to say, they will exhibit the true motions of all kinds of shells and cannon-shot, as far as 45° of elevation, and of all musket-bullets fired with their largest customary charges, if not elevated more than 30° . Indeed, if experiments are made with extraordinary quantities of powder, producing potential randoms greatly surpassing the usual rate; then in large angles some farther modifications may be necessary. And though, as these cases are beyond the limits of all practice, it may be thought unnecessary to consider them; yet, to enable those who are so disposed to examine these uncommon cases, I shall here insert a proposition, which will determine the actual motion of a projectile at 45° , how enormous soever its original velocity may be. But as this proposition will rather relate to speculative than practical cases, instead of supposing the actual range known, thence to assign the potential random, I shall now suppose the potential random given, and the actual range to be thence investigated.

"PROP. III. Given, the potential random of a given shell or bullet, to determine its actual range at 45° ?

"SOL. Divide the given potential random by the F corresponding to the shell or bullet given, and call the quotient q , and let l be the difference between the tabular logarithms of 25 and of q , the logarithm of 10 being supposed unity; thence the actual range fought

is $3.4 F + \frac{2F - 10}{10} F$, where the double sine of $2F$ is to be thus understood; that if q be less than 25, it must be $-2F$; if it be greater, then it must be $+2F$. In this solution, q may be any number not less than 3, nor more than 2500.

ART. IX. Instruments used in loading Cannon.

There are several instruments employed in the loading of cannon. The names of these are as follow:

1. The lantern, or ladle, which serves to carry the powder into the piece, and which consists of two parts, viz. of a wooden box, appropriated to the caliber of the piece for which it is intended,

and

PROJECTILES.

and of a caliber and a half in length with its vent; and of a piece of copper nailed to the box, at the height of half a caliber. This lantern must have three calibers and a half in length, and two calibers in breadth, being rounded at the end to load the ordinary pieces.

2. The rammer is a round piece of wood, commonly called a box, fastened to a stick 12 feet long, for the pieces from 12 to 33 pounders: and 10 for the 8 and 4 pounders; which serves to drive home the powder and ball to the breach.

3. The sponge is a long staff or rammer, with a piece of sheep or lamb-skin wound about its end, to serve for scouring the cannon when discharged, before it be charged with fresh powder, to prevent any spark of fire from remaining in her, which would endanger the life of him who should load her again.

4. Wad-screw, consists of two points of iron turned serpent-wise, to extract the wad out of the pieces when one wants to unload them, or the dirt which had chanced to enter into it.

5. The boteveux are sticks two or three feet long, and an inch thick, split at one end, to hold an end of the match twisted round it, to fire the cannon.

6. The priming-iron is a pointed iron rod, to clear the touch-hole of the pieces of powder or dirt; and also to pierce the cartridge, that it may sooner take fire.

7. The primer, which must contain a pound of powder at least, to prime the pieces.

8. The quins of mire, which are pieces of wood with a notch on the side to put the fingers on, to draw them back or push them forward when the gunner points his piece. They are placed on the sole of the carriage.

9. Lead plates which are used to cover the touch-hole, when the piece is charged, lest some dirt should enter it and stop it.

Before charging the piece, it is well spunged, to clean it of all filth and dirt within-side; then the proper weight of gunpowder is put in and rammed down; care being taken that the powder be not bruised in ramming, which weakens its effects; it is then run over by a little quantity of paper, hay, or the like; and lastly, the ball is thrown in.

To point, level, or direct the piece, so as to play against any certain point, is done by the help of a quadrant with a plummet: which quadrant consists of two branches made of brass or wood; one about a foot long, eight lines broad, and one line in thickness; the other four inches long, and the same thickness and breadth as the former. Between these branches is a quadrant, divided into 90 degrees, beginning from the shorter branch, and furnished with thread and a plummet.

The longest branch of this instrument is placed in the cannon's mouth, and elevated or lowered till the thread cuts the degree necessary to hit the proposed object. Which done, the cannon is primed, and then set fire to. The method by the sector, however, proposed by Dr. Lind, is certainly in all cases to be preferred.

A 24-pounder may very well fire 90 or 100 shots, every day in summer: and 60 or 75 in winter. In case of necessity, it may fire more. And some French officers of artillery declare, that they have caused such a piece to fire every day 150 shots in a siege. A 16 and a 12 pounder fire a little more, because they are easier served. There have been some occasions, where 200 shots have been fired from these pieces in the space of nine hours, and 138 in the space of five. In quick firing, tubes are made use of. They are made of tin, and their diameter is two-tenths of an inch, being just sufficient to enter into the vent of the piece. They are about six inches long, with a cap above, and cut slanting below, in the form of a pen; the point is strengthened with some folder, that it may pierce the cartridge without bending. Through this tube is drawn a quick match, the cap being fitted with mealed powder moistened with spirits of wine. To prevent the mealed powder from falling out by carriage, a cap of paper or flannel steeped in spirits of wine is tied over it. To range pieces in a battery, care must be taken to reconnoitre well the ground where it is to be placed, and the avenues to it. The pieces must be armed each with two lanterns or ladles, a rammer, a sponge, and two priming-irons. The battery must also be provided with carriages, and other implements, necessary to remount the pieces which the enemy should chance to dismount. To serve expeditiously and safely a piece in a battery, it is necessary to have to each a sack of leather, large enough to contain about 20 pounds of powder to charge the lanterns or ladles, without carrying them to the magazine; and to avoid thereby making those trains of powder in bringing back the lantern from the magazine, and the accidents which frequently happen thereby.

A battery of three pieces must have 30 gabions, because six are employed on each of the two sides or epaulments, which make 12, and nine for each of the two merlons.

There ought to be two gunners and six soldiers to each piece, and four officers of artillery.

The gunner posted on the right of the piece, must take care to have always a pouch-full of powder, and two priming irons; his office is to prime the piece, and load it with powder. The gunner on the left fetches the powder from the little magazine, and fills the lantern or ladle which his comrade holds; after which, he takes care that the match be very well lighted, and ready to set fire to the piece at the first command of the officer.

There are three soldiers on the right, and three on the left of

the piece. The two first take care to ram and sponge the piece, each on his side. The rammer and sponge are placed on the left, and the lantern or ladle on the right. After having rammed well the wad put over the powder, and that put over the bullet, they then take each a handspike, which they pass between the foremost spokes of the wheel, the ends whereof will pass under the head of the carriage, to make the wheel turn round, leaning on the other end of the handspike, towards the embrasure.

It is the office of the second soldier on the right, to provide wad, and to put it into the piece, as well over the powder as over the bullet; and that of his comrade on the left, to provide 50 bullets, and, every time the piece is to be charged, to fetch one of them and put it into the piece after the powder has been rammed. Then they both take each an handspike, which they pass under the hind part of the wheel, to push it in battery.

The officer of artillery must take care to have the piece diligently served.

In the night he must employ the gunners and soldiers, who shall relieve those who have served 24 hours, to repair the embrasures.

If there be no water near the battery, care must be taken to have a cask filled with it, in which to dip the sponges, and cool the piece, every 10 or 12 rounds.

The carriage, for a mortar of 12 inches of diameter, must be 6 feet long, the flasks 12 inches long, and 10 thick. The trunnions are placed in the middle of the carriage.

The carriage of an 18-inch mortar must be 4 feet long; and the flasks 11 inches high, and 6 thick.

To mount the mortars of new invention, they use carriages of cast iron.

ART. X. *Methods of managing Mortars.*

In Germany, to mount mortars from 8 to 9 inches, and carry them into the field, and execute horizontally as a piece of cannon, they make use of a piece of wood, 8 feet two inches long, with a hole in the middle, to lodge the body of the mortar and its trunnions as far as half their diameter, and mounted on two wheels, four feet high, to which they join a vantrain proportioned to it; and made like those which serve to the carriages of cannons.

Having mounted the mortar on its carriage, the next thing is to caliber the bomb, by means of a great caliber, the two branches whereof embrace the whole circumference of the bomb; these two branches are brought on a rule where the different calibers are marked, among which that of the bomb is found.

If no defect be found in the bomb, its cavity is filled by means of a funnel, with whole gunpowder: a little space or liberty is left, that when a fusée or wooden tube, of the figure of a truncated cone, is driven through the aperture (with a wooden mallet, not an iron one, for fear of accident) and fastened with a cement made of quick-lime, ashes, brick-dust, and steel filings, worked together in a glutinous water, or of four parts of pitch, two of colophony, one of turpentine, and one of wax, the powder may not be bruised. This tube is filled with a combustible matter, made of two ounces of nitre, one of sulphur, and three, or more, of gunpowder-dust, well rammed.

This fusée, set on fire, burns slowly till it reaches the gunpowder; which goes off at once, bursting the shell to pieces with incredible violence. Special care, however, must be taken, that the fusée be so proportioned, as that the gun-powder do not take fire before the shell arrives at the destined place; to prevent which, the fusée is frequently wound round with a wet clammy thread.

To serve expeditiously a mortar in battery, there are required, five strong handspikes; a dame, or rammer, of the calibre of the conic chamber, to ram the wad and the earth; a wooden knife a foot long, to place the earth round the bomb: an iron scraper two feet long, one end whereof must be four inches broad, and round-wise, to clean the bore and the chamber of the mortar, and the other end, made in form of a spoon, to clean the little chamber; a kind of brancard to carry the bomb, a shovel, and pickaxe. The officer who is to mind the service of the mortar, must have a quadrant, to give the degrees of elevation.

It must be observed, that in this art, it is impossible we should ever arrive at absolute perfection: that is, it can never be expected that a gunner, by any method of calculation whatever, could be enabled to point his gun in such a manner, that the shot would hit the mark if placed any where within its range. Aberrations, which can by no means be either foreseen or prevented, will take place from a great number of different causes. A variation in the density of the atmosphere, in the dampness of the powder, or in the figure of the shot, will cause variations in the range of the bullet, which cannot by any means be reduced to rules, and consequently must render the event of each shot very precarious. The resistance of the atmosphere simply considered, without any of those anomalies arising from its density at different times, is a problem which, notwithstanding the labours of Mr. Robins and others, hath not been completely solved: and indeed, if we consider the matter in a physical light, we shall find, that without some other data than those which are yet obtained, an exact solution of it is impossible.

The principal Authors which have been consulted in this Treatise are, Emerson, Simpson, Hutton, Muller, Gray, Robins, &c.

T. MARQUOIS.

PROJECTION, in mechanics, the action of giving a projectile its motion. If the direction of the force, whereby the projectile is put in motion, be perpendicular to the horizon, the projection is said to be perpendicular; if parallel to the apparent horizon, it is said to be an horizontal projection; if it makes an oblique angle with the horizon, the projection is oblique.

PROJECTION, in perspective, denotes the appearance or representation of an object on the perspective plane. The projection, e. g. of a point, as A, Plate I. Fig. I. is a point *a*, through which the optic ray OA passes from the objective point through the plane to the eye; or it is the point wherein the plane cuts the optic ray. And hence is easily conceived what is meant by the projection of a line or plane. See the System, Sect. II.

PROJECTION of the Sphere in Plano, is a representation of the several points or places of the surface of the sphere, and of the circles described thereon, or of any assigned parts thereof, such as they appear to the eye situate at a given distance, upon a transparent plane placed between the eye and the sphere.

To project the sphere upon the plane of the solstitial colour, or upon the meridian of any place (those planes being supposed to coincide) see the System of ASTRONOMY, Sect. IX. Problem I. Plate IV. Fig. II.

To project the sphere upon the plane of the equator, see said System, Sect. IX. Problem II. and Plate IV. Fig. II.

For the projection of the sphere upon the plane of the equator, see the System of ASTRONOMY, Sect. IX. Problem III. and Plate IV. Fig. III.

For the projection of the sphere upon the plane of the ecliptic, see the System, Sect. IX. Problem IV. and Plate IV. Fig. IV.

The principal use of projection of the sphere is in the construction of the planispheres, and, particularly, maps and charts; which are said to be of this or that projection according to the several situations of the eye, and the perspective plane, with regard to the meridians, parallels, and other points and places to be represented. The most usual projection of maps of the world is that on the plane of the meridian, which exhibits a right sphere; the first meridian being the horizon: the next is that on the plane of the equator, wherein the pole is in the centre, and the meridians the radii of a circle, &c. This represents a parallel sphere. The projection of the sphere is usually divided into orthographic and stereographic; to which may be added gnomonic.

Orthographic PROJECTION, is that wherein the superficies of the sphere is drawn on a plane, cutting it in the middle; the eye being placed at an infinite distance vertically to one of the hemispheres.

Stereographic PROJECTION, is that wherein the surface and circles of the sphere are drawn upon a plane of a great circle, the eye being in the pole of that circle.

Gnomonic PROJECTION of the Sphere. See the Treatise on DIALLING.

Mercator's PROJECTION. See the System of NAVIGATION, Sect. I. No. 13, and the Plate of Mercator's Chart.

PROJECTION of Shadows. See the System of PERSPECTIVE, Sect. VII.

PROJECTIVE Dialling, a manner of drawing, by a method of projection, the true hour-lines, furniture of dials, &c. on any kind of surface whatsoever, without any regard to the situation of those surfaces, either as to declination, reclination, or inclination. See Treatise on DIALLING, Sect. II.

PROLAPSUS Ani, in surgery, is when upon a discharge by stool the intestinum rectum is protruded so far, as that it cannot be drawn back again into the body; or, when drawn back, falls out again. This is sometimes a chronic disease, especially when it arises from a palsy: its causes are a relaxation of the fibres of the rectum, or of the sphincter muscle; either from the adstriction of the alvus, or from a diarrhoea, dysentery, or tenebrius. It is very difficultly cured when attended with hæmorrhoids: the principal cure is by astringents. External assistance is also required to reduce the fallen gut, which, if it be not soon done, is apt to tumefy and mortify, by the contact of the air. It is subject to relapse after reduction in children, especially upon violent crying; and is difficult to keep up, in case of a diarrhoea.

PROLAPSUS Vagine, is a descent of the vagina, so as to appear wholly or in part without the labia pudendi: when the whole vagina is prolapsed, it appears like a swelled, bloody ring of flesh, in which case, if the prolapsed part be much inflamed, a circumstance that sometimes proceeds from difficult labour, there is danger of a mortification: but if none of these symptoms appear, there is no danger. A partial prolapsus of the vagina is often mistaken for an excrescence, fœcus, or sarcoma; and danger attends the treatment of it, either by ligatures or the knife. In order to distinguish a prolapsus uteri from that of the vagina, and both from an excrescence, it is to be observed, that the first never happens with an inversion, except immediately after labour; whereas the vagina may subside and appear externally at any time, either within or without the time of gestation: but it most frequently attends a difficult labour. In this disorder, if the prolapsed parts be uninfamed, they should be immediately replaced, and the patient rest in bed for some days, using an injection of warm vinegar and water, or red wine and water: but if these fail, the T bandage must be applied. If the pro-

lapsed parts are inflamed, discutient fomentations and cataplasms should be applied externally, and recourse should be had to internal medicines and bleeding; and after reducing the inflammation, the parts may be safely returned, without danger of mortification.

PROLAPSUS Vesicæ Urinariæ, or the displacing of the bladder, accompanies the inversion of the uterus; in which case, the bulb of the bladder being forced down, is no longer subject to the pressure of the abdominal muscles, and the patient can never discharge water without squeezing the bladder.

PROLAPSUS Uteri, the descent, or falling down of the womb, caused by a relaxation of the ligaments which should hold it in its place. If the uterus fall to the middle of the vagina, or even with the meatus urinarius, it is called a *bearing down* of the womb. If it fall quite down, so as to hang pendulous without the labia, but so as that no more of the inside than the orifice is seen, it is called a *prolapsus* or *procidencia*. Some distinguish between the *procidencia* and *prolapsus*, confining the former term to the descent of the uterus to the labia pudendi, and applying the latter to its descent through the labia. If falling thus low, it be turned inside out, and hang like a fleshy bag, with a rugged unequal surface, it is called a *perversio* or *inversio uteri*. There is also another case of this disorder, called the *retroversio uteri*. These disorders may proceed from violent motions, vehement coughing, sneezing, and the fluor albus. They appear most frequent in women with child, from the weight pressing and bearing hard upon the uterus; but especially if the fetus be dead, lie in a wrong posture, or be violently extracted. After replacing the part, restringents, both inwardly and by injections, are here used; such as obtain in diarrhoeas, hæmorrhoids, the gonorrhœa simplex, &c. The first step towards a cure of the *procidencia uteri*, or falling down of the womb, is to reduce it to its natural situation, and to keep it there by means of pessaries. But as some disadvantages attend the use of the common pessaries, Dr. Thomas Simpson has contrived one, and given us a description and figure of it in the Medical Essays of Edinburgh, vol. iii. art. 18.

PROLIFIC, in medicine, something that has the qualities necessary for generating. See FECUNDITY.

PROLOCUTOR of the Convocation, the speaker or chairman of that assembly. The archbishop of Canterbury is, by his office, president or chairman of the upper house of convocation, The prolocutor of the lower is an officer chosen by the members the first day of their meeting, and is to be approved of by the higher. It is by the prolocutor their affairs, debates, &c. are to be directed; and their resolutions, messages, &c. delivered to the higher house: by him all things propounded to the house are read, suffrages are collected, &c. See CONVOCATION.

PROLOGUE, *Prologus*, in dramatic Poetry, a discourse addressed to the audience before the drama or play begins. The original intention of the prologue was to advertise the audience of the subject of the piece, and to prepare them to enter more readily into the action; and sometimes to make an apology for the poet. The prologue is of a much more ancient standing than the epilogue. The French have left off the use of prologues, except in their operas; those few they now and then make, having nothing in them of the genuine prologue, as bearing no relation to the subject, but being mere flourishes or harangues in praise of the king, &c. In the ancient theatre, the *prologus* was properly the actor who rehearsed the prologue: the prologue was esteemed one of the dramatis personæ, and never appeared in the piece in any other character; so that the learned are surprised to find Mercury, in Plautus's Amphitryo, speaking the prologue, and yet acting a considerable part in the play afterwards. The prologue, therefore, among them, was a part of the piece; indeed, not an essential, but an accessory part. With us the prologue is no part at all; but something entirely distinct and separate: with them the drama was opened with the appearance of the prologue; with us it is not opened till after the prologue is retired; with us therefore the curtain is kept down till after the prologue; with them it must have been withdrawn before. Hence proceeds a still more considerable difference in the practice of the prologue; for with us the prologue speaks in his real and personal character; with them, the prologue spoke in his dramatic character. With us, he always directs his speech to the audience, considered as in a play-house; to pit, box, and gallery; with them, he ought, in propriety, to have spoken as to a chorus of by-standers, or persons to be present at the real action; but this being in good measure inconsistent with the design of the prologue, their persons spoke in the dramatic capacity to the audience in its principal capacity; which was an irregularity that either the good fortune, or the good sense of the moderns have freed them from.

PROMONTORY, in geography, a high point of land, or rock, projecting out into the sea. The extremity of which to the sea-ward is usually called a *cape*, or *head-land*. See the System, under the article *Natural Divisions of the Earth*.

PRONATOR, *radii quadratus, brevis, five transversus*, in anatomy, a small fleshy muscle, nearly as broad as it is long, lying transversely on the inside of the lower extremity of the fore-arm. See the System, Part II. Table of Muscles Art. 22.

PRONATOR teres five obliquus, a small muscle, broader than it is thick, situated on the upper part of the ulna, opposite to the supinator,

pinator brevis, with which it forms an angle like the letter V. See the System, Part II. Table of Muscles, Art. 22. Plate II. fig. 1, letter d; being the first of MYOLOGY.

PRONOUN, *Pronomen*, in grammar, a part of speech used instead of a noun, or name, as its substitute or representative. Whence the denomination from *pro*, and *nomen*; q. d. *for noun*, or *name*. See the System, Part I. Chap. I. Sect. II. and Part II. Chap. III. Art. III.

PRONUNCIATION, in grammar, the manner of articulating or founding the words of a language. Pronunciation makes the most difficult part of written grammar; in regard that a book expressing itself to the eyes, in a matter that wholly concerns the ears, seems next akin to that of teaching the blind to distinguish colours: hence it is that there is no part so defective in grammar as that of pronunciation, as the writer has frequently no term whereby to give the reader an idea of the sound he would express; for want of a proper term, therefore, he substitutes a vicious and precarious one. To give a just idea of the pronunciation of a language, it seems necessary to fix as nearly as possible all the several sounds employed in the pronunciation of that language. Cicero tells us, that the pronunciation underwent several changes among the Romans, and indeed it is more precarious in the living languages, being, as Du Bos tells us, subservient to fashion in these. The French language is clogged with difficulty in pronunciation from which most others are free; and it consists in this, that most of their words have two different pronunciations, the one in common prose, the other in verse. It is not enough to know the just pronunciation of single letters, but also of words: in order to which, the accenting of words ought to be well understood; since nothing is more harsh and disagreeable to the ear, than to hear a person speak or read with wrong accents. And, indeed, in English, the same word is often both a noun and a verb, distinguished only by the accent, which is on the first syllable of the noun, and on the last of the verb; as *ferment* and *ferment*, *record* and *record*, &c. We are to observe also, that in order to a just expression of words, some require only a single accent on the syllable, as in *törmént*, &c.; but in others it should be marked double, as in *animal*, because it is pronounced as if the letter was wrote double, viz. *animal*. See the article *Pro-jody*, in the System of GRAMMAR, Part II. Chap. II.

PRONUNCIATION, is also used for the fourth and last part of oratory, which consists in regulating and varying the voice and gesture agreeably to the matter and words; so as more effectually to persuade and touch the hearers. See the System, Part IV. throughout.

PROOF, *Probatio*, in arithmetic, an operation whereby the truth and justness of a calculation is examined and ascertained. The proper proof is always by the contrary rule: thus subtraction is the proof of addition, and multiplication of division: and *vice versa*. The proof of multiplication by 9 or by 7 is precarious. See the System, Chap. II. Articles 2, 3, 4 and 5. There would need no proofs in arithmetic were it not that a man is liable to make mistakes; for all the rules and operations being built on demonstration, it is thence we are assured of their truth and certitude. The proof, then, does not confirm the rule, but only shews us whether or no we have applied it right.

PROOF, in logic, &c. denotes the mediums or arguments used to evince the truth of any thing. See the System, Part II. Sect. V.

PROOF in artillery. See the Article GUNPOWDER, and the Treatise on PROJECTILES.

PROPAGATION, *Propagatio*, the act of multiplying the kind, or of producing the like in the way of natural generation. See GENERATION.

PROPAGATION, in acoustics. For explanation of this term as it relates to the doctrine of sounds, see the System, Sect. II. and III.

PROPER, *Proprium*, something naturally and essentially belonging to any being.

PROPER, in respect of words, denotes their immediate and peculiar signification, or that directly and peculiarly attached to them. In which sense the word stands opposed to figurative and metaphorical.

PROPER is also used in a moral sense, to denote something that is usually found in things; as their particular or specific virtues, &c. In which sense we say magnanimity is the proper virtue of heroes.

PROPER is also used for the natural qualities necessary to succeed in a thing. In which sense we say, people of a hot vigorous temperament are proper for the army; the cold and phlegmatic are proper for study. The Romans became less proper for war, in proportion as they grew more learned and polite.

PROPER, in grammar, is also applied to nouns or names, which are distinguished into proper and appellative. Man is the appellative, Peter the proper name. The proper name among Christians is that imposed at baptism. See the System, Part I. Chap. I. Sect. I.

PROPERTY, in a general sense, that which constitutes or denominates a thing proper; or is a particular virtue or quality which nature has bestowed on some things exclusive of all others: thus, colour is a property of light; extension, figure, divisibility, and impenetrability, are the properties of body.

PROPERTY, in law, is described to be the highest right which a person has or can have to any thing. There is nothing which so generally strikes the imagination, and engages the affections of mankind, as the right of property; or that sole and despotic domi-

nion which one man claims and exercises over the external things of the world, in total exclusion of the right of any other individual in the universe. And yet there are very few that will give themselves the trouble to consider the original and foundation of this right. Pleased as we are with the possession, we seem afraid to look back to the means by which it was acquired, as if fearful of some defect in our title; or at best we rest satisfied with decision of the laws in our favour, without examining the reason or authority upon which those laws have been built. We think it enough that our title is derived by the grant of the former proprietor, by descent from our ancestors, or by the last will and testament of the dying owner; not caring to reflect, that (accurately and strictly speaking) there is no foundation in nature or in natural law, why a set of words upon parchment should convey the dominion of land; why the son should have a right to exclude his fellow-creatures from a determinate spot of ground, because his father had done so before him; or why the occupier of a particular field, or of a jewel, when lying on his death-bed, and no longer able to maintain possession, should be entitled to tell the rest of the world which of them should enjoy it after him. These enquiries, it must be owned, would be useless, and even troublesome, in common life. It is well if the mass of mankind will obey the laws when made, without scrutinizing too nicely the laws, or into the reasons of making them. But when law is to be considered not only as a matter of practice, but also as a rational science, it cannot be improper or useless to examine more deeply the rudiments and grounds of these positive constitutions of society.

In the beginning of the world, we are informed by holy writ, the all-bountiful Creator gave to man "dominion over all the earth, and over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth." This is the only true and solid foundation of man's dominion over external things, whatever airy metaphysical notions may have been started by fanciful writers upon this subject. The earth, therefore, and all things therein, are the general property of all mankind, exclusive of other beings, from the immediate gift of the Creator. And, while the earth continued bare of inhabitants, it is reasonable to suppose, that all was in common among them, and that every one took from the public stock to his own use such things as his immediate necessities required.

These general notions of property were then sufficient to answer all the purposes of human life; and might perhaps still have answered them, had it been possible for mankind to have remained in a state of primeval simplicity; as may be collected from the manners of many American nations, when first discovered by Europeans, and from the ancient method of living among the first Europeans themselves, if we may credit either the memorials of them preserved in the golden age of the poets, or the uniform accounts given by historians of those times wherein *erant omnia communia et indivisa omnibus, veluti unum cunctis patrimonium esset*. Not that this communion of goods seems ever to have been applicable, even in the earliest ages, to aught but the substance of the thing; nor could it be extended to the use of it. For, by the law of nature and reason, he who first began to use it, acquired therein a kind of transient property, that lasted so long as he was using it, and no longer: or, to speak with greater precision, the right of possession continued for the same time only that the act of possession lasted. Thus the ground was in common, and no part of it was the permanent property of any man in particular; yet whoever was in the occupation of any determinate spot of it, for rest, for shade, or the like, acquired for the time a sort of ownership, from which it would have been unjust, and contrary to the law of nature, to have driven him by force; but the instant that he quitted the use or occupation of it, another might seize it without injustice. Thus also a vine or other tree might be said to be in common, as all were equally entitled to its produce; and yet any private individual might gain the sole property of the fruit, which he had gathered for his own repast. A doctrine well illustrated by Cicero, who compares the world to a great theatre, which is common to the public, and yet the place which any man has taken is for a time his own.

But when mankind increased in number, craft, and ambition, it became necessary to entertain conceptions of more permanent dominion; and to appropriate to individuals, not the immediate use only, but the very substance of the thing to be used. Otherwise innumerable tumults must have arisen, and the good order of the world been continually broken and disturbed, while a variety of persons were striving who should get the first occupation of the same thing, or disputing which of them had actually gained it. As human life also grew more and more refined, abundance of conveniences were devised to render it more easy, commodious, and agreeable; as habitations for shelter and safety, and raiment for warmth and decency. But no man would be at the trouble to provide either, so long as he had only an usufructuary property in them, which was to cease the instant that he quitted possession; if, as soon as he walked out of his tent, or pulled off his garment, the next stranger who came by would have a right to inhabit the one, and to wear the other. In the case of habitations in particular, it was natural to observe, that even the brute creation, to whom every thing else was in common, maintained a permanent property in their dwellings, especially for the protection of their young; that the

the birds of the air had nests, and the beasts of the field had caverns, the invasion of which they esteemed a very flagrant injustice, and would sacrifice their lives to preserve them. Hence a property was soon established in every man's house and home-stall; which seem to have been originally mere temporary huts, or moveable cabins, suited to the design of Providence for more speedily peopling the earth, and suited to the wandering life of their owners, before any extensive property in the soil or ground was established. And there can be no doubt, but that moveables of every kind became sooner appropriated than the permanent substantial soil; partly because they were more susceptible of a long occupancy, which might be continued for months together without any sensible interruption, and at length by usage ripened into an established right; but principally because few of them could be made fit for use, till improved and meliorated by the bodily labour of the occupant; which bodily labour, bestowed upon any subject which before lay in common to all men, is universally allowed to give the fairest and most reasonable title to an exclusive property therein.

The article of food was a more immediate call, and therefore a more early consideration. Such as were not contented with the spontaneous product of the earth, sought for a more solid refreshment in the flesh of beasts, which they obtained by hunting. But the frequent disappointments incident to that method of provision induced them to gather together such animals as were of a more tame and sequacious nature, and to establish a permanent property in their flocks and herds, in order to sustain themselves in a less precarious manner, partly by the milk of their dams, and partly by the flesh of the young. The support of these their cattle made the article of water also a very important point. And therefore the book of Genesis, the most venerable monument of antiquity, considered merely with a view to history, will furnish us with frequent instances of frequent contentions concerning wells, the exclusive property of which appears to have been established in the first digger or occupant, even in such places where the ground or herbage remained yet in common. Thus we find Abraham, who was but a sojourner, asserting his right to a well in the country of Abimelech, and exacting an oath for his security, "because he had digged that well." And Isaac, about 90 years afterwards, reclaimed this his father's property; and, after much contention with the Philistines, was suffered to enjoy it in peace.

All this while the soil and pasture of the earth remained still in common as before, and open to every occupant; except, perhaps, in the neighbourhood of towns where the necessity of a sole and exclusive property of lands (for the sake of agriculture) was earlier felt, and therefore more readily complied with. Otherwise, when the multitude of men and cattle had consumed every convenience upon one spot of ground, it was deemed a natural right to seize upon and occupy such other lands as would more easily supply their necessities. This practice is still retained among the wild and uncultivated nations, that have never been formed into civil states, like the Tartars and others in the East; where the climate itself, and the boundless extent of their territory, conspire to retain them still in the same savage state of vagrant liberty, which was universal in the earliest ages, and which Tacitus informs us continued among the Germans till the decline of the Roman empire. We have also a striking example of the same kind in the history of Abraham and his nephew Lot. When their joint subsistence became so great that pasture and other conveniences grew scarce, the natural consequence was, that a strife arose between their servants; so that it was no longer practicable to dwell together. This contention Abraham endeavoured to compose: "Let there be no strife, I pray thee, between thee and me. Is not the whole land before thee? Separate thyself, I pray thee, from me: If thou wilt take the left-hand, then I will go to the right; or if thou depart to the right-hand, then I will go to the left." This plainly implies an acknowledged right in either to occupy whatever ground he pleased, that was not pre-occupied by other tribes. "And Lot lifted up his eyes, and beheld all the plain of Jordan, that it was well watered every where, even as the garden of the Lord. Then Lot chose him all the plain of Jordan, and journeyed east; and Abraham dwelt in the land of Canaan."

Upon the same principle was founded the right of migration, or sending colonies to find out new habitations, when the mother-country was overcharged with inhabitants, which was practised as well by the Phenicians and Greeks, as the Germans, Scythians and other northern people. And, so long as it was confined to the stocking and cultivation of desert uninhabited countries, it kept strictly within the limits of the law of nature. But how far the seizing on countries already peopled, and driving out, or massacring, the innocent and defenceless natives, merely because they differed from their invaders in language, in religion, in customs, in government, or in colour; how far such a conduct was consonant to nature, to reason, or to Christianity, deserved well to be considered by those who have rendered their names immortal by thus civilizing mankind.

As the world, by degrees, grew more populous, it daily became more difficult to find out new spots to inhabit, without encroaching upon former occupants; and, by constantly occupying the same individual spot, the fruits of the earth were consumed, and its spontaneous produce destroyed, without any provision for a future sup-

ply or succession. It therefore became necessary to pursue some regular method of providing a constant subsistence; and this necessity produced, or at least promoted and encouraged, the art of agriculture; and the art of agriculture, by a regular connection and consequence, introduced and established the idea of a more permanent property in the soil than had hitherto been received and adopted. It was clear that the earth would not produce her fruits in sufficient quantities without the addition of tillage; but who would be at the pains of tilling it, if another might watch an opportunity to seize upon and enjoy the product of his industry, art, and labour? Had not, therefore, a separate property in lands, as well as moveables, been vested in some individuals, the world must have continued a forest, and men have been mere animals of prey; which, according to some philosophers, is the genuine state of nature. Whereas now (so graciously has Providence interwoven our duty and our happiness together) the result of this very necessity has been the ennobling of the human species, by giving it opportunities of improving its rational faculties, as well as of improving its natural. Necessity beget property: and in order to insure that property, recourse was had to civil society, which brought along with it a long train of inseparable concomitants; states, governments, laws, punishments, and the public exercise of religious duties. Thus connected together, it was found that a part only of society was sufficient to provide, by their mutual labour, for the necessary subsistence of all; and leisure was given to others to cultivate the human mind, to invent useful arts, and to lay the foundations of science.

The only question remaining is, How this property became actually vested; or what it is that gave a man an exclusive right to retain in a permanent manner that specific land, which before belonged generally to everybody, but particularly to nobody? And, as we before observed, that occupancy gave the right to the temporary use of the soil; so it is agreed upon all hands, that occupancy gave also the original right to the permanent property in the substance of the earth itself, which excludes every one else, but the owner, from the use of it. There is, indeed, some difference among the writers on natural law, concerning the reason why occupancy should convey this right, and invest one with this absolute property: Grotius and Puffendorf insisting, that this right of occupancy is founded upon a tacit and implied assent of all mankind, that the first occupant should become the owner; and Barbeyrac, Titius, Mr. Locke, and others, holding that there is no such implied assent, neither is it necessary that there should be; for that the very act of occupancy alone, being a degree of bodily labour, is from a principle of natural justice, without any consent or compact, sufficient of itself to gain a title. A dispute that favours too much of nice and scholastic refinement. However, both sides agree in this, that occupancy is the thing by which the title was, in fact, originally gained; every man seizing to his own continued use, such spots of ground as he found most agreeable to his own convenience, provided he found them unoccupied by any one else.

Property, both in lands and moveables, being thus originally acquired by the first taker, which taking amounts to a declaration that he intends to appropriate the thing to his own use, it remains in him, by the principle of universal law, till such time as he does some other act which shews an intention to abandon it; for then it becomes, naturally speaking, *publica juris* once more, and is liable to be again appropriated by the next occupant. So if one is possessed of a jewel, and casts it into the sea, or a public highway, this is such an express dereliction, that a property will be vested in the first fortunate finder that will seize it to his own use. But if he hides it privately in the earth, or other secret place, and it is discovered, the finder acquires no property therein; for the owner hath not by this act declared any intention to abandon it, but rather the contrary; and if he loses or drops it by accident, it cannot be collected from thence that he designed to quit the possession; and therefore in such case the property still remains in the loser, who may claim it again of the finder. And this, we may remember, is the doctrine of our law with relation to *TREASURE-TROVE*.

But this method of one man's abandoning his property, and another seizing the vacant possession, however well founded in theory, could not long subsist in fact. It was calculated merely for the rudiments of civil society, and necessarily ceased among the complicated interests, and artificial refinements, of polite and established governments. In these it was found, that what became inconvenient and useless to one man, was highly convenient and useful to another; who was ready to give in exchange for it some equivalent that was equally desirable to the former proprietor. This mutual convenience introduced commercial traffic, and the reciprocal transfer of property by sale, grant, or conveyance: which may be considered either as a continuance of the original possession which the first occupant had; or as an abandoning of the thing by the present owner, and an immediate successive occupancy of the same by the new proprietor. The voluntary dereliction of the owner, and delivering the possession to another individual, amount to a transfer of the property; the proprietor declaring his intention no longer to occupy the thing himself, but that his own right of occupancy shall be vested in the new acquirer. Or, taken in the other light, if I agree to part with an acre of my land to Titius, the deed of conveyance is an evidence of my intending

PRO

to abandon the property; and Titius, being the only or first man acquainted with such my intention, immediately steps in and seizes the vacant possession: thus the consent expressed by the conveyance, gives Titius a good right against me; and possession, or occupancy, confirms that right against all the world besides.

The most universal and effectual way of abandoning property, by the death of the occupant: when, both the actual possession and intention of keeping possession ceasing, the property, which is founded upon such possession and intention, ought also to cease of course. For, naturally speaking, the instant a man ceases to be, he ceases to have any dominion: else, if he had a right to dispose of his acquisitions one moment beyond his life, he would also have a right to direct their disposal for a million of ages after him; which would be highly absurd and inconvenient. All property must therefore cease upon death, considering men as absolute individuals, and unconnected with civil society: for then, by the principles before established, the next immediate occupant would acquire a right in all that the deceased possessed. But as, under civilized governments, which are calculated for the peace of mankind, such a constitution would be productive of endless disturbances, the universal law of almost every nation (which is a kind of secondary law of nature) has either given the dying person a power of continuing his property, by disposing of his possessions by will; or, in case he neglects to dispose of it, or is not permitted to make any disposition at all, the municipal law of the country then steps in, and declares who shall be the successor, representative, or heir of the deceased; that is, who alone shall have a right to enter upon this vacant possession, in order to avoid that confusion, which its becoming again common would occasion. And farther, in case no testament be permitted by the law, or none be made, and no heir can be found so qualified as the law requires, still, to prevent the robust title of occupancy from again taking place, the doctrine of escheats is adopted in almost every country; whereby the sovereign of the state, and those who claim under his authority, are the ultimate heirs, and succeed to those inheritances to which no other title can be formed.

The right of inheritance, or descent to the children and relations of the deceased, seems to have been allowed much earlier than the right of devising by testament. We are apt to conceive at the first view that it has nature on its side; yet we often mistake for nature what we find established by long and inveterate custom. It is certainly a wife and effectual, but clearly a political, establishment; since the permanent right of property, vested in the ancestor himself, was no natural, but merely a civil, right. It is true, that the transmissions of one's possessions to posterity has an evident tendency to make a man a good citizen and an useful member of society: it sets the passions on the side of duty, and prompts a man to deserve well of the public, when he is sure that the reward of his services will not die with himself, but be transmitted to those with whom he is connected by the dearest and most tender affections. Yet, reasonable as this foundation of the right of inheritance may seem, it is probable that its immediate original arose not from speculations altogether so delicate and refined, and, if not from fortuitous circumstances, at least from a plainer, and more simple principle. A man's children, or nearest relations, are usually about him on his death-bed, and are the earliest witnesses of his decease. They became, therefore, generally the next immediate occupants, till at length, in process of time, this frequent usage ripened into general law. And therefore also in the earliest ages, on failure of children, a man's servants, born under his roof, were allowed to be his heirs; being immediately on the spot when he died. For we find the old patriarch, Abraham, expressly declaring, that "since God had given him no seed, his steward Eliezar, one born in his house, was his heir."

While property continued only for life, testaments were useless and unknown; and when it became inheritable, the inheritance was long indefeasible, and the children or heirs at law were incapable of exclusion by will. Till at length it was found, that so strict a rule of inheritance made heirs disobedient and headstrong, defrauded creditors of their just debts, and prevented many provident fathers from dividing or charging their estates as the exigence of their families required. This introduced pretty generally the right of disposing of one's property, or a part of it, by testament; that is, by written or oral instructions properly witnessed and authenticated, according to the pleasure of the deceased; which we therefore emphatically style his will. This was established in some countries much later than in others. With us in England, till modern times, a man could only dispose of one-third of his moveables from his wife and children; and, in general, no will was permitted of lands till the reign of Henry VIII. and then only of a certain portion: for it was not till after the reformation, that the power of devising real property became so universal as at present.

Wills, therefore, and testaments, rights of inheritance, and successions, are all of them creatures of the civil or municipal laws, and, accordingly, are in all respects regulated by them; every distinct country having different ceremonies and requisites to make a testament completely valid; neither does any thing vary more than the right of inheritance under different national establishments. In England particularly, this diversity is carried to such a length, as if it had been meant to point out the power of the laws in regulating

PRO

the succession to property, and how futile every claim must be that has not its foundation in the positive rules of the state. In personal estates, the father may succeed to his children; in landed property, he never can be their immediate heir, by any the remotest possibility: in general, only the eldest son, in some places only the youngest, in others, all the sons together, have a right to succeed to the inheritance. In real estates, males are preferred to females; and the eldest male will usually exclude the rest; in the division of personal estates, the females of equal degree are admitted together with the males, and no right of primogeniture is allowed.

This one consideration may help to remove the scruples of many well-meaning persons, who set up a mistaken conscience in opposition to the rules of law. If a man disinherits his son, by a will duly executed, and leaves his estate to a stranger, there are many who consider this proceeding as contrary to natural justice; while others so scrupulously adhere to the supposed intention of the dead, that if a will of lands be attested by only two witnesses instead of three, which the law requires, they are apt to imagine that the heir is bound in conscience to relinquish his title to the devisee. But both of them certainly proceed upon very erroneous principles: as if, on the one hand, the son had by nature a right to succeed to his father's lands; or as if, on the other hand, the owner was by nature entitled to direct the succession of his property after his own decease. Whereas the law of nature suggests, that on the death of the possessor, the estate should again become common, and be open to the next occupant, unless otherwise ordered, for the sake of civil peace, by the positive law of society. The positive law of society, which is with us the municipal law of England, directs it to vest in such person as the last proprietor shall by will, attended with certain requisites, appoint; and, in defect of such appointment, to go to some particular person, who, from the result of certain local constitutions, appears to be the heir at law. Hence it follows, that, where the appointment is regularly made, there cannot be a shadow of right in any one but the person appointed; and, where the necessary requisites are omitted, the right of the heir is equally strong, and built upon as solid a foundation, as the right of the devisee would have been, supposing such requisites were observed.

But, after all, there are some few things, which, notwithstanding the general introduction and continuance of property, must still unavoidably remain in common: being such wherein nothing but an usufructuary property is capable of being had; and therefore they still belong to the first occupant, during the time he holds possession of them, and no longer. Such (among others) are the elements of light, air, and water; which a man may occupy by means of his windows, his gardens, his mills, and other conveniences; such also are the generality of those animals, which are said to be *fera natura*, or of a wild and untameable disposition; which any man may seize upon and keep for his own use or pleasure. All these things, so long as they remain in possession, every man has a right to enjoy without disturbance; but if once they escape from his custody, or he voluntarily abandons the use of them, they return to the common flock, and any man else has an equal right to seize and enjoy them afterwards.

Again, there are other things in which a permanent property may subsist, not only as to the temporary use, but also the solid substance; and which yet would be frequently found without a proprietor, had not the wisdom of the law provided a remedy to obviate this inconvenience. Such are forests and other waste grounds which were omitted to be appropriated in the general distribution of lands: such also are wrecks, elays, and that species of wild animals, which the arbitrary constitutions of positive law have distinguished from the rest by the well-known appellation of game. With regard to these and some others, as disturbances and quarrels would frequently arise among individuals contending about the acquisition of this species of property by first occupancy, the law has therefore wisely cut up the root of dissention, by vesting the things themselves in the sovereign of the state; or else in his representatives appointed and authorized by him, being usually the lords of manors.

The laws of England are, therefore, in point of honour and justice, extremely watchful in ascertaining and protecting the right of property. Upon this principle the great charter has declared, that no freeman shall be disseised or divested of his freehold, or his liberties, or free customs, but by the judgment of his peers, or by the law of the land. And by a variety of ancient statutes, viz. 5 Edw. III. cap. 9; 25 Edw. III. stat. 5, cap. 4; 28 Edw. III. cap. 3; it is enacted, that no man's lands or goods shall be seized into the king's hands against the great charter, and the law of the land; and that no man shall be disinherited, nor put out of his franchises or freehold, unless he be duly brought to answer, and be forejudged by course of law; and if any thing be done to the contrary, it shall be redressed, and holden for none. So great is the regard of the law for private property, that it will not authorize the least violation of it; no, not even for the general good of the whole community.

The objects of dominion or property are things, as contradistinguished from persons; and things are, by the law of England, distributed into two kinds, viz. things real, and things personal. Things real, are such as are permanent, fixed, and immoveable, which cannot be carried out of their place, as lands, tenements, and hereditaments of all kinds; things personal are goods, money, and

and all other moveables which may attend the owner's person wherever he thinks proper to go: Hence property is divided into personal and real. And thus our legislature has universally promoted the grand ends of civil society, the peace and security of individuals, by steadily pursuing that wise and orderly maxim, of assigning to every thing capable of ownership a legal and determinate owner.

LITERARY PROPERTY. See LITERARY.

PROPHECY, ΠΡΟΦΗΤΕΙΑ, a prediction, made by divine inspiration. One of the strongest evidences for the truth of revealed religion is that series of prophecies which is preserved in the Old and New Testament; and a greater service, says an excellent writer, could not be done to Christianity than to lay together the several predictions of scripture with their completions, to shew how particular things have been foretold, and how exactly fulfilled. A work of this kind was desired by the lord Bacon (vide de Augmentis Scientiarum, lib. ii. cap. 11) and he entitles it the History of Prophecy, in which he proposes, that every prophecy of the scripture be sorted with the event fulfilling the same throughout the ages of the world, both for the better confirmation of faith, and for the better illumination of the church, touching those parts of prophecies which are yet unfulfilled; allowing, nevertheless, that latitude which is agreeable and familiar unto divine prophecies, being of the nature of the author with whom a thousand years are but as one day, and therefore they are not fulfilled punctually at once, but have springing and germinant accomplishment throughout many ages, though the height or fulness of them may refer to some one age. A work of this kind has been actually executed by the learned bishop Newton, in his Dissertation on the Prophecies.

With regard to the credibility of prophecy, it may be observed in general, that it is not at all incredible that God should upon special occasions foretell future events; and, if he affords an extraordinary revelation of his will to mankind, that he should attest it by divine original by this kind of evidence; an evidence, which, if the prophecies point to the events, and the events correspond with the prophecies, is in the highest degree conclusive and convincing. No previous conjectures nor accidental coincidence are sufficient to counteract and invalidate this kind of evidence.

As to most of the scripture prophecies, they comprehend such a variety of particulars; they so minutely describe distant events, to be accomplished in circumstances which no human sagacity could foresee or conceive likely to occur; and they accord so exactly with the facts to which they refer, that there is no way of evading the conclusion, but by either denying the premises that such prophecies were ever delivered and recorded, against which fact or history militate, or by pretending that what we call predictions are only histories written after the events had happened, in a prophetic style and manner. But it is alleged, in answer to this absurd plea, that there are all the proofs and authorities, which can be had in cases of this nature, that the prophets prophesied in one age, and that the events happened in another and subsequent age: and we have as much reason to believe these, as we have to believe any ancient matter of fact whatever; and by the same rule which leads us to deny these, we may as well controvert and contradict the credibility of all ancient history: but, besides, Christian writers undertake to prove the truth of prophecy, and consequently the truth of revelation, not by an induction of particulars long ago foretold and long ago fulfilled, the predictions of which may be supposed to have been written after the histories; but by instances of things which have confessedly many ages ago been foretold, and have in these later ages been fulfilled, or are fulfilling at this very time; so that there is no pretence for asserting such prophecies to have been written after the events: but it must be acknowledged that the events many ages after correspond exactly with the predictions many ages before.

Dr. Stanhope laments the loss of the Jewish traditions or rules for interpreting Scripture received among the rabbins, and followed by the apostles. But this loss, Surenhusius, Hebrew professor at Amsterdam, thinks he has retrieved from the Jewish Talmud, and the ancient Jewish commentaries; and has accordingly published to the world the rules whereby the apostles quoted the Old Testament. But these rules are too precarious, strained, and unnatural, to gain much credit.

Mr. Whiston condemns all allegorical explanations of the prophecies of the Old Testament cited in the New, as weak, enthusiastic, &c.; and adds, that if a double sense of the prophecies be allowed, and there be no other method of shewing their completion than by applying them secondarily and typically to our Lord, after having been in the first and primary intention long ago fulfilled in the times of the Old Testament, we lose all the real advantages of the ancient prophecies, as to the proofs of Christianity. He therefore sets up a new scheme in opposition thereto: he owns, that taking the present text in the Old Testament for genuine, it is impossible to expound the apostles' citations of the prophecies of the Old Testament on any other than the allegorical foundation; and therefore, to solve the difficulty, he is forced to have recourse to a supposition contrary to the sense of all Christian writers before him, viz. that the text of the Old Testament has been greatly corrupted since the apostolic age, by the Jews. His hypothesis is, that the apostles made their quotations out of the Old Testament, rightly

and truly from the Septuagint version, which in their time was in vulgar use, and exactly agreed with the Hebrew original; and that as they made exact quotations, so they argued justly and logically from the obvious and literal sense of the said quotations, as they then stood in the Old Testament; but that, since their times, both the Hebrew and Septuagint copies of the Old Testament have been so greatly corrupted, and so many apparent disorders and dislocations introduced therein, as to occasion many remarkable differences and inconsistencies between the Old and New Testament in respect to the words and sense of those quotations.

As to the manner wherein these corruptions were introduced, he says, the Jews, in the second century, greatly corrupted and altered both the Hebrew and Septuagint, especially in the prophecies cited by the apostles, to make their reasoning appear inconclusive: that, in the third century, they put into Origen's hand one of these corrupted copies of the Septuagint; which Origen mistaking for genuine, inserted in his Hexapla, and thus brought into the church a corrupted copy of the Septuagint; and that, in the end of the fourth century, the Jews put into the hands of the Christians, who, till then, had been almost universally ignorant of the Hebrew, a corrupted copy of the Hebrew Old Testament. The disagreement, then, between the Old and New Testament, in respect to the said quotations, he contends, has no place between the genuine text of the Old Testament (now no where existing) but only between the present corrupted text of the Old and New Testament; and therefore, to justify the reasonings of the apostles, he proposes to restore the text of the Old Testament, as it stood before the days of Origen, and as it stood in the days of the apostles; from which text, thus restored, he doubts not, it will evidently appear, that the apostles cited exactly, and argued justly and logically, from the Old Testament. But this scheme of accomplishing prophecies labours under difficulties at least as great as the allegorical scheme. Its foundation is incredible, and its superstructure, from first to last, precarious. In effect, it is inconceivable that the Old Testament should be so corrupted; and it may be even made appear, that the Hebrew and Septuagint disagreed in the times of the apostles: add to this, that the means whereby he proposes to restore the true text, will never answer that end; nor has he himself, from all the means he is yet possessed of, been able to restore one prophetic citation, so as to make that seem literally, which before only seemed allegorically applied.

PROPHET, in general, a person who foretells future events; but is particularly applied to such inspired persons among the Jews as were commissioned by God to declare his will and purposes to that people. Among the canonical books are those of sixteen prophets; four of which are denominated the *greater prophets*, viz. Isaiah, Jeremiah, Ezekiel, and Daniel; so called from the length or extent of their writings, which exceed those of the others; viz. Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Haggai, Zechariah, and Malachi; who are called the *lesser prophets*, from the shortness of their writings. The writings of the prophets form one of the three divisions of the Canon of the Old Testament; and to those already enumerated, called the books of the latter prophets, are added those of the former prophets; viz. Joshua, Judges, Samuel, and Kings. The Jews only reckon three greater prophets: Daniel they exclude, as no more to be ranked among the prophets than David: not but that both the one and the other foretold many important things, but because their manner of life differed from that of the other prophets; David being a king, and Daniel a peer. In the Greek church, the lesser prophets are placed in order before the great ones; apparently because many of the lesser prophets are more ancient than the greater. Among the Greeks, too, Daniel is ranked among the lesser prophets. In the forty-eighth chapter of Ecclesiasticus, Isaiah is particularly called the great prophet; both on account of the great things he foretold, and the magnificent manner wherein he did it. Spinoza says, the several prophets prophesied according to their respective humours, Jeremiah, *e. gr.* melancholy and dejected with the miseries of life, prophesied nothing but misfortunes. Dacier observes that among the ancients, the name poet is sometimes given to prophets; as that of prophet is, at other times, given to poets.

PROPIATION, in religion, a sacrifice offered to God, to assuage his wrath, and render him propitious. Among the Jews, there were both ordinary and public sacrifices, as holocausts, &c. offered by way of thanksgiving; and extraordinary ones offered by particular persons guilty of any crime, by way of propitiation. The Romish church believe the mass to be a sacrifice, of propitiation, for the living and the dead. The reformed churches allow of no propitiation, but that one offered by Jesus Christ on the cross.

PROPIATION also gives the name to a solemn feast among the Jews, celebrated on the tenth of the month Tifri, which is their seventh month, and answers to our September. It was instituted to preserve the memory of the pardon proclaimed to their forefathers by Moses on the part of God; who thereby remitted the punishment due for their worship of the golden calf.

PROPIIATORY, among the Jews, was the cover or lid of the ark of the covenant; which was lined both within and with outside with plates of gold; inasmuch that there was no wood to be seen. Some even take it to have been one piece of massive gold. The cherubims spread their wings over the propitiatory. This

propitiatory was a type or figure of Christ, whom St. Paul calls the propitiatory ordained from all ages. See *ARK* of the Covenant.

PROPOLIS, *Προπολιν*, a thick yellow odorous substance, smelling like storax, nearly akin to wax, but more tenacious; wherewith the bees stop up the holes and crannies of their hives, to keep out the cold air, &c. These wary animals not only stop up in this manner all the cracks they can find, but even examine all the weak places of the hive, and will eat away a rotten or too weak part, and make up the deficiency with this propolis. This was elegantly seen in the case of some of Mr. Reaumur's glass hives, which were framed of wood, and had squares of glass in the proper places: these squares of glass were fastened in with slips of pasted paper. The bees finding this a much weaker part of the hive than any other, and capable of being eaten through by their enemies, soon gnawed to pieces all the paper and paste, and covered those parts with the propolis in the place of that matter.

PROPORTION, *Proportio*, in arithmetic, the identity or similitude of two ratios. Proportion is frequently confounded with ratio; yet have two, in reality, very different ideas, which ought by all means to be distinguished. Ratio is, properly, that relation or habitude of two things, which determines the quantity of one from the quantity of another, without the intervention of any third; thus we say, the ratio of 5 and 10 is 2; the ratio of 12 and 24 is 2. Proportion is the sameness or likeness of two such relations; thus the relations between 5 and 10, and 12 and 24, being the same, or equal, the four terms are said to be in proportion. Hence ratio exists between two numbers; but proportion requires at the least three. See the *System*, under the article *Single Rule of Three*.

Arithmetical PROPORTION, is the equality of difference between three or more several quantities.

Geometrical PROPORTION, is the equality of two geometrical ratios, or comparisons of two couples of quantities. Thus, 4 : 8 :: 12 : 24, are in geometrical proportion; the ratio of 4 and 8 being equal to that of 12 and 24; i. e. 4 is contained as often in 8, as 12 is in 24. Again, 9, 3, 1, are in geometrical proportion, 9 being triple of 3, as 3 is of 1. A series of progression of more than four geometrical proportionals is called a geometrical progression. See the *System*, Art. XXI.

Harmonical or Musical PROPORTION, is a third kind of proportion formed out of the other two, thus; of three numbers, if the first be to the third as the difference of the first and second to the difference of the second and third; the three numbers are in harmonical proportion. Thus, 2, 3, 6 are harmonical, because 2 : 6 :: 1 : 3. So also four numbers are harmonical, when the first is to the fourth as the difference of the first and second to the difference of the third and fourth. See the *System* of ARITHMETIC, Art. XII. Chap. XIX.

PROPORTION, in architecture, denotes the just magnitude of the members of each part of a building, and the relation of the several parts to the whole; e. g. of the dimensions of a column, &c. with regard to the ordonnance of the whole building. See the *System*, on the Orders of ARCHITECTURE in general.

PROPORTION, in drawing, is the just magnitude of the several members of a figure, a groupe, &c. with regard to one another, to the whole figure, the groupe and the entire piece. Proportion makes one of the most important articles in the art of drawing. For an ample description of which, see the *Treatise* on DRAWING, Sect. III. and the three Plates which illustrate it.

Rule of PROPORTION, in arithmetic, a rule whereby we find a fourth proportional to three numbers given. This is popularly called the golden rule, and sometimes the rule of three. See the *System*, under the *RULE of THREE*, Chap. VII.

PROPORTIONALS, in geometry, are quantities, either linear or numeral, which bear the same ratio, or relation to each other. See the *System*, Sect. IV.

PROPOSITION, *Propositio*, in logic, part of an argument, wherein some quality, either negative or positive, is attributed to a subject. See the *System*, Part II. Sect. II. III. and IV.

PROPOSITION, in mathematics, is either some truth advanced and shewn to be such by demonstration; or some operation proposed, and its solution shewn. If the proposition be deduced from several theoretical definitions compared together, as this: a parallelogram is double of a triangle, standing on the same base, and of the same altitude; it is called a theorem. If it be deduced from a praxis or series of operations, it is called a problem; as to find a third proportional to two given quantities.

PROPOSITION, in oratory, is that part of a just and regular discourse, in which the speaker lays down or proposes the subject upon which he designs to treat, in a distinct and express manner. See the *Article* NARRATION, and the *Treatise* on ORATORY, Part II. Sect. II.

PROPRIETY, in grammar, is where the direct and immediate signification of a word agrees to the thing it is applied to. In which sense propriety is used in opposition to a figurative or remote signification. See the *Treatise*, Sect. I throughout.

PROROGATION, *Prorogatio*, the act of prolonging, adjourning, or putting off to another time.

PROROGATION of Parliament. See *PARLIAMENT*.

PROSE, *Prosa*, the natural language of mankind, loose, and unconfined by poetical measures, rhymes, &c. In which sense it

stands opposed to verse. Though prose had its connections, which sustain it, and a structure which renders it numerous, it ought still to appear free; its character consists in running easy, and unrestrained. Poets very rarely have the talent of prose; the habit of wearing chains sits fast upon them, even when the chains are off. St. Evremont compares prose-writers to foot-travellers, who walk with less noise, but more security, than the cavaliers.

PROSELYTE, *Profelytus*, a new convert to the faith. The term was much used in the primitive church. The Jews, too, had their proselytes, who, from being Gentiles, embraced Judaism.

PROSERPINE, in mythology, the daughter of Jupiter and Ceres, wife of Pluto, stolen by him out of Sicily, and carried to his subterranean dominion, where she was the partner of his empire. The poets and painters represent her with a dark complexion, and a melancholy air in her face. Statius Theb. 8. v. 11, assigns her the employment of keeping a register of the dead, and marking down all that should be added to that number. He also says, lib. 5, Sylv. 1, v. 257, that when any woman dies, who has been a remarkably good wife in this world, *Proserpine* prepares the spirits of the best women in the other to make a procession to welcome her into Elysium with joy, and to strew all the way with flowers, where she is to pass.

PROSODY, *Profodia*, that part of grammar which teaches and directs the pronunciation and manner of rehearsal; marks the accents; and distinguishes the long and short syllables. The English prosody turns chiefly on two things; numbers, that is, a certain number of feet or syllables; and rhyme, or a similitude of sound between the last syllables of words. See the *Articles*, *NUMBERS*, and *RHYME*.

PROSOPOPEIA, *Προσωποποιεα*, formed from *προσωπον*, person, and *ποιεω*, I make, or feign; in rhetoric, a figure, whereby we make persons that are absent, or dead, or even things which are inanimate, as cities, &c. to speak. The poets, in their fictions, make frequent use of the prosopopeia; as also do the orators in their painting of violent passions, which seem to transport, and make them forget themselves.

PROSTATE, *Προσταται*, in anatomy, two white spongy, glandulous bodies, situate at the root of the penis, or just below the neck of the bladder, and about the size of walnuts. See the *System*, Part III. Sect. XV. and for representation, Plate X. fig. 1, Letter E.

PROTECTOR, a person who undertakes to shelter and defend the weak, helpless, or distressed. God, and the magistrate, are the protectors of the widow and orphan. Among the heathens, Minerva was esteemed the protectress of arts. Every catholic nation, and every religious order, has a protector residing at the court of Rome, who is cardinal, and is called the cardinal protector.

PROTECTOR, is sometimes also used for a regent of a kingdom, made choice of to govern it during the minority of a prince. Cromwell assumed the title and quality of *lord protector of the commonwealth of England*.

PROTEST, in law, is used for a caution, or call of witness, or an open affirmation, that a person does, either not at all, or but conditionally, yield his consent to any act; or to the proceeding of any judge in a court, wherein his jurisdiction is doubtful; or to answer upon his oath farther than by law he is bound. Any of the lords in parliament have a right to protest their dissent to any bill passed by a majority; which protest is entered in form. This privilege is said not to be very ancient: the commons have no right to protest.

PROTEST, in commerce, is a summons made by a notary public to a merchant, banker, or the like, to accept or discharge a bill of exchange drawn on him; after his having refused either to accept or pay the same. It is called a protest, because it contains a protestation, that the party will return the bill, and even take up money at interest; and charge all costs, damages, carriage, and recarriage, on the refuser. There are two kinds of protests, the one for want of acceptance, and the other for want of payment. The first is to be made by the bearer of the bill, at the time of presenting it, in case the person on whom it is drawn refuses to accept it for the time, or the sum there expressed. The latter is made as the bill falls due, whether it has been accepted or not. The bearers of bills of exchange that have been accepted, or which become payable at a certain day, are obliged to have them either paid or protested within three days after due, on the penalty of answering for the omission. And it must be observed, that if the third day happen to be a holiday, the protest is to be made on the eve thereof.

PROTESTANT, a name first given in Germany to those who adhered to the doctrine of Luther; because, in 1529, they protested against a decree of the emperor Charles V, and the diet of Spire; and declared, that they appealed to a general council. The name has been since also given to those who adhere to the sentiments of Calvin; and is now become a common denomination applied indiscriminately to all the sects, of whatever denomination, which have revolted from the Roman see.

PROTESTANT Dissenters. See *DISSENTERS*, *NONCONFORMISTS*, and *PURITANS*.

PROTHONOTARY, *Prothonotarius*, *Protonotary*, a term properly signifying *first notary*; and which was anciently the title of the principal notaries of the emperors of Constantinople.

With us, prothonotary, called also preignotary, is used for an officer in the court of king's bench, and common pleas; the latter whereof has three, the former one.

PROTHONOTARY of the King's Bench, records all actions civil, filed in that court; as the clerk of the crown-office doth in all criminal causes.

PROTHONOTARIES of the Common Pleas, enter and enrol all declarations, pleadings, assizes, judgments, and actions: they also make out all judicial writs, as the venire facias, after issue joined; except habeas corpus, and distringas jurator, for which there is a separate office; writs of execution and seisin, of superseatas, of privilege, &c. they enrol all recognizances acknowledged in that court, all common recoveries, make exemplifications of records, &c.

PROTRACTOR, a name of an instrument used in surgery, to draw out any foreign or disagreeable bodies from a wound or ulcer, in like manner as the forceps.

PROTRACTOR, is also an instrument used in surveying, whereby the angles taken in the field with a theodolite, circumferentor, or the like, are plotted, or laid down, on paper.

PROVERB, according to Camden, is a concise, witty, and wise speech, grounded upon experience, and for the most part containing some useful instructions.

Book of PROVERBS, a canonical book of the Old Testament, containing a part of the proverbs of Solomon the son of David king of Israel. The first 24 chapters are acknowledged to be the genuine work of that prince; the next five chapters are a collection of several of his proverbs, made by order of king Hezekiah; and the two last seem to have been added, though belonging to different and unknown authors, Agur the son of Jakeh; and king Lemuel. In this excellent book are contained rules for the conduct of all conditions of life: for kings, courtiers, masters, servants, fathers, mothers, children, &c.

PROVIDENCE, *Providentia*, the conduct and direction of the several parts of the universe, by a superior intelligent Being. The notion of a providence is very ancient, even in the heathen theology; we find Thales mentions it. It is founded on this supposition, that the Creator has not so fixed and ascertained the laws of nature, nor so connected the chain of second causes, as to leave the world to itself: but that he still preserves the reins in his own hands, and occasionally intervenes, alters, restrains, enforces, suspends, &c. those laws, by a particular providence. Some use the word providence in a more general sense, signifying by it that power or action whereby the several parts of the creation are ordinarily directed.

The Epicureans deny any divine providence, as thinking it inconsistent with the ease and repose of the divine nature, to meddle at all with human affairs. Others deny the existence of a providence, from the seemingly unjust distribution of good and evil; which appears to fall indiscriminately on the just and unjust. Simplicius argues thus for a providence: if God does not look to the affairs of the world, it is either because he cannot, or will not; but the first is absurd, since, to govern cannot be difficult where to create was easy; and the latter is both absurd and blasphemous. See **GOD**.

The sentiments of Cicero are likewise very precise and pertinent to this purpose. He thinks it impossible for one who duly considers the innumerable objects of the universe, and their invariable order and beauty, to entertain the least doubt, but that there is some efficient cause who presides over and directs the mighty fabric. Nay, he lays it down as a fundamental principle of all societies, that there is a divine providence, which directs all events, observes the actions of mankind, whether good or bad, discerns the very intentions of the heart, and will certainly make a difference between good men and the wicked.

PROVINCE, a canton, or division, of a kingdom or commonwealth, comprehending several cities, towns, &c. all under the same government; and usually distinguished by the extent either of the civil or ecclesiastical jurisdiction. The provinces were anciently duchies, counties, &c. which have been since all reunited under the same chief. The church distinguishes its provinces by archbishoprics, each containing a certain number of bishoprics. In this sense England is divided into two provinces, Canterbury and York. The United Provinces are the seven northern provinces of the Low Countries; which, revolting from the Spanish dominion, made a firm and perpetual alliance, offensive and defensive, at Utrecht, in the year 1579.

PROVINCIAL, *Provincialis*, something relating to a province. Thus we say a provincial council or synod, &c. See **SYNOD**.

PROVOCATIVE, in physic, a medicine which strengthens nature, and stimulates or incites to venery. Such are cantharides, saurian, &c.

PROVOST, is the chief municipal magistrate in several considerable trading cities; particularly Edinburgh, Paris, and Lyons, which is much the same with the mayor in other places. The provost presides at the city-courts, and, together with the sheriffs, or bailiffs, decides all differences relating to trade and merchandise: he takes cognizance of the affairs of officers of policy of the city with regard to their functions; of the delinquencies of merchants, commissioners, and factors; inspects the ports, rivers, duties, imposts, &c. The provost of Edinburgh has the title of lord; the bailiffs are his deputies. He calls conventions of the boroughs by his own missives.

PROXIMITY, *Proximitas*, denotes the relation of nearness, either in respect of place, blood, or alliance.

PROXY, *Procurator*, a deputy, or person who officiates in the room of another. Princes are usually married by proxies, or representatives. Peers are allowed to give their votes by proxies.

PROXY, *Procuracy*, among civilians, also denotes a commission given to a proctor, by a client, to manage a cause in his behalf.

PRUNES, *Pruna*, are plums, dried or baked in an oven, or in the sun. Three sorts of this fruit are ranked among the articles of the materia medica: The French prunes and damsons are the most emollient, lubricative, and laxative; they are taken by themselves for gently loosening the belly in colic habits, and where there is a tendency to inflammation; decoctions of them afford an useful basis for laxative or purging mixtures, and the pulp in substance for electaries.

PRUNING, in gardening and agriculture, the operation of lopping or cutting off the superfluous branches of trees; either to dispose them to bear better, to grow higher, or to appear more regular. Pruning is one of the most important branches of the gardener's province, and that whereon the thriving or barrenness of his fruit-trees, as well as the form and regularity of his garden, in a great measure depends. For the most approved methods of pruning the different fruit-trees, see the **System of GARDENING**, under the article **FRUIT-GARDEN**, months of *January, March, May, and July*.

PRURITUS, a painful, and yet pleasurable kind of sensation of the skin, popularly called itching; which is supposed to arise hence, that the extremities of the capillary veins being obstructed, cannot take up the redundant blood of the limbs, to carry it back again to the heart; whence, as there is a fresh flock of blood continually sent into the part by the incessant pulsation of the heart, the fibres become preternaturally stretched or distended, and hence the usually titillating sense of itching.

PSEUDO, a term or particle, used in the composition of divers Latin and English words; in the sense of false or spurious. The word is formed from *ψευδς*, *lie, falsehood*, of *ψευδω*, *I deceive*. We say a *pseudo-martyr*, q. d. *a false witness*; *pseudo-prophet*, *pseudo-apostle*, *pseudo-christ*, &c.

PSITTACUS, in ornithology, a genus belonging to the order *Pica*. The beak is hooked, the superior mandible being furnished with a moveable wax; the nostrils are placed at the base of the beak; the tongue is fleshy, blunt, and entire; and the feet are fitted for climbing. There are 45 species, distinguished by their colour and the length of their tails. This genus includes the parrot kind, which are all natives of warm climates. The parrot is a well known bird, of which there are several very beautiful kinds. Its head is large, and beak and skull extremely hard and strong. It might seem a wonder why nature has destined to this, which is not naturally a bird of prey, but feeds on fruit and vegetable substances, the crooked beak allotted to the hawk and other carnivorous birds: but the reason seems to be, that the parrot being a heavy bird, and its legs not very fit for service, it climbs up and down trees by the help of this sharp and hooked bill, with which it lays hold of any thing, and secures itself before it flirs a foot; and besides this, it helps itself forward very much, by pulling its body on with this hold.

Of all animals, the parrot and crocodile are the only ones which move the upper jaw; all creatures else moving the lower only. As some particular animals beside are fond of particular foods, so the parrot loves nothing so much as the seeds of the carthamus, or bastard-saffron; and eats them without any hurt, though they are a purge when given to other creatures. The parrots are common both in the East and West Indies; they are a brisk and lively bird in the warmer countries; but with us lose much of their vigour. They lay two or three eggs in the hollow of a tree. In all the known parrots the nostrils are round, and placed very high upon the beak, and very near to one another.

Parrots are divided into three kinds: 1. The larger, which are as big as a moderate fowl, called *macaos*, *cockatoos*; these have very long tails. 2. The middle-sized ones, commonly called parrots, which have short tails, and are a little larger than a pigeon. And, 3. The small ones, which are called *paroquets*, and have long tails, and are not larger than a lark or blackbird. For representation, see Plate I. Genus 5.

PSOAS Magnus, or *Lumbaris*, in anatomy, a round, hard, fleshy muscle, which arises from the internal side of the transverse processes of the vertebræ of the loins, within the abdomen, and descending upon part of the internal side of the ilium, is inserted in the lower part of the little trochanter. It is the first of the flexors of the thigh. For the origin, insertion, and use, see the **System**, Sect. XIII.

PSOAS Parvus, arises fleshy from the inside of the upper vertebræ of the loins, and hath a thin and broad tendon, which embraces the *psaos magnus*; and which is inserted into the os innominatum, where the os pubis and ilium join together. This, though ordinarily reckoned among the muscles of the thigh, properly belongs to the lower venter. For origin, insertion, and use, see the **System**, Sect. XIII.

PSOROPHTHALMIA, *Ψωροφθαλμία*, formed from *ψωρο*, *itch*, and *οφθαλμος*, *eye*, a scurfy eruption of the eyebrows, attended with a pruritus, or itching of the part, or an inflammation and ulceration of

of the edges of the eye-lids. Mr. Ware, in his Remarks on the Ophthalmia, Pterophthalmia, and Purulent Eye, 1780, proposes for the cure of this disorder the unguentum citrinum of the Edinburgh dispensatory, applied to the parts, either with the finger or a small brush of camel's hair. He has exemplified the utility of this application by the relation of several cases.

PSYCHOLOGY, *ψυχολογία*, formed from *ψυχή*, soul, and *λογος*, discourse; the doctrine of the soul. Anthropology, or the science which considers man, consists of two parts; the first treating of the body, and the parts belonging thereto, called anatomy; and the second of the soul, called psychology.

PTERYGOIDEUS Major, or *Internus*, in anatomy, is a muscle that lies on the inside of the lower jaw, almost in the same manner that the masseter does on the outside, and is of the same figure with that muscle, only smaller and narrower. For origin, insertion, and use, see the System, Part III. Sect. XI.

PTERYGOIDEUS Minor, or *Externus*, an oblong small fleshy muscle, situated almost horizontally between the outside of the apophysis pterygoidea, and the condyloide apophysis of the lower jaw, the subject being considered in an erect posture. For origin, &c. see the System, Part III. Sect. XI.

PTERYGOPHARYNGÆI, a pair of muscles arising from the processus pterygoidei, where the tendon of the pterygostaphylinus is reflected. Some fleshy fibres of them do likewise arise from the upper jaw-bone, behind the farthest grinder, and some from the sides of the tongue, and os hyoides. For origin, insertion, and use, see the System, Sect. XI.

PTINUS, in the system of entomology, a genus of insects of the coleoptera order. For description and classification, see the System, Order I. Genus 4.

PTISAN, *Πτισαν*, in medicine, a cooling potion usually made of barley boiled in water, and sweetened with liquorice, &c. To these are sometimes added the roots of quick-grass, and sometimes fenna, to render it laxative. Most of the decoctions of physicians are called ptisans. Feverish patients are prohibited wine, &c. and reduced to ptisans.

PTYALISM, *Πτυαλισμός*, formed from *πτύω*, spuo, *exspuo*, I spit, in medicine, a spitting, or a discharge of saliva by the glands of the mouth: whether it amount to an absolute salivation, or not.

PUBERTY, *Pupertas*, in the civil law, a natural majority, or the age wherein a person is allowed to contract marriage. Boys arrive at puberty at fourteen years of age, maids at twelve. Full puberty is accounted at eighteen.

Dr. Kramur observes, that all boys at the time of puberty, between twelve and fourteen years of age, complain of uneasiness at their breasts, which are swelled and itchy, the nipples and areolæ round them inflaming with pain, and sometimes excoriation and exulceration of some of the lactiferous ducts. The best remedy for which, he says, is to press out the white serum then contained in them, after which they cure with a bit of plaster. By the law of Scotland, persons under puberty, or under the years of discretion, are capable of committing the higher crimes, which being contrary to the law of nature, are obvious. But they are not chargeable with smaller offences, arising from positive law or statute.

PUBES, a term used for the external parts of the pudenda, or parts of generation in both sexes. This, from the age of puberty, is supposed to be covered, more or less, with hair; whence the name.

PUBIS (os), or *Os PECTINIS*, in anatomy, a bone of the hips, situate in the fore and middle part of the trunk, and making the lower and inner part of the os innominatum. See the System, Part II. Sect. II. and Plate I. Fig. 1. Letter h.

PUBLICAN, *Publicanus*, among the Romans, a person who farmed the imposts, taxes, and public revenues. These publicans are distinguished by Sigonius into three sorts of degrees, the farmers of the revenues, their partners, and their securities: in which he follows Polybius. These are called the Mancipes, Socii, and Prædes, who were all under the Quæstores Aerarii, that presided over the finances at Rome. But there were properly only two sorts of publicans, the Mancipes and the Socii. The former called by the Greeks *εργησιλωναυ*, were much superior to the common publicans in dignity, being mostly of the equestrian order: so they were generally in their moral character. Cicero mentions them with great respect and honour; *flos*, says he, *equitum Romanorum, ornamentum civitatis, firmamentum reipublicæ, publicanorum ordine continetur*. Orat. pro Plancio, apud Opera, vol. v. sect. 9. p. 544. Olivet edit. He likewise calls them *ordinem mihi commendatissimum*. Epist. Fam. lib. xiii. epist. 10 Oper. vol. vii. p. 442. epist. 9. and epist. ad Attic. lib. i. epist. 17. vol. viii. p. 80.

But as for the common publicans, the collectors or receivers, as many of the Socii were, they are spoken of with great contempt, by Heathens as well as Jews; and particularly by Theocritus, who said, that among the beasts of the wilderness, bears and lions are the most cruel; among the beasts of the city, the publican and parasite. The reason of this general hatred was, without doubt, their rapine and extortion. For having a share in the farm of the tribute, at a certain rate, they were apt to oppress the people with illegal exactions, to raise as large a fortune as they could for themselves. Besides, publicans were particularly odious to the Jews,

who looked upon them to be the instruments of their subjection to the Roman emperors; to which they generally held it sinful for them to submit. So that paying tribute to the Roman emperor, they looked upon to be a virtual acknowledgment of his sovereignty. This was, therefore, a peculiar grievance, and created an aversion to the collectors, as the instruments of illegal oppression, apart from all consideration of their rapacious practices. Moreover, the Jews, who accepted the office of publicans, were on that account hated of their own nation equally with Heathens; and according to the rabbies it was a maxim, a religious man, who becomes a publican, is to be driven out of the society of religion.

PUBLICATION, *Publicatio*, the act of promulgating, or making a thing known to the world. By the canons, publication is to be made of the banns of marriage three times before the ceremony can be solemnized; without especial licence to the contrary. See MARRIAGE.

PUCERON, the English name given by naturalists to the Aphid, a small insect of a peculiar nature, frequently found on the young branches of trees and plants, often in such clusters as wholly to cover them.

The puceron is a small animal, but very numerous in the several genera and species; inasmuch that Reaumur has observed that there is scarce a vegetable to be found, either in the fields or gardens, that has not its peculiar species of puceron to feed on its juices. M. de la Hire, of the Paris Academy, has left many curious particulars in regard to these animals in the memoirs of the year 1703; and Mr. Leewenhoeck, and others since, have given figures and descriptions of several of the species. See the article APHIS, and the System of ENTOMOLOGY, Order II. Genus 39.

PUDENDUM, denotes a thing to be ashamed. Hence, *pudendum virile*, and *pudendum muliebre*. See the System of ANATOMY, Part III. Sect. II. Part V. Sect. XII. and Plate 10.

It is remarkable, that among the fish-tribe, all that are oviparous have no pudenda, properly speaking; that is they have no penis or vulva, unless the ovaria of the females, and the viculæ feminales of the males, may be called by that name. The viviparous fish, on the other hand, as the cetaceous fish in particular, and many kinds of the cartilaginous, have the penis and vulva, distinctly so called.

PUFFIN, in ornithology, the English name of the genus *Procellaria*. See PROCELLARIA.

PULEX, in entomology, a genus of insects. For description and classification, see the System, Order VII. Genus 77.

PULLEY, in mechanics, one of the five mechanical powers: consisting of a little wheel or rundle, having a channel around it, and turning on an axis, serving by means of a rope which slides in its channel, for the raising of weights. For a full description of the construction and uses of this mechanical power, see the System, Sect. III. For representation, see Plate II. Fig. 3, 7, 5, 1, and Plate III. Fig. 4.

PULMONARY Vessels, in anatomy, are those which carry the blood from the heart to the lungs, and back again from the lungs to the heart. There are two in number; viz. the *pulmonary artery* and *vein*. The *pulmonary artery*, which the ancients called *vena arteriosa*, the *arterial vein*, is, in reality, an artery, and is composed, like the rest, of several tunics. It arises from the right ventricle of the heart, and divides into two large branches; which, subdividing into several smaller, diffuse themselves throughout the whole substance of the lungs. *Pulmonary vein*, which the ancients called *arteria venosa*, the *venous artery*, consists of four membranes like the other veins. It arises in the lungs from an infinity of little branches; which, uniting in one trunk, open into the left ventricle of the heart. See the System, Part I. Sect. III. Part IV. Sect. I. and Part V. Sect. XVIII. For the office of these vessels, see the article BLOOD.

PULMONARY Consumption, or consumption of the lungs, is what we properly call a PHTHISIS. See the System of MEDICINE, Genus 30.

PULSATION, *Pulsatio*, in medicine, the motion of the pulse, or the beating of an artery.

PULSE, in the animal economy, denotes the beating or throbbing of the heart or arteries. No doctrine has been involved in more difficulties than that of pulses; since, in giving a physiological account of them, physicians have espoused quite opposite sentiments; whilst some doubt whether the pulse is owing to the systole or diastole: as also, whether the motion of the heart and arteries, is one and the same, for a moment of time. The pulse is that reciprocal motion of the heart and arteries, whereby the warm blood, thrown out of the left ventricle of the heart, is so impelled into the arteries, to be by them distributed throughout the body, as to be perceivable by the finger. The pulsation of the arteries arises from that of the heart; and has, like it, a systole and a diastole; the systole of the one corresponding to the diastole of the other. Galen tells us, that Hippocrates was the first who observed the motion of the pulse. The pulse is thus accounted for. When the left ventricle of the heart contracts, and throws its blood into the great artery, the blood in that artery is not only thrust forwards towards the extremities, but the channel of the artery is likewise dilated; because fluids, when they are pressed, press again towards all sides, and their pressure is always perpendicular to the sides of the containing

containing vessels; but the coats of the artery, by any small impetus, may be distended; therefore, upon the contraction of the heart, the blood from the left ventricle will not only press the blood in the artery forwards, but both together will distend the sides of the artery: and thus is a motion of dilatation effected. And when the impetus of the blood against the sides of the artery ceases, that is, when the left ventricle ceases to contract, then the spiral fibres of the artery, by their natural elasticity, return again to their former state, and contract the channel of the artery, till it is again dilated by the systole of the heart: so that there is a motion of dilatation and contraction effected. The diastole or dilatation of the artery is called its pulse, and the time of the spiral fibres returning to their natural state is the distance between two pulses. This pulse is in all the arteries of the body at the same time; for while the blood is thrust out of the heart into the aorta, that artery being full, the blood must be propelled in all the arteries at the same time; and because the arteries are conical, and the blood moves from the bases of the cone to the apex, therefore the blood is continually pressing against the sides of the vessels; and consequently every point of the artery must be dilated, at the same time that the blood is thrown out of the left ventricle of the heart; and as soon as the elasticity of the spiral fibres can overcome the impetus of the blood, the arteries are again contracted. Thus, two causes, operating alternately, the heart and fibres of the arteries keep the blood in a continual motion. The observation of the pulse has been deemed of the utmost importance to a physician; both as it discovers the state of the heart, the first mover in the animal frame, and as it shews the nature, quantity, and motion of the blood, that universal humour, whereon all the rest depend; and also as it indicates the condition of the artery, the primary vessel of the whole body. However, Celsus calls the pulse *res fallacissima*: and as the variety of pulses, with regard to their being quick or slow, is owing to the different degrees of irritability in different constitutions, every accident that happens to the body, and every affection of the mind, have an influence upon them, so that the conclusions deduced from the state of the pulse, separately considered, are often very insufficient and erroneous. It is certain that the climate will alter the pulse of persons, and on this is founded the observation of pulses being naturally various in people of different nations. The pulses of Frenchmen are said to be more equal and quick, and those of the British, Dutch, and Germans more irregular and uncertain; and this is to be jointly attributed to the air of the country, and to the manner of living. With regard to motion, the pulses are reckoned only four; great and little, quick and slow. When quickness and greatness are joined together, it becomes violent; and when it is little and slow, it is called a weak pulse. They are also said to be frequent and rare, equal and unequal: but these are not the essential affections of motion. Frequency and quickness are often confounded with each other. A pulse is said to be hard or soft, with regard to the artery, according as it is tense, renitent, and hard, or flaccid, soft and lax; for the disposition of the arteries contributes greatly to the change of the pulse; wherefore it sometimes happens, that the pulse in both arms is not alike, which is very common in a hemiplexy. Add to these a convulsive pulse, which does not proceed from the blood, but from the state of the artery; and is known by a tremulous subfultory motion, and the artery seems to be drawn upwards; this, in acute fevers, is the sign of death; and is said to be the pulse in dying persons, which is likewise generally unequal and intermitting. A great pulse shews a more copious afflux of the blood to the heart, and from thence into the arteries; a little pulse the contrary. But of all others the wandering pulse is the most terrible and fatal; this is felt sometimes in one part of the artery, and sometimes in no part at all. This is a certain forerunner of death, and that usually very speedily following: and if great power in nature gives a short reprieve after this, it is only a very short relief. The pulse has been observed to beat faster in persons electrified. Phil. Trans. No. 478. p. 59.

In general, the higher and nearer the sun is, the quicker is the pulse; and the lower and farther off, the slower. In rainy seasons, the pulse is more free and quick, because of the smaller pressure of the atmosphere. It is more impetuous in the spring; more equal after a quiet sleep; weak and uncertain in men very intent upon business. Melancholy renders the pulse extremely inconstant, probably through the great thoughtfulness of such men; in bilious tempers it is high and strong; in sanguine more equal and regular than in any; in the phlegmatic, equal enough, but more slow; in children, especially infants, the pulse is very small; and in old men it is extremely uncertain; in gluttonous people it is dull and slow, unless by drinking it is made stumbling and vertiginous: this sort of pulse also frequently foretells sudden death. By too sparing a diet it becomes small and slow, and always abates upon fasting. Labour, motion, and exercise of the body, increase the circulation of the blood, the excretions, and particularly respiration; rest renders the circulation slow and weak; intense speaking increases the circulation, and consequently renders the pulse large and quick. In watching, the pulse is more evident; in sleep, more slow and languid. After drinking hot things, such as coffee and tea, or hot bath-waters, as well as after meals, the pulse vibrates more quick. In fevers the pulse is varied according to the beginning, height, and declination. In scorbutic and hysteric persons, it is very uncertain; in hydro-pical persons, it is much stopped and interrupted by stagnant hu-

mours; in the gout it is free and expedite; in the plague, as in the asthma, it is mightily oppressed, unless freed by the hot fit. In general, any variation of the pulse certainly denotes some alteration in the habit of the body. But nothing produces a greater change in the pulse than affections of the mind; in terror, it is unequal, small, and contracted; in joy, frequent and great; in anger, quick and hard; in sadness, slow, small, deep, and weak; and in intense study, languid and weak. With regard to the air, when, after the predominance of a west or south wind, it becomes north or east, the pulse is stronger and larger; as also when the quicksilver rises in the barometer. But when the atmosphere is dense, humid, and rainy, with a long south wind; as also where the life is sedentary, the sleep long, and the season autumnal, the pulse is languid and small, and the perspiration decreased. In May it is great, and sometimes violent; in the middle of summer, quick but weak; in the autumn, slow, soft, and weak; in the winter, hard and great. A drastic purge and an emetic render the pulse hard, quick, and weak, with loss of strength; chalybeates, and the bark, render it great and robust, and the complexion lively; volatiles amplify and increase the pulse; acids and nitrous remedies refrigerate the body, and appease the pulse; opiates, and the like, render it small and weak, and decrease the elasticity of the solids; and poisons render it small, contracted, and hard. When the quantity of the blood is too great, bleeding raises the pulse.

Dr. Heberden (Lond. Med. Trans. vol. ii. p. 18, &c.) has given us some observations on the pulse, which shew how little it is to be depended upon, without the concurrence of other symptoms; in how few cases an attention to the pulse is of real importance; and how groundless are the various distinctions of pulses. Those most to be regarded, are the quick and slow pulses. To this writer we are indebted for the following observations on this subject. The pulse of a child under two years old should be felt while it is asleep, because it is so easily quickened by every new sensation. The pulse of a healthy infant, on the day of its birth, and when it is asleep, is between 130 and 150 in a minute; the mean rate during the first month is 120, and rarely, if ever, below 108. During the first year, the limits may be from 108 to 120: the second year, at 90 and 108; the third year at 80 and 108; the fourth, fifth, and sixth, nearly the same as the third; the seventh year it is sometimes at 72, but generally more; twelfth, about 70. In adults it is usually from a little below 60 to a little above 80.

PUMP, in hydraulics, a machine formed on the model of a syringe, for raising of water. Vitruvius ascribes the first invention of pumps to Ctesibius the Athenian; whence the Latins call it *machina Ctesibii*. Pumps are distinguished into several kinds, with regard to the several manners of their acting.

For a full explanation of the construction of several kinds of pumps, see the system of HYDROSTATICS and HYDRAULICS, Part II. Art. V. and VI. For representation, see Plate I. fig. 18, 19, and 20. For the naval chain-pump, see the Treatise on NAVAL AFFAIRS, Sect. II. Plate III. fig. 6. For the description of the common air-pump, and its uses, see the System of PNEUMATICS, Sect. II. and Plate III. fig. 9. For the construction and use of Prince's American air-pump, see Sect. II. and Plate III. See also various experiments under that article, with references to the several figures on the plate which illustrates them.

PUN, or PUNN, a lusus verborum, the wit whereof depends on a resemblance between the sounds or syllables of two words, which have different, and, perhaps, contrary significations. Puns, when they come easily, and are very ingenious, poignant, and apposite, are allowed of in conversation, letters, epigrams, madrigals, and the like compositions; but they are absolutely banished out of the grave, serious, and sublime, because they weaken its force, and diminish its beauty, which consists in something great and elevated. The Greeks and Romans, it is true, sometimes indulged themselves in the practice, and used puns as ornaments in the most serious discourses: but the more severe and philosophical genius of our age is by no means satisfied with such an outside of wit. Devices, symbols, rebuffs, mottoes, &c. are their proper sphere, where they shine to most advantage. Aristotle describes two or three kinds of puns among the beauties of good writing, and produces instances of them out of some of the greatest authors in the Greek tongue. Cicero has sprinkled several of his works with puns; and, in that work, where he lays down the rules of oratory, quotes abundance of sayings, which he calls pieces of wit, that, upon examination, prove perfect puns.

PUNCH, a sort of compound drink frequent in England, and about the maritime parts thereof. Its basis is spring water, which being rendered cooler, brisker, and more acid with lemon juice, and sweetened again to the palate with fine sugar, makes what they call sherbet; to which a proper quantity of a spirituous liquor, as brandy, rum, or arrack, being superadded, the liquor commences punch. Several authors condemn the use of punch as prejudicial to the brain and nervous system. Dr. Cheyne insists, that there is but one wholesome ingredient in it, viz. the mere water. The proportions of the ingredients are various: some, instead of lemon-juice, use lime-juice, which makes what they call punch royal: this is found less liable to affect the head, as well as more grateful to the stomach. Some also make milk punch, by adding near as much milk to the sherbet as there is water, which tempers the acrimony

mony of the lemon. Others prefer tea punch, made of green tea instead of water, and drank hot.

PUNCTUATION, in grammar, the art of pointing; or dividing a discourse into periods, and members of periods, by points expressing the pauses to be made in the reading thereof; and necessary both for understanding and pronouncing it. The points used herein are four; viz. the period, colon, semicolon, and comma. See the particular use of each under its proper article in the System, Part II. Chap. IV.

PUNCTUM Salientis, in anatomy, the first rudiments of the heart, in the formation of the fetus, where a throbbing motion is perceived. This is easily observed with a microscope in a brood-egg, wherein, after conception, we see a little speck or cloud; the middle whereof is a spot that appears to beat, or leap, a considerable time before the fetus be formed for hatching.

PUNCTUM Lachrymale, in anatomy, a little hole in the edge of each eye-lid, opened into a bag called *glandula lachrymalis*. See the System, Part VI. Sect. XI.

PUNCTURE, *punctura*, in surgery, &c. any wound made by a pointed instrument.

PUNISHMENT, a penalty imposed upon the commission of some crime or offence against the laws. It is essential to the nature of a law, that it import or decree a punishment to the transgressors thereof. The forms and manners of punishment are various in various countries and ages, and for various crimes: as treason, felony, adultery, parricide, &c. Amongst the principal civil punishments are fines, imprisonments, the stocks, pillory, burning in the hand, whipping, ducking-stool, hanging, beheading, quartering, burning, transportation, &c. The ecclesiastical punishments are censures, suspensions, deprivations, degradations, excommunications, anathemas, penances, &c. The military punishments are, being shot, running the gantelope, riding the wooden horse, the bilboes, &c. Among the Turks, &c. impaling, bastinadoes on the soles of the feet, &c. prevail.

PUPIL, *pupilla*, in anatomy, denotes a little aperture in the middle of the uvea and iris of the eye, through which the rays of light pass to the crystalline, in order to be painted on the retina, and cause vision. See the System, Part VII. Sect. V. and Plate XI. Fig. 13, Letter K.

PURCHASE, in law, in its largest and most extensive sense, is defined by Lyttleton to be the possession of lands and tenements, which a man hath by his own act or agreement, and not by descent from any of his ancestors or kindred. In this sense it is distinguished from acquisition by right of blood, and includes every other method of coming to an estate, but merely that by inheritance: wherein the title is vested in a person, not by his own act or agreement, but by the single operation of law. Purchase, in its vulgar and confined acceptation, is applied only to the acquisition of goods, lands, tenements, or the like, by means of money, or some other valuable consideration.

PURFLEW, a term in heraldry, expressing ermines, peans, or any of the furs, when they compose a border round a coat of arms. Thus they say, he beareth gules a border, *purple*, or *vairy*; meaning, that the border is *vairy*.

PURGATION, the art of purging, scouring, or purifying a thing, by separating, or carrying off any impurities found therein. Thus, in pharmacy, purgation is the cleansing of a medicine by retrenching its superfluities. In chymistry, it is used for the several preparations of metals and minerals intended to clear them of their impurities, more usually called *purification* and *refining*. See **REFINING**. In medicine, purgation is an excretory motion arising from a quick and orderly contraction of the fleshy fibres of the stomach and intestines, whereby the chyle, corrupted humours, and excrements lodged therein, are protruded further and further, and at length quite excluded the body by stool. See **CATHARTICS**.

For the menstrual purgation of women, see the System of MEDICINE, Genus 46 and 126.

PURIFICATION, in matters of religion, a ceremony, which consists in cleansing any thing from a supposed pollution or defilement. The Pagans, before they sacrificed, usually bathed or washed themselves in water; and they were particularly careful to wash their hands, because with these they were to touch the victims consecrated to the gods. It was also customary to wash the vessel with which they made their libations. The Mahometans use purifications as previous to the duty of prayer; these also are of two kinds, either bathing, or only washing the face, hands, and feet. The first is required only in extraordinary cases, as after having lain with a woman, touched a dead body, &c. But lest so necessary a preparation for their devotions should be omitted, either where water cannot be had, or when it may be of prejudice to a person's health, they are allowed in such cases to make use of fine sand, or dust instead of it: and then they perform this duty by clapping their open hands on the sand, and passing them over the parts, in the same manner as if they were dipped in water. There were also many legal purifications among the Hebrews. When a woman was brought to bed of a male child, she was esteemed impure for 40 days; and when of a female, for 60; at the end of which time she carried a lamb to the door of the temple to be offered for a burnt-offering, and a young pigeon or turtle for a sin-offering; and by this ceremony she was cleansed or purified. The holy Virgin,

though, according to the fathers, exempt from the terms of the law, yet complied therewith; and, at the time prescribed, went to the temple, and accomplished the law; in commemoration whereof, the church yearly solemnizes the feast of the Purification of the Virgin, on the second of February; called also the *feast of CAN-DLEMAS*.

PURITANS, in ecclesiastical history, a term formerly used for the Calvinists of Great Britain, from their professing to follow the pure word of God, in opposition to all traditions, human constitutions, and other authorities. The separation, whence this distinguishing appellation took its rise, commenced on the following occasion. Upon the accession of queen Mary, it is well known that popery revived in this kingdom; the statutes of king Edward were repealed, and the penal laws against heretics were put in execution against the reformers. Many suffered at home; and others escaped the fury of persecution by seeking refuge in foreign countries. Some went into France and Flanders, some to Geneva, and others into those parts of Germany and Switzerland, where the reformation had taken place, and where the magistrates received them with great humanity, and allowed them places for public worship. The exiles were most numerous at Frankfort; and there that contest and division began, which gave rise to the Puritans, and to that separation from the church of England, which continues to this day. In the year 1556, Dr. Cox, afterwards bishop of Ely, came to settle at Frankfort with several of his friends; and obtaining leave of the magistrates for the free use of king Edward's service book, performed divine worship according to the rites that had been authorized by that prince; while others, who preferred the Genevan method of worship, as more pure and simple, left the city of Frankfort, and removed to Basil and Geneva. Thus commenced the distinction of Puritans and Conformists, by which the two parties were afterwards known. The former were called Conformists, on account of their compliance with the ecclesiastical laws enacted by Edward VI. and the denomination of Nonconformists and Puritans were given to the latter, from their insisting upon a form of worship more exempt from superstition, and of a purer kind than the liturgy of Edward seemed to them to be. They were first called Puritans in the beginning of the reign of queen Elizabeth, from their attempting a purer form of worship and discipline than had yet been established; and whose sentiments in many points were agreeable to those maintained by John Wickliffe, the first reformer. For they agreed with him in opinion, that in the sacrament of orders there ought to be but two degrees, presbyters or bishops, and deacons; that all human traditions are superfluous and sinful; that we must practice and teach only the laws of Christ; that mystical and significant ceremonies in religious worship are unlawful; and that to restrain men to a prescribed form of prayer is contrary to the liberty granted them by God. The old festivals, with their eves and the popish habits, were continued as they were in the second year of king Edward VI. In 1558 the act of supremacy was passed, in which there is a remarkable clause, that gave rise to the court of high commission, which proved afterwards so oppressive; and in 1559 was passed an act for the uniformity of common prayer, and service in the church, and administration of the sacraments. The Puritans remonstrated against these proceedings, and complained, that the gross superstitions of popery, which they had looked upon as abrogated and abolished, were now revived, and even imposed by authority.

The Conformists and Puritans maintained that the holy scriptures were a perfect rule of faith; the bishops and court reformers did not allow them to be the standard of discipline or church government, affirming that our Saviour and his apostles left it to the discretion of the civil magistrate, in those places where christianity should obtain, to accommodate the government of the church to the policy of the state. But the Puritans apprehended the holy scriptures to be a standard of church discipline as well as of doctrine; at least that nothing should be imposed as necessary but what was expressly contained in, or derived from them, by necessary consequence; and, besides, they maintained that the discretionary power was not lodged with the civil magistrate, but with the spiritual officers of the church. Farther, the court reformers maintained, that the practice of the primitive church for the first four or five centuries was a proper standard of church government and discipline, and in some respects a better than that of the apostles, which (according to them) was only accommodated to the infant state of the church while it was under persecution, whereas theirs was suited to the grandeur of a national establishment. Whereas the Puritans were for adhering to the Bible in the main principles of church government, and for admitting no church officers or ordinances, but such as are herein mentioned; and they apprehended, that the apostles in establishing the first Christian church on the aristocratical plan then observed in the Jewish sanhedrim, designed it as an unchangeable model to be followed in all times and places. The court reformers also maintained, that things indifferent in their own nature, which are neither forbidden nor commanded in the holy scripture, such as rites, ceremonies, habits, &c. might be settled, determined, and made necessary by the command of the civil magistrate, and that in such cases it was the indispensable duty of all subjects to observe them. But the Puritans insisted, that those things which Christ had left indifferent ought not to be made necessary by any human

human laws, and that such rites and ceremonies as had been abused to idolatry, and had a manifest tendency to lead them back to popery and superstition, were no longer indifferent, but to be rejected as unlawful. Nevertheless, both parties agreed too well in asserting the necessity of an uniformity of public worship, and of calling in the sword of the magistrate for the support and defence of their several principles; which they made an ill use of in their turns, as they could grasp the power into their hands. The standard of uniformity, according to the bishops, was the queen's supremacy, and the law of the land; according to the Puritans, the decrees of provincial and national synods, allowed and enforced by the civil magistrate; but neither party was for admitting that liberty of conscience, and freedom of profession, which is every man's right as far as is consistent with the peace of the government under which he lives. In the year 1564, upon a report that the habits enjoined on the clergy were generally neglected, and also of inattention to other imposed forms, the queen directed the ecclesiastical commissioners to consult some proper methods to reduce them to an exact uniformity; and accordingly issued out a proclamation in 1565, peremptorily requiring uniformity in the habits, upon pain of prohibition from preaching, and deprivation. Parker, the archbishop of Canterbury, was violent and unrelenting: and, by various methods of severity, harassed, silenced, and deprived many of those who scrupled the use of the habits. The Puritanical ministers finding that renewed applications to the queen and her commissioners were ineffectual, published, in 1566, a small treatise in vindication of their conduct; in which they alledged, that neither the prophets of the Old Testament, nor the apostles in the New, were distinguished by their garments; that a distinction of garments in the Christian church did not generally obtain till long after the rising of anti-christ; that they were an offence to weak Christians, an encouragement to ignorant and obstinate papists, and the use of them an affliction of returning to their communion; that at best they were only human appointments.

In 1566 they came to a resolution, alledging it to be their duty, in their present circumstances, to break off from the public churches, and to assemble, as they had opportunity, in private houses; and as they were cut off from the church of England, they resolved to set up the purest and best form of worship, most consonant to the holy scriptures, and to the practice of the foreign reformers. They complained of the bishops affecting to be thought a superior order to presbyters, and claiming the sole right of ordination, and the use of the keys; and assuming, in connexion with their offices, temporal dignities, titles, and employments. As long, however, as the English bishops pretended to derive their dignity and authority from no other source than the laws of their country, and pleaded a right, merely human, to the rank they held in the church and state, the controversy was carried on without excessive animosity and zeal; but the flame broke out with redoubled fury in the year 1588, when Bancroft, afterwards archbishop of Canterbury, ventured to assert that the order of bishops were superior to the body of presbyters, not in consequence of any human institution, but *jure divino*, or by the express appointment of God himself. Farther, the Puritans excepted against the titles and offices of archdeacons, deans, chapters, and other officials belonging to cathedrals, as having no foundation in scripture, or primitive antiquity, and intrenching upon the privileges of the presbyters in the several dioceses. They complained of the exorbitant power and jurisdiction of the bishops and their chancellors in their spiritual courts, as derived from the canon law of the pope, and not from the word of God, or the statute law of the land. They disapproved of several of the church festivals or holidays, as having no foundation in scripture, or primitive antiquity; and they disallowed the cathedral mode of worship. In point of doctrine there was, at this time, no difference between the Puritans and Conformists; and if we add one article more to the preceding, we shall have the principal heads of controversy between the church of England and the protestant dissenters at this day; viz. the natural right which every man has to judge for himself, and make profession of that religion which he apprehends most agreeable to truth, as far as it does not affect the peace and safety of the government under which he lives; without being determined by the prejudices of education, the laws of the civil magistrate, or the decrees of councils, churches, or synods.

Queen Elizabeth was violent in her opposition to the Puritans through the whole course of her reign; and besides the ordinary courts of the bishops, she erected, as we have already observed, a new tribunal, called the court of high commission, which suspended, and deprived men of their livings, not by the verdict of twelve men upon oath, but by the solemn determination of three commissioners of her own nomination, founded not upon the statute law of the realm, but upon the canon law; and instead of producing witnesses in open court to prove the charge, they assumed a power of administering an oath *ex officio*, whereby the prisoner was obliged to answer all questions the court should put to him, though ever so prejudicial to his own defence. If he refused to swear, he was imprisoned for contempt; and if he took the oath, he was convicted upon his own confession.

After the restoration of Charles II. in the year 1662, the name of Puritans, says bishop Burnet, was changed into that of *Protestant Non-conformists*, who were subdivided into *Presbyter-*

rians, *Independents*, *Anabaptists*, and *Quakers*. See the respective Articles. At this time a public law, called the *Act of Uniformity*, was enacted, by which all who refused to observe the rites, and subscribe to the doctrines of the church of England, were entirely excluded from its communion. From this period until the reign of king William III. the Non-conformists were in a precarious and changing situation, sometimes involved in calamity and trouble, and at other times enjoying some intervals of tranquillity and certain gleams of hope, according to the varying spirit of the court and ministry, but never entirely free from perplexities and fears. But in the year 1689, their affairs took a favourable turn; when a bill for the toleration of all protestant dissenters from the church of England, except the Socinians, passed in parliament, almost without opposition, and delivered them from the penal laws to which they had been subjected by the act of uniformity, and other acts passed under the house of Stuart. For the present state of the toleration, see *TOLERATION*.

PURITY, in oratory, is one of the constituent parts of elegance, and denotes the choice of such words and phrases as are suited and agreeable to the use of the language in which we speak. See the *Treatise*, Part III. Sect. XI. Art. I.

PURPLE, *purpura*, *πορφυρα* a red colour, bordering on violet; now dyed chiefly with cochineal. For the method of dyeing purple, see the *Treatise*, Sect. II.

PURPURE, *POURPRE*, or *PURPLE*, in heraldry, according to some, is one of the five colours of armories, mixed or compounded of gules and azure, bordering on violet; and, according to others, of a little black and much red colour. See the *System*, Sect. III. and Plate II.

PURULENT, *purulentus*, in medicine, something mixed with, or partaking of, pus or matter. Phthysical people frequently spit a purulent matter. In a dysentery, the stools are purulent; when there is an ulcer in the reins or bladder, the urine is purulent. The purulent eye is a disorder to which new-born children are subject; for the cure of which Mr. Ware recommends the application of astringents, on a conviction that the discharge is not real pus, but merely mucus, increased in quantity, and altered in colour, by some irritating cause. The remedy which he has found to be highly useful in this disorder, is the aqua camphorata of Bate's Dispensatory, much diluted with water, and injected with a syringe. Ware's Remarks on the Ophthalmia, &c. 8vo. 1780.

PUS, formed of the Greek *πυος* in medicine, a putrid matter, white and thick, formed of blood corrupted in a wound or ulcer, and issuing out of the lips thereof. Wounds are always to be kept open while they suppurate, i. e. while they generate pus. A very small portion of pus, absorbed into the blood-vessels, raises a putrid fever as certainly as yeast does a fermentation in wort. This fever is not owing to its stimulating the solids to quicker and greater vibrations, but to its increasing the intestine motion, and accelerating the animal process, hastening the changes of the juices to that subtle acrid state, which renders them unfit to be retained in the body, and disposes them to run off in colliquative evacuations, such as sweating and purging, which constantly attend these putrid or hectic fevers, or rising to internal ulcers. Med. Ess. Edinb. vol. v. art. 77.

PUTORIUS, the name of a species of the Genus *Mustela*, in the System of Mammalia. For description of the Genus, see *MUSTELA*.

PUTREFACTION, one of the natural processes, directly opposite to the life of animals and vegetables, by which organized bodies are dissolved, and reduced to what may be called their *original elements*. Putrefaction differs from chymical solution; because, in the latter, the dissolved bodies are kept in their state of solution by being combined with a certain agent from which they cannot easily be separated; but in putrefaction, the agent which dissolves the body appears not to combine with it in any manner of way, but merely to separate the parts from each other. It differs also from the resolution of bodies by distillation with violent fire; because, in distillation, new and permanent compounds are formed, but by putrefaction every thing seems to be resolved into substances much more simple and indestructible than those which are the result of any chymical process. The bodies most liable to putrefaction are those of animals and vegetables, especially when full of juices. Stones, though by the action of the weather they will moulder into dust, yet seem not to be subject to any thing like a real putrefaction, as they are not resolved into any other substance than sand, or small dust, which still preserves its lapideous nature. In like manner, vegetables of any kind, when deprived of their juices by drying, may be preserved for many ages without being subjected to any thing like a putrefactive process. The same holds good with respect to animals, the parts of which, by simple drying, may be preserved in a sound state for a much longer time than they could be without the previous exhalation of their juices.

Putrefaction is one of the instruments in nature by which many great changes are brought about. In the process of vegetable putrefaction, if we throw together any of the tender, green, and succulent parts of recent vegetables, whether acid or alkaline, in a large heap, in the warm open air, and press them down with an additional weight, if their own be inconsiderable; the middle part of the heap will, in a little time, spontaneously conceive a small degree of heat, and pass successively through the other degrees, till it arrive at a state of ebullition, and be perfectly putrefied. In the space

PUT

space of three days, from the first putting them together, they will yield a heat, perceivable by the hand, equal to that of a human body in a healthy state; by the fifth, the heat will be too great for the hand to bear without pain; and, lastly, by the sixth, seventh, or eighth day, the juices will generally appear ready to boil; and sometimes the matter will even flame, and burn away. By this spontaneous operation, the vegetable acquires an abominably putrid, stercoraceous, or cadaverous, taste and odour; and turns entirely into one soft, similar, pulpy mass, or crassamentum, greatly resembling foetid human excrements in the scent, and putrefied flesh in the taste.

Experiments have been made in the coldest and most succulent, or watery plants; such as purslane, sorrel, &c. as well as with the hottest or most acrimonious, such as the spurges, &c. and it was always found to succeed; but that the sooner, as the vegetable employed contained the greater quantity of oil; though with the same phenomena. It will likewise succeed with dry vegetables, provided they be moistened with water before they are thrown into heaps; and thus we sometimes see, that stacks of hay will spontaneously take fire, and burn away; especially if the hay was not well dried in the making. It is surprising to consider, that, by this means, the difference betwixt vegetables may be entirely taken away, and the whole kingdom thereof reduced to the same common nature; so that wormwood and tanfy, for instance, or sorrel and scurvy-grass, shall appear as one and the same thing; and this thing appears no otherwise than like putrefied flesh. Though sorrel be famed for its power of preserving the animal fluids uncorrupted whilst they are circulating in the body, and scordium, for its embalming virtue, as continuing them in a state of incorruption after death; yet even these plants are themselves thus easily corrupted and changed into such a kind of putrefied flesh, as it is their virtue to prevent. This Boerhaave considers as a general law of nature, wisely established to produce wonderful changes in the world, and to prevent the inaction and decrease of matter in our globe; this active principle, or medium, giving an easy and reciprocal transposition of vegetable into animal substances, and of animal into vegetable. This operation may let us a little into the nature of animal digestion, or the change which the aliment suffers in the human body. For the change our vegetable foods undergo in the body, being such as brings them to be of the same nature, and to afford the same principles, with the change induced by putrefaction, is a presumption, that digestion is nothing else. Besides, as we know that neither animal nor vegetable substances can become aliment, without undergoing some degree of putrefaction, many distempers must proceed from a deficiency of this action; the crisis of fevers seems to depend upon it, and even animal heat, according to Dr. Stevenson, does the same.

Now, that the concoction of the humours is nothing else but putrefaction, seems probable from hence, that whenever they are in that state, they are always more fluid, and fitter to pass through the smaller vessels, where they stagnated before. Again, the offensiveness of the sweats, or other excretions consequent on a crisis, is likewise a sure sign of a high degree of corruption. The time of resolution or putrefaction depends on the degree of heat, the habit of the patient, and on the part obstructed.

Putrefaction is generally allowed to be a kind of fermentation, or rather to be the last stage of that process; which, beginning with the vinous fermentation, goes on through the acetous, to the stage of putridity, where it stops. It is argued, however, and seemingly not without a great deal of reason, that if putrefaction is a fermentation, it must necessarily be a kind, distinct from either the vinous or acetous; since we frequently observe, that it takes place where neither the vinous nor the acetous stages have gone before; of consequence it must be, in some cases at least, entirely independent of and unconnected with them. In several other respects it differs so much from these processes, that it seems in some degree doubtful whether it can with propriety be called a fermentation or not. Both the vinous and acetous fermentations are attended with a considerable degree of heat: but in the putrefaction of animal matters especially, the heat is for the most part so small, that we cannot be certain whether there is any degree of it or not produced by the process. In cases, indeed, where the quantity of corrupting animal matter is very great, some heat may be perceived; and accordingly Dr. Monro tells us, that he was sensible of heat on thrusting his hand into the flesh of a dead and corrupting whale. But the most remarkable difference between the putrefactive fermentation and that of the vinous and acetous kinds is, that the end of both these processes is to produce a new and permanent compound; but that of the putrefactive process is not to produce any new form, but to destroy, and resolve one which already exists, into the original principles, from which all things seem to proceed. Thus, the vinous fermentation produces ardent spirits; the acetous vinegar: but putrefaction produces nothing but earth, and some effluvia, which, though most disagreeable and even poisonous to the human body, yet, being imbibed by the earth and vegetable creation, give life to a new race of beings. It is commonly supposed, indeed, that volatile alkali is a production of the putrefactive process: but this seems liable to dispute. The vapour of pure volatile alkali is not hurtful to the human frame, but that of putrefying substances is exceeding-

PUT

ly so; and, excepting in the case of urine, the generation of volatile alkali in putrid substances is very equivocal. This substance, which produces more alkali than any other, is much less offensive by its putrid fætor than others; and all animal substances produce a volatile alkali on being exposed to the action of fire, of quick-lime, or of alkaline salts. In these cases the volatile alkali is not supposed to be produced by the quick-lime or fixed salt, but only to be extricated from a kind of ammoniacal salt pre-existing in the animal matters; the probability is the same in the other case, viz. that volatile alkali is not produced, but only extricated from these substances by putrefaction.

The only thing in which the putrefactive fermentation agrees with the other kinds is, that in all the three there is an extrication of fixed air. In the putrefactive process, it has been thought that this escape of the fixed air deprives the body of its cohesion; and Dr. Macbride has wrote a treatise in which he endeavours to prove, that fixed air is the very power of cohesion itself, and that all bodies when deprived of their fixed air entirely lose their cohesion. According to this, the cause of putrefaction is the escape of fixed air: but it is impossible to give a reason why fixed air, after having so long remained in a body, and preserved its cohesion, should of a sudden begin to fly off without being acted upon by something else. To a similar objection the hypothesis of those is liable, who suppose putrefaction to be occasioned by the escape of phlogiston; for phlogiston will not fly off without something to carry it off, any more than fixed air.

It appears from the experiments of Dr. Priestley, that fixed air corrects and renders wholesome, air tainted with respiration or putrefaction. Hence he infers, that lime-kilns which discharge great quantities of this air may be wholesome in the neighbourhood of populous towns, the atmosphere of which must abound with putrid effluvia. Sir William Lee, in a hot season, contrived, by impregnating water with fixed air, and washing meat with it two or three times a-day, not only to preserve it as perfectly sweet and good to the extent of ten days, as at the first killing, but also to recover some meat that had begun to change. And it is farther well known, that fixed air has been lately introduced into the materia medica, and administered with success in a variety of putrid cases. Putrefying and fermenting substances have been found, by the experiments of Mr. Cavendish, Dr. Priestley, &c. to yield not only fixed but inflammable air. From an experiment of Dr. Priestley, intended to determine the proportion of each of the kinds of air, in the different stages of the putrefactive process, it appears that a piece of mutton weighing four penny-weights six grains, yielded in all $2\frac{1}{4}$ measures of air, of which $2\frac{1}{4}$ was fixed, and the rest inflammable; and that all the inflammable part was exhausted a considerable time before the fixed air. The same ingenious writer has observed, that the diminution of common air, by means of putrefaction, amounts to a complete fourth part of the whole, notwithstanding the production of some permanent air from the putrefying substance, and has, in all respects, the appearance of being produced solely by the precipitation of fixed air. It must occur to every reader, in any way acquainted with this subject, that if inflammable air be the same with phlogiston, as Dr. Priestley seems lately to have discovered, many of the phenomena of putrefaction, depending on this principle, such as the smell, colour, light, &c. will probably from hence admit of an easy explication.

Animalcules have been thought to be the cause of putrefaction; but if animal substances are covered so as to exclude the access of flies or other insects, no such animalcules are to be discovered though putrefaction has taken place; and indeed it requires little proof to convince us, that animals are produced in corrupted bodies only because substances prove a proper nidus for the eggs of the parent insects. It is well known, that bodies are preserved from putrefaction by covering them with wax, suet, &c. and Mr. Boyle relates, that he has preserved lemons, oranges, and other fruits from putrefaction during several years, by including them in an exhausted receiver. Experiments of the same kind have been made by Mr. Eller, of Berlin, which shew that substances, even of the most putrescent nature (such as blood) may be kept sound in *vacuo* for many years. That putrescent substances emit light, is an unquestionable fact; and on this principle philosophers account for the luminousness of the sea, the *ignis fatuus*, &c. To this purpose M. Ant. Martin, Swed. Abhad. vol. xxiii. p. 225, cited by Dr. Priestley, in his History of Light, &c. p. 576, observes, that human bodies have sometimes emitted light about the time they begin to putrefy; and that the walls and roof of a place in which dead bodies had often been exposed, had a kind of dew or clamminess upon them, which was sometimes luminous. And he imagines that the lights which are said to be seen in burying grounds, may be owing to this cause. It has been observed, that heat extinguishes the light of putrescent substances; Mr. Canton, attending to this circumstance in some experiments for ascertaining the cause of the luminousness of the sea, remarks, that though the greatest summer-heat is well known to promote putrefaction, yet twenty degrees more than that of the human blood seems to hinder it; for putting a small piece of luminous fish into a thin glass ball, he found, that water of the heat of one hundred and eighteen degrees would extinguish its light in less than half a minute; but that on taking it out of the water, it would

PUT

would begin to recover its light in about ten seconds : but it was never afterwards so bright as before. See LIGHT.

To understand the true cause of putrefaction, we must take notice of the circumstances in which the process goes on most rapidly. These are heat, a little moisture, and confined air. However, it is observed, by Sir John Pringle, that the putrefaction of meat and other substances, advances quicker in a confined than free air; for as the most putrid parts are also the most fugitive, they incessantly issue from a corruptible substance, and disperse with the wind; but in a stagnation of air they remain about the body, and, in the nature of a ferment, excite its corruption. Extreme cold prevents putrefaction, as well as perfect dryness; and a free circulation of air carries off the putrid effluvia, a stagnation of which seems to be necessary for carrying on the process. It seems also to hold pretty generally, that putrefying bodies swell and become specifically lighter; for which reason the carcases of dead animals, after having sunk in water, rise to the top and float. This last phenomenon, as has been observed under the article BLOOD, shews that these bodies have received a certain quantity of an elastic principle from the air, which thus swells them up to such a size. It may be said, indeed, that this increase of size in putrefying bodies is owing only to the extrication of air within themselves: but this amounts to the same thing; for the air which exists internally in the body of any animal, is entirely divested of elasticity while it remains there, and only shews its elastic properties upon being extricated. The elastic principle which combines with the air fixed in the animal substance, therefore, must come from the external atmosphere; and consequently the agent in putrefaction must be the elastic principle of the atmosphere itself, probably the same with elementary fire. But, granting this to be true, it is difficult to shew why putrefaction should not take place in a living body as well as a dead one; seeing the one is as much exposed to the action of the air as the other. This difficulty, however, is not peculiar to the present hypothesis; but will equally occur whatever we may suppose the cause of putrefaction to be. The difficulty seems to be a little cleared up by Dr. Priestley, who shews, that by means of respiration the body is freed from many noxious effluvia which would undoubtedly destroy it, and by the retention of which, he thinks, a living body would putrefy as soon as a dead one. The way in which respiration prevents the putrefaction of the body, is evidently the same with that in which the wind prevents fish or flesh hung up in it from becoming putrid. The constant inspiration of the air is like a stream of that element continually blown upon the body, and that not only upon its surface, but into it, by which means putrefaction is prevented in those parts that are most liable to become putrid. On the other hand, the elastic principle received from the air by blood, by invigorating the powers of life, quickening the circulation, and increasing perspiration, enables the body to expel noxious particles from other parts of the body which cannot conveniently be expelled by the lungs.

This leads us to consider the reason why a free exposure to the air prevents the coming on of putrefaction, or why the confining of the putrid effluvia should be so necessary to this process. Here it will be proper to recollect, that putrefaction is a simple resolution of the body into earth, air, &c. of which it seems originally to have been composed. This resolution is evidently performed by an expansive power seemingly situated in every particle of the body. In consequence of this principle, the body first swells, then bursts, flies off in vapour, and its particles fall asunder from each other. The action of the putrefactive process, then, is analogous to that of fire, since these are the very properties of fire and the very effects which follow the action of fire upon any combustible body. It is therefore exceedingly probable, that the agent in the air which we have all along considered as the cause of putrefaction, is no other than fire itself; that is, the ethereal fluid expanding itself every where, as from a centre to a circumference. The force of the fluid, indeed, is much less in putrefaction than in actual ignition; and therefore the effects also take place in a much smaller degree, and require a much longer time: nevertheless, the same circumstances that are necessary for keeping up the action of fire, are also necessary for keeping up the putrefactive process. One of these is a free access of air, yet without too violent a blast; for as fire cannot burn without air, neither can it endure too much of it, thus a candle goes out if put under a receiver, and the air exhausted; and it will do the same if we blow violently upon it. In like manner, putrefaction requires a certain quantity of air, much less indeed than fire: and as it requires less to support it, so it can also endure much less air than fire; for a stream of air which would not put out a fire, will effectually prevent putrefaction. The cause of this in both is the same. Fire cannot burn because the vapour is carried off too fast; and thus the latent heat which ought to support the flame is entirely dissipated. In like manner putrefaction is as certainly attended with an emission of phlogistic vapours, as fire is with an emission of flame. These vapours contain a great quantity of latent heat; or of the expansive principle already mentioned; and if these are carried off with greater rapidity than the heat of the atmosphere can produce them, the consequence must be, that an opposite principle to that which produces putrefaction, namely, a principle of cold, or condensation, instead of expansion, must take place, and the body cannot putrefy. That this must be the case is

PUT

evident from the property which all evaporations have of producing cold; and it is well known that a brisk current of air promotes evaporation to a great degree. Hence also the reason is evident why bodies are preserved uncorrupted by cold; for thus the action of the expansive principle is totally overcome and suspended, so that none of its effects can be perceived.

Thus we may see, that one reason why an animal body does not putrefy while alive, is its ventilation, as we may call it, by respiration; and another is, the continual accession of new particles, less disposed to putrefy than itself, by the food and drink which are constantly taken in. But if either of these ways of preventing the commencement of this process are omitted, then putrefaction will take place as well in a living as in a dead body. Of the truth of this last fact we have innumerable instances. When air is infected with the putrid effluvia of marshes, and thus the natural effluvia are not carried off from the human body, but, on the contrary, some enter into it which are not natural to it, the most putrid diseases are produced. The same thing happens from the putrid effluvia of dead bodies.

Of this we have a remarkable instance in the fever which took place in Germany, in the war of 1755: one reason of which is said to have been an infection of the air by the vast numbers of people killed in battle, to which was added a calm in the atmosphere for a long time; the putrid effluvia being by this prevented from flying off. When Mr. Holwell with 145 others were imprisoned in the black-hole at Calcutta, after passing a night in that dismal habitation, he found himself in a high putrid fever. When sailors in long voyages are obliged to feed upon putrid aliments; when through stormy weather they are much exposed to wet; in the one case the putrescent effluvia being kept from flying off, and in the other a greater quantity being thrown into the body than what it naturally contains, the scurvy, malignant fevers, &c. make their appearance. Neither can these diseases be removed without removing every one of the causes just now mentioned: for as putrid diseases will be the consequence of confined air, nastiness, &c. though the provisions be ever so good; so, on the other hand, if the provisions be bad, the best air, and most exact cleanliness, nay, the best medicines in the world, will be of no service; as hath been often observed in the scurvy. See the System of MEDICINE, Genus 60.

From this account of the nature, cause, and method of preventing putrefaction by means of a current of air, we may easily see the reason why it does not take place in some other cases also. Bodies will not putrefy in *vacuo*, because there the atmosphere has not access to impart its elastic principle; and though in the vacuum itself the principle we speak of does undoubtedly exist, yet its action there is by far too weak to decompose the structure of an animal body. In extreme cold, the reason why putrefaction does not take place has been already shewn. If the heat is extremely great, the process of ignition or burning takes place instead of putrefaction. If the body is very dry, putrefaction cannot take place, because the texture is too firm to be decomposed by the weak action of the elastic principle. Putrefaction may also be prevented by the addition of certain substances; but they are all of them such as either harden the texture of the body, and thus render it proof against the action of the elastic fluid, or, by dissolving its texture entirely, bring it into a state similar to what it would be brought by the utmost power of putrefaction, so that the process cannot then take place. Thus, various kinds of salts and acids harden the texture of animal substances, and thus are successfully used as antiseptics. The same thing may be said of ardent spirits; while oils and gums of various kinds prove antiseptic by a total exclusion of air, which is necessary in some degree for carrying on the process of putrefaction. Many vegetables, by the astringent qualities they possess, harden the texture of animal substances, and thus prove powerfully antiseptic; while, on the other hand, fixed alkaline salts, quicklime, and caustic volatile alkali, though they prevent putrefaction, yet they do it by dissolving the substances in such a manner that putrefaction could do no more though it had exerted its utmost force. There is only one other antiseptic substance whose effects deserve to be considered, and that is sugar. This, though neither acid nor alkaline, is yet one of the most effectual means of preventing putrefaction: and this seems to be owing to its great tendency to run into the vinous fermentation, which is totally inconsistent with that of putrefaction; and this tendency is so great, that it can scarce be counteracted by the tendency of animal substances to putrefy in any circumstances whatever.

Some kinds of air are remarkably antiseptic, though this subject has not been so fully inquired into as could be wished. The most powerful of them in this respect is the nitrous air; next to it, is fixed air: but the powers of dephlogisticated and inflammable air are not so well known. It is probable that the antiseptic properties of fixed and nitrous air, are owing to their quality of extinguishing fire, or at least that the principle is the same; but, till the nature of these two kinds of air are better known, little can be said with certainty on the subject.

Lord Bacon observes that an inquiry into the means of preventing and staying putrefaction, is of most important use in medicine; and Sir John Pringle has made experiments to determine the powers of certain substances to promote or to prevent putrefaction.

From these experiments he has formed the following Table, shewing the relative antiseptic powers of the saline substances mentioned. Having found that two drams of beef put into a phial with two ounces of water, and placed in a heat equal to 90° of Fahrenheit's thermometer, became putrid in 14 hours, and that 60 grains of sea-salt preserved a similar mixture of beef and water more than 30 hours, he made the antiseptic power of the sea salt a standard, to which he compared the powers of the other salts. The algebraic character + signifies, that the substance to which it is annexed had a greater antiseptic power than is expressed by the numbers.

Sea-salt, or the standard	1	Saline mixture	3
Sal-gem	1+	Nitre	4+
Vitriolated tartar	2	Salt of hartshorn	4+
Spiritus Mindereri	2	Salt of wormwood	4+
Soluble tartar	2	Borax	12
Sal diureticus	2+	Salt of amber	20
Crude sal ammoniac	3	Alum	30

N. B. The quantities of spiritus Mindereri and of the saline mixture were such, that each of them contained as much alkaline salt as the other neutral salts.

Myrrh, aloes, asafetida, and terra Japonica, were found to have an antiseptic power 30 times greater than the standard. Gum ammoniacum and sagepenum showed little antiseptic power. Of all resinous substances, camphor was found to resist putrefaction most powerfully. Sir John Pringle believes that its antiseptic power is 300° greater than that of sea-salt. Camomile flowers, Virginian snake-root, pepper, ginger, saffron, contrayerva-root, and galls, were found to be 12 times more antiseptic than sea-salt. Infusions of large quantities of mint, angelica, ground-ivy, green tea, red-roses, common wormwood, mustard, and horse-radish, and also decoctions of poppy-heads, were more antiseptic than sea-salt. Decoctions of wheat, barley, and other farinaceous grains, checked the putrefaction by becoming four. Chalk, and other absorbent powders, accelerated the putrefaction, and resolved meat into a perfect mucus. The same powders prevented an infusion of farinaceous grains from becoming mucilaginous and four. One dram of sea-salt was found to preserve two drams of fresh beef in two ounces of water, above 30 hours uncorrupted, in a heat equal to that of the human body, or above 20 hours longer than meat is preserved in water without salt: but half a dram of salt did not preserve it more than two hours longer than pure water. Twenty-five grains of salt had little or no antiseptic quality. Twenty grains, 15 grains, but especially 10 grains only of sea-salt were found to accelerate and heighten the putrefaction of two drams of flesh. These small quantities of sea-salt did also soften the flesh more than pure water. The same learned and ingenious physician made experiments to discover the effects of mixing vegetable with animal matters.

Dr. Macbride's experiments confirm many of those above related, especially those which show that the fermentation of vegetable substances is increased by a mixture of animal or putrescent matter; that the putrescency of the latter is corrected by the fermentative quality of the former; and that the putrefaction and fermentation of mixtures of animal and vegetable substances were accelerated by additions of absorbent earths and of Peruvian bark. He also found, that although unburnt calcareous earths were septic, quick-lime and lime-water prevented putrefaction, but that they destroyed or dissolved the texture of flesh.

The experiments of the author of the *Essai pour servir à l'Histoire de la Putrefaction*, show that metallic salts, resinous powders, extracts of bark, and opium, are very powerfully antiseptic, and that salts with earthy bases are less antiseptic than any other salts.

Sir John Pringle has made many curious experiments, with a view of determining the power of certain substances to promote or to prevent putrefaction, together with remarks on this subject, which are published in the Phil. Trans. vol. xlvi. p. 480, 525, 550, and by way of appendix to his Observations on the diseases of the Army. From the experiments of this learned and judicious physician, it appears, that salts of every kind, whether acid, alkaline, or neutral, fixed or volatile, as well as the astringent and gummy resinous part of vegetables, all of them resist and most of them correct putrefaction; and he pursued this branch of his enquiry so far as to enable him to form a table shewing the comparative antiseptic power of the several substances, that of sea-salt being the standard.

PUTREFACTION of Water. It is said to be the peculiar quality of the Thames water, that it will stink and yet be wholesome; and after this will recover itself again. Many sailors have been obliged to drink it stinking, so that they held their noses while they poured it down their throats, yet no sickness ensued from it. It generates a sort of spirit also in this stinking state, which will take fire at the approach of a lighted candle, as if spirit of wine were touched by the flame.

It appears from the preceding article, that, though a volatile alkali may be obtained from putrid substances by distillation, such substances must not be suffered to remain too long before they are distilled, unless they are kept in close vessels; because the volatile alkali, which is the offspring of putrefaction, is dissipated as fast as it is generated, inasmuch that, at length, nothing is left behind but an insipid water, or a solid matter, being an earth similar to common mould. It is in this way, says Dr. Macbride, that stinking water, after some time, becomes sweet; the volatile alkali, generated by

the putrefaction of the animal and vegetable substances at first contained in the water, being, after a while, entirely dissipated, leaves the remainder without any disagreeable smell.

A method of preserving water free from putrefaction was some years since proposed by Dr. Alston. It consisted in adding a quantity of lime to every cask of water; and as lime is known to have a strong antiseptic property, water, as long as it retains the impregnation of lime, never putrefies. In order to free the water at the time of using it from the lime, Dr. Alston proposes the precipitation of the latter by throwing in a quantity of magnesia alba, on this principle, that as lime-stone is rendered soluble in water by the deprivation of its fixed air, and has a greater affinity with that air than magnesia has, the particulars of quicklime dissolved in the water would attract the air from the magnesia, and thereby becoming no longer soluble, would fall to the bottom, and leave the water tasteless and fit for oeconomic uses.

The expense, however, attending this process prevented the execution of the proposal. Mr. Henry has lately suggested a cheap and easily practicable method of precipitating the lime, and thus of restoring the water to its original taste. The following is a short sketch of the author's process. To preserve the water from putrefaction, two pounds of good quicklime are directed to be added to each cask of water of a hundred and twenty gallons. To free the water afterwards from the lime with which it has been impregnated, it is to be drawn off into a strong cask, containing about sixty gallons, with an aperture at one end large enough to admit a vessel, which is to be let down into it by means of strings, and which contains a proper quantity of effervescent materials, that is, of marble or chalk, and vitriolic acid. Eight ounces of mild calcareous earth, and six ounces of strong vitriolic acid, will be sufficient for sixty gallons of lime water. The mouth of this last vessel is to be stopped with a tubulated stopper, through which the fixed air, let loose from the marble, passes up through the body of the water. The lime is thus rendered insoluble, and is soon precipitated in the form of an impalpable powder of chalk; the water being thus restored to the same state of purity as when it was first shipped on board; or, as Mr. Henry believes, to a state of still greater purity; several hard waters having in consequence of this process, been rendered as soft as rain-water, and freed from different impregnations. For farther particulars, and the description and drawing of an apparatus for this operation, see Henry's Account of a Method of preserving Water at Sea, &c. p. 10, &c. 1781.

PUTRID, *putridus*, something rotten or putrid. See **PUTREFACTION**. Thus we say putrid flesh; a putrid humour; putrid limbs, i. e. mortified ones, are to be cut off.

PUTRID Fever, For description, causes, prognosis, prevention, and cure, see the **System of MEDICINE**, Genus 6.

PYLORUS, in anatomy, the right and lower orifice of the stomach, whereby it discharges itself into the intestines. The pylorus is situate on the right side of the stomach, and passes by an oblique ascent, to the duodenum, to prevent the too precipitate passage of the aliment out of the stomach. See the **System**, Part III. Sect. III.

PYRAMID, *pyramis*, in geometry, a solid standing on a square, triangular, or polygonal basis, and terminating at top in a point; or a body whose base is a regular rectilinear figure, and whose sides are plain triangles; their several vertices meeting together in one point. Euclid defines it a solid figure, consisting of several triangles whose bases are all in the same plane, and have one common vertex.

PYRAMID, in architecture, denotes a solid, massive edifice; which, from a square, triangular, or other base, rises diminishing to a point, or vertex. When they are very narrow at bottom i. e. their base very small, they are called *obelisks*, and *needles*. Pyramids are sometimes erected to preserve the memory of singular events, and, sometimes, to transmit to posterity the glory and magnificence of princes; but, as they are the symbol of immortality, they are more commonly used as funeral monuments. Such is that of Cestius at Rome, the mausoleum of this distinguished Roman, who was one of the seven officers called *epulones*, and is said to have lived under Augustus, repaired in 1673, by Alexander VII. and those other celebrated ones of Egypt, as famous for their size as their antiquity. The pyramids of Egypt, comprehending the great and small, are very numerous; of these there are about twenty of the largest size. The most remarkable are the three pyramids of Memphis, or, as they are now called, of Gheisa of Gize. The dimensions of the greatest of these have been differently stated both by ancient and modern writers. Herodotus (lib. ii.) makes the base of it to be 800 feet long; Diodorus (lib. i.) 700; Strabo (lib. xvii.) less than 600; and Pliny (lib. xxxvi. cap. 12.) 883 feet. Among the moderns, Sandys found it to be 300 paces; Bellonius 324; Greaves 693 English feet; and Le Brun 770 feet. In order to reconcile these differences, Dr. Shaw observes, that none of the sides of this pyramid are exactly upon a level; so that it is difficult to find a true horizontal base; besides it is impossible to say how much the drifts of sand, to which it is exposed, may have been accumulated above the foundation of it; and, therefore, all calculations, depending upon the times and circumstances of the situation, when they were made, must be extremely precarious. For a particular and copious account of these curious remains of antiquity, see Banks's Geography, pages 386 and 387.

P Y R

PYRAMIDALES *Abdominis*, in anatomy, denote small muscles in the abdomen. For their origin, insertion, and use, see the System, Part II. Sect. I. Table of Muscles, Art. 15.

PYRIFORMIS, called also *pyramidalis*, in anatomy, a small oblong muscle of the thigh, receiving its name from its figure, which resembles that of a pear. It is also called *iliacus externus*, from its situation. For its origin, insertion, and use, see Part II. Table of Muscles, Art. 24.

PYRMONT Water, in physiology and medicine, a very brisk, spirituous, chalybeate, abounding in fixed air, and which, when taken up from the fountain at Pyrmont in Westphalia, in Germany, whence its name, sparkles like the briskest Champaign wine. It has a pleasant vinous taste, and somewhat sulphureous smell. It is perfectly clear, and bears carriage better than the Spa water. The history of these waters is accurately given by Hoffman in his observations on them, both in their natural state and in mixture with other bodies. He observes, that they contain a volatile and subtle principle, much more penetrating and strong, as well as in larger quantity, than any other mineral water: but that this is not to be expected in them any where but upon the spot, for those who transport them to other places are constrained to let a part of this fly off to preserve the rest. If either glass or earthen vessels be filled at the spring, and immediately corked and fastened down, the consequence is, that they will burst on the first motion or heat of the weather. They are, therefore, forced to fill them only in part at first, and let them stand awhile for this subtle spirit to exhale, and then a while after the filling them to cork and fit them for carriage. If they are drank upon the spot in a morning on an empty stomach, they affect the nose with a pungent tingling, and disturb the head for many hours afterwards. If they are taken at the spring, they purge but very little; but if taken in another place, after transportation, they purge considerably more, and render the stools black. It is observable also, that, if they are left in an open vessel a few days, their virtue wholly exhales, and they no longer purge nor render the stools black.

If a quantity of Pyrmont water be exposed twenty-four hours to the open air in a balon, it will at the end be found to have lost all its virtues, tasting wholly insipid, and being turbid, instead of the fine clearness it had before, and a yellow ochereous earth is precipitated to the bottom; after this the liquor will no longer shew any of those qualities which were before its distinguishing character, it will no longer ferment with acids, nor turn black with galls, nor green with syrup of violets.

It appears from the whole, that the Pyrmont waters possess a pure, extremely penetrating, and elastic mineral spirit, and that in a very large proportion; and to this their virtues are principally to be attributed. This mineral spirit, while it remains engaged in a calcareous earth, emulates the properties of an alkaline substance; and when joined with a subtle martial earth, it emulates the properties of vitriol, giving the stools a black colour, and turning a tincture of galls into ink: and while this remains in the water in these forms of an alkaline or vitriolic principle of so great subtilty, it cannot but give them very great virtues in strengthening the tone of the viscera, opening obstructions, and stimulating in a proper manner the excretory ducts, so as to make them duly perform their office; but as soon as by the standing of the water open, or by any other accident, this subtle element is evaporated, all the virtues of the water must be gone with it. The great quantity of this powerful spirit contained in the waters, makes them more fit for the robust and strong constitutions, when depraved by illness, than for the weak and tender ones; but even the tenderest people may take them, only observing to take but a small dose, or to dilute them with an equal quantity of common water immediately before the taking them. Hoffman also recommends the Pyrmont water mixed with equal quantities of milk, on his own experience, in scorbutic and gouty cases. Hoffman. Opera. tom. v. p. 143. seq. Pyrmont water, and other mineral waters of a similar nature, owe their acidulous taste and peculiar virtues to the fixed air which they contain. We shall here add some farther remarks on the effects and medical uses of this water. Persons who drink it at the well are affected with a kind of giddiness or intoxication, which is probably owing to the great quantity of fixed air with which the water abounds. The common operation of this water is by urine; but it is also a gentle sudorific; and if taken in large quantity proves laxative. However, in order to this effect, it is usual to mix some salts with the first glasses. It is drank out of glasses in the morning to the quantity of from one to five or six pints, according to circumstances; those who drink it, walking about between each glass. This water is recommended in cases where the constitution is relaxed: in want of appetite and digestion; weakness of the stomach, and heart-burn; the green sickness; female obstructions and barrenness; the scurvy and cutaneous diseases; and in the gout, especially as Hoffman observes, when mixed with milk: in cholics; bloody fluxes; disorders of the breast and lungs; in which case it is best taken lukewarm: in nervous, hysterical, and hypochondriacal disorders; in apoplexies and palsies: in the gravel and urinary obstructions; in foulness of the blood; and in obstructions of the finer vessels. It amends the lax texture of the blood; exhilarates the spirits without inflaming, as vinous liquors are apt to; and is reckoned among the best restoratives in decayed and broken con-

P Y T

stitutions. It is said to possess the general virtues of the Spa water, and at the fountain it is more spirituous, as well as a stronger chalybeate. Elliot's Med. Virtues, &c. of Mineral Waters, 1781. p. 181. Near the famous well at Pyrmont, is a stone quarry under ground, from some parts in which a sulphureous steam comes out, which commonly rises to a small height. Animals held in this steam are soon suffocated, but recover if quickly taken out. When a man stands in this steam, but with his head over it, it proves an excellent sudorific. Dr. Seip proposes to perform cures in several diseases with it. See Phil. Trans. No. 448, sect. 4. and Misc. Berolin. tom. v. part 2. sect. 4.

PYROTECHNY, *Πυροτεχνία*, formed from *πυρ*, fire, and *τεχνη*, art, the art of fire, or a science which teaches the management and application of fire in several operations. Pyrotechny is of two kinds, military and chymical.

Military PYROTECHNY, is the doctrine of artificial fire-works, and fire-arms, teaching the structure and use both of those used in war for the attacking of fortifications, &c. as gunpowder, cannons, bombs, granadoes, carcasses, mines, fuses, &c. and of those made for amusement, as rockets, stars, serpents, &c. Some call pyrotechny, by the name *artillery*; though that word is usually confined to the instruments used in war. Others choose to call it *pyrobology*, or rather *pyrobology*, q. d. the art of missile fires, from the Greek *πυρ*, fire, and *βολη*, to cast, or throw. Wolfius has reduced *pyrotechnia* into a kind of a mixt mathematical art: indeed it will not allow of geometrical demonstrations: but he brings it to tolerable rules and reasons. whereas before it had used to be treated by authors at random, and without any regard to reason at all. See the elements of *military pyrotechny*, under the several instruments and operations, CANNON, BOMB, ROCKET, GUNPOWDER, &c.

Chymical PYROTECHNY, is the art of managing and applying fire in distillations, calcinations, and other operations of chymistry. Some reckon a third kind of *pyrotechnia*, viz. the art of fusing, refining, and preparing metals.

PYRUS, the pear-tree; a Genus of the Pentagynia order, belonging to the Icosandria class of plants: To this genus Linnæus has joined the apple and quince. For the culture of pear and apple trees, see Treatise on GARDENING, article *Fruit Garden*, months *January* and *February*.

PYTHAGOREANS, a sect of ancient philosophers, who adhered to the doctrine of Pythagoras. Pythagoras, the founder of this sect, was of Samos, the son of a lapidary, and a pupil of Pherecydes, and flourished, says Bayle, about five hundred years before Christ, in the time of Tarquin, the last king of Rome, and not in Numa's time, as many authors have supposed. See Cicero Tuscul. Quest. lib. iv. cap. 1. This sect was also called the *Italic sect*, or *Italic school*, because Pythagoras, after travelling into Egypt, Chaldea, and even into the Indies, to inform his understanding, returning home to his own country, and there unable to bear the tyranny of Polycrates, of Syloson, retired into the eastern part of Italy, then called the Greater Greece, and there taught and informed his sect. Pythagoras made his scholars undergo a severe noviciate of silence for at least two years; and it is said, that, where he discerned too great an itch for talking, he extended it to five: his disciples were therefore divided into two classes, of which the first were simple hearers, and the last such as were allowed to propose their difficulties, and learn the reasons of all that was taught there. The Pythagoreans, it is said, on their rising from bed, roused the mind with the sound of the lyre, in order to make them more fit for the actions of the day; and at night resumed the lyre, in order to prepare themselves for sleep, by calming all their tumultuous thoughts. The figurative manner in which he gave his instructions, was borrowed from the Hebrews, Egyptians, and other orientals. Some think he derived his philosophy from the books of Moses, and that he conversed with Ezekiel and Daniel at Babylon: but this is mere conjecture. He was the first who assumed the modest title *philosopher*, or *lover of wisdom*; those who excelled in the knowledge of nature, and made themselves conspicuous by an exemplary life, till his time, having borne the arrogant appellation *σοφισταις*. His school in Italy was at Crotona, where he is said to have been attended by no less than six hundred scholars. His house was called the temple of Ceres, and the street where it stood, the Museum. Out of this school proceeded the greatest philosophers and legislators Zaleucus, Charondas, Archytas. Porphyry says, as soon as he arrived in Italy, he had an auditory of two thousand people, to whom he explained the laws of nature, reason, and justice. His school became so popular, that whole cities, and people committed their republics to the government of his scholars. At length, Porphyry adds, envy stirring up sedition against them, they were oppressed; and, in time, their learning, which they ever kept secret, was lost, except some difficult things learnt by rote by the crowd of hearers; for Pythagoras never committed anything to writing. His maxims of morality were admirable; for he was for having the study of philosophy solely tend to elevate man to a resemblance of the Deity. He believed that God is a soul diffused through all nature, and that from him human souls are derived; that they are immortal, and that men need only take pains to purge themselves of their vices, in order to be united to the Deity. He made unity the principle of all things; and believed, that between God and man there are various orders of spiritual beings, who are the ministers of the Supreme Being.

P Y T

He condemned all images of the Deity, and would have him worshipped with as few ceremonies as possible. His disciples brought all their goods into a common stock, and condemned the pleasures of sense, abstained from swearing, eat nothing that had life, and believed in the doctrine of a metempsychosis. See the article **METEMPSYCHOSIS**.

It is said, that Pythagoras, considering God as the mover of the universe, and the soul of the world, affirmed, that our souls are portions of God. Cicero *De Nat. Deorum*, lib. i. cap. 11. Pythagoras also asserted a metempsychosis, or transmigration of souls; and therefore the immortality of the soul. He also taught, that virtue is harmony, health, and every good thing; and that God, and therefore all things, consist of harmony. With respect to the end of our actions and studies, he taught, that the study of philosophy should tend to make men like God; and that the acquisition of truth was the only way to attain to the likeness of God; but that truth cannot be known, unless it be inquired after with a purified soul, and such as have overcome the passions of the body. The best presents which heaven gave to men, according to Pythagoras, are

to speak truth, and to do good offices; those two things, said he, resemble the works of God. The circumstances of his death are variously related. Some say, that he was burnt at Milo's house at Crotona, together with his disciples. Others say, that he escaped from the flames; and, being pursued out of the city, stopped in a field of beans, and chose rather to be killed, than open his mouth. Dicaearchus says, that he fled to the temple of the Muses at Metapontus, where he died of hunger. Others assert, that he was killed, with all his disciples, by the Agrigentines. Arnobius affirms, that he was burnt alive in a temple, &c. Justin seems to insinuate, that after his having lived 20 years at Crotona, he died in peace, in a very advanced age, at Metapontum, to which city he had retired. His memory was held in such veneration, that his house was converted into a temple, and he was honoured as a god. Some authors say, that he left nothing in writing; but Laërtius and others attribute several treatises to him. His golden verses, attributed by some to one of his disciples, are allowed to be an exact copy of the sentiments of that divine philosopher, from whose school proceeded the greatest philosophers and legislators.

P Y T

Q U A

Q, or *q*, the 16th letter and 12th consonant of our alphabet; but is not to be found either in the Greek, old Latin, or Saxon alphabets; and indeed some would entirely exclude it, pretending that it ought to be used wherever this occurs. However, as it is formed in the voice in a different manner, it is undoubtedly a distinct letter. The *q* is never sounded alone, but in conjunction with *u*, as in *quality, question, quite, quote, &c.* and never ends any English word.

QUACK, in medicine. See **EMPIRIC**.

QUADRAGESIMA, a term sometimes used for the time of **LENT**; because consisting of forty days. Quadragesima Sunday is the first Sunday in **LENT**; so called, because it is about the fortieth day before Easter. On the same account, the three preceding Sundays are called **QUINAGESIMA**, **SEXAGESIMA**, and **SEPTUAGESIMA**.

QUADRANGLE, in geometry, a quadrangular, or quadrilateral figure: or a figure which has four sides, or four angles. To the class quadrangles, or *quadrangular figures*, belong the *square, parallelogram, trapezium, rhombus, and rhomboides*. See the **System**, Part I. Sect. I.

QUADRANT, *quadrans*, in geometry, an arch of a circle, containing 90 degrees, or one-fourth of the entire periphery. Sometimes, also, the space or area, included between this arch and two radii, drawn from the centre to each extremity thereof, is called a quadrant, or, more properly, a quadrantal space: as being a quarter of the entire circle. See the **System**, Part I. Sect. III.

QUADRANT also denotes a mathematical instrument, of great use in navigation and astronomy, for the taking of altitudes, angles, &c. See the respective **Systems**.

The quadrant is variously contrived, and furnished with different apparatus, according to the several uses for which it is intended; but they have all this in common, that they consist of a quadrant, or quarter of a circle, whose limb is divided into 90 degs. and that they have a plumbet suspended from the centre; and are furnished with pinnule or sights, through which to look. The principal, most usual, and useful quadrants, are, the *common or surveying quadrant, the astronomical quadrant, Adams's quadrant, Bird's quadrant, Mural quadrant, Davis's quadrant, and Hadley's quadrant improved*.

The common or surveying quadrant is made of brass, wood, or other matter, usually twelve or fifteen inches radius. Its circular limb is divided into 90°, and each of those subdivided into as many equal parts as the space will allow, either diagonally or otherwise. For its construction and uses see the **System**.

The *astronomical QUADRANT*, is a quadrant usually made of brass or iron bars, having its limb curiously divided, diagonally, or otherwise, into degrees and minutes, and even seconds, if possible; with plain sights fixed on one side of it; or, instead thereof, a telescope, and an index moving about the centre, carrying either plain sights, or a telescope. For the construction and uses of Adams's astronomical quadrant, see the **System**, Sect. XVI. For the representation, see Plate V. Fig. I.

Bird's Twelve Inch QUADRANT. For the construction and method of adopting it, see the **System** of **ASTRONOMY**, Sect. XVI. For representation, see Plate V. Fig. 2.

Mural QUADRANT. For its construction and uses, see the **System** of **ASTRONOMY**, Sect. XVI. For representation, see Plate V. Fig. 3.

Davis's QUADRANT. For its description and uses, see the **System** of **NAVIGATION**, Part III. Sect. I. For representation, see the Plate, Fig. 11.

Hadley's QUADRANT, the common name for the justly esteemed quadrant, invented by the late John Hadley, esq. This quadrant, which at first shared the fate of many other ingenious inventions, to be neglected by ignorant and obstinate men, even though highly useful to them in their profession, has at last made its way, in spite of habit and prejudice, and is now generally used. For a full de-

Q.

scription of Hadley's quadrant, as constructed in the best manner by Mr. Adams, together with directions for its management and several uses in the practical part of navigation, see the **System** of **NAVIGATION**, Part III. Sect. IV. For representation, see the Plate, Fig. 14.

Other quadrants have been contrived since, by some ingenious artists, all of which have their merit; but the particulars of their constructions are too many for this place; and perhaps, on the whole, nothing preferable to Mr. Hadley's invention has yet been found.

QUADRANT, in gunnery, called also the *gunner's square*, is an instrument serving to elevate or point cannons, mortars, &c. according to the places they are to be levelled or directed to. For its description and management, see the treatise on **PROJECTILES**, Part II. Art. IX.

QUADRANT of Altitude, is an appendage of the artificial globe; consisting of a lamina or slip of brass, the length of a quadrant of one of the great circles of the globe; and divided into ninety degrees. See **Treatise on the GLOBES**, under the Article *Description of the Globes*. For representation, see the Plate, Fig. 3, Letters Z A.

QUADRATRIX, in geometry, a mechanical line, by means whereof we could find right lines equal to the circumference of circles, or other curves, and of the several parts thereof. For its full definition and peculiar properties, see the **System**, Part III. Article **CONIC SECTIONS**, Sect. IV. For representation, see Plate II. Fig. 52.

QUADRATURE, *quadratura*, in geometry, the act of squaring, or of reducing a figure to a square; or finding a square equal to some other figure proposed. Thus, the finding of a square containing just as much surface or area as a circle, an ellipsis, a triangle, or other figure, is called the quadrature of a circle, of an ellipsis, a triangle, or the like. See the **System**, Part III. Sect. X.

QUADRATURE, in astronomy, that aspect or situation of the moon, when she is 90 degrees distant from the sun. See the **System**, Sect. VII. Article **DEFINITIONS**.

QUADRATUS, in anatomy, a name applied to several muscles, in respect of their square figure; as *Quadratus Femoris*. See the **System**, Part II. under the several articles to which they respectively appertain.

QUADRILATERAL, in geometry, a figure whose perimeter consists of four right lines, making four angles; whence it is also called a quadrangular figure. See the **System**, Part I. Sect. I.

QUADRILLE, a well known game at cards; and which has been, in several cases, the object of mathematical computation. See Mr. De Moivre's *Doctrine of Chances*, 3d edit. p. 97, &c.

QUADRUPED, in zoology. The essential character of quadrupeds is, that they have a hairy body and four feet, and that the females are viviparous, and give suck to their young. Quadrupeds are distinguished, by the number of their feet, from other animals, which have only two feet, as birds; from those which have no feet, as fishes and reptiles; and from those which have more than two feet, as insects. Linnæus brings these animals into the first kingdom of nature, called zoology, and makes them of the first class of this kingdom, in which classification he differs from many preceding and following authors, by introducing cetaceous fish in the same class. His reason for which is, that they give suck; therefore he makes this the line of discrimination, and calls them by one general term, *Mammalia*, meaning all animals that give suck. For description of their classical characters, their systematic arrangement, characteristic description of the several orders, and classification of their generic characters, see the **System** of **MAMMALIA**, under their respective heads. For description of the several genera, with their most remarkable species, see the order of the alphabet as they respectively occur. For representation, see the Plates annexed to the **System** of **MAMMALIA**.

QUAIL,

QUAIL, the English name of a species of the Genus Tetrao, in the System of ORNITHOLOGY. See TETRAO.

QUAKERS, in ecclesiastical history, a religious sect, who made their appearance in England about the middle of the seventeenth century. George Fox, an illiterate person, born at Drayton, in Leicestershire, in the year 1624, by trade a shoe-maker, was the first who publicly preached the doctrine of the sect. He proposed but few articles of faith, dwelt mostly on morality, and preached mutual charity and the love of God, and a deep attention to the inward motions of the spirit. He would have a religion and worship simple, and without ceremonies; making it a principal point to wait in profound silence, for the influence and directions of the Holy Spirit.

The name of Quaker was affixed to this people early, by way of reproach. In their assemblies it sometimes happened, that some were so far struck with remembrance of their past follies and forgetfulness of their condition, others so deeply affected with a sense of God's mercies to them, that they actually trembled and quaked. The nickname so suited the vulgar taste, that it immediately became general. *Friends*, or *The friends of truth*, was the name they were commonly known by to one another; but the epithet above mentioned was stamped upon them by their adversaries, and perhaps indelibly.

This denomination is likewise said to be partly owing to an exhortation addressed to Gervas Bennet, esq. a justice of peace in Derbyshire, by Fox and his companions, who, when they were called before him in the year 1650, desired him, with a loud voice, and a vehement emotion of body, to *tremble* at the word of the Lord; but, as a term of mutual love, which ought to subsist amongst Christians, they called themselves *Friends*. An eager zeal at first led some of them, who were off their guard, into several extravagances; and one of them, viz. James Naylor, is said to have had the impiety to suffer himself to be called the son of God, son of Justice, and king of Israel, by a few deluded followers, who strewed garments before him, and hailed him, at his entry into Bristol, with Hosanna, son of David! He had his trial for the same, and was whipped, and otherwise severely punished, for blasphemy; and so far from being countenanced in these proceedings by his brethren, he was, in the early part of his delusion, admonished, and at length excommunicated by them, and he afterwards condemned publicly his own conduct. The doctrines of the Quakers being in many respects different from those generally held, together with their disusing the customary compliment of the hat, and the usual salutations, subjected them to grievous sufferings, such as imprisonment, whipping, fines, and premature, in this kingdom; and four of them were hanged in New England. Their refusing to pay tythes &c. and to frequent the established worship, and their holding public meetings of their own (at that time contrary to law,) were the chief crimes laid to their charge; and when these failed, their persecutors were sure to find occasion against them by tendering to them the oath of allegiance, which, in common with all others, their principles would not admit of their taking. Besides these penalties they were ridiculed in writing, and exposed on the stage; but they despised both the press and the prison, and, notwithstanding all opposition, they became a regular body, with stated laws and polity, which they retain, with great oeconomy, to this day. At length the peaceable demeanor of this people induced the legislature to grant them relief. They had shared, with other dissenters, the benefit of the proclamation for liberty of conscience, and of the act of toleration. The profession of belief enjoined upon the Quakers by this act is as follows: "I, A. B. profess faith in God the Father, and in Jesus Christ his eternal son, the true God, and in the Holy Spirit, one God blessed for evermore; and do acknowledge the Holy Scripture of the Old and New Testament to be given by divine inspiration." But they were particularly eased by an act of 1 W. & M. cap. 18. which allowed to their affirmation (except in a few cases) the validity of an oath. This indulgence was confirmed by subsequent acts; thus in 1695, they obtained, by a temporary act, that their solemn affirmation should be accepted in all cases, where the oath is required by law; except in criminal cases, upon juries, and in places of profit and trust under the government, in this form: "I, A. B. do declare, in the presence of Almighty God, the witness of the truth of what I say, &c. This act was afterwards continued; and at last made perpetual. But this form not being such as was desired, and having, in reality, all the essentials of an oath, they applied to parliament for an alteration, which they obtained, anno 1721; when the following form was settled to their general satisfaction; viz. "I, A. B. do sincerely, solemnly, and truly declare and affirm." Which is the form used, in the same manner, and under the same limitation with the former. 8 Geo. 6. cap. 6. 22 Geo. II. cap. 46. Any person deposing, upon his solemn affirmation, a known falsehood, incurs the penalty of wilful and corrupt perjury. 8 Geo. cap. 6. By the same act, Quakers are allowed, instead of the oaths of allegiance and supremacy, to make a declaration of fidelity. In consequence of these statutes, &c. provision being also made for the easy recovery of tythes, and other ecclesiastical demands, from them, they are at present generally unmolested in the exercise of their profession. However, long before this happy change in their condition, they were constrained, by the vexations and persecutions they suffered in

their native country, during the reign of Charles II. to look about for some distant settlements, where they might shelter themselves from the storm; and with this view they began to disseminate their religious principles in various countries. Attempts of this nature were made in Germany, Prussia, France, Italy, Greece, Holland, and Holdstein, but with little success. The Dutch, however, were at length persuaded to allow a certain number of them to settle in Holland, where they still continue to reside. Multitudes of them also went over to America, and formed settlements there, not long after the first rise of their sect; and it afterwards happened, by a singular concurrence of events, that this new world became the chief seat of their prosperity and freedom. William Penn, son of the famous vice-admiral of that name, who embraced Quakerism in 1668, received in 1680, from Charles II. and from the English parliament, the grant of an ample, fertile, but uncultivated province in America, as a reward for the eminent services of his father. This illustrious quaker carried over with him into his new dominions a considerable colony of his friends and brethren, and founded a republic; whose form, laws, and institutions, resemble no other known systems of government; whose pacific principles and commercial spirit, have long blessed it with tranquillity and opulence, and which, till the eruption of the late unhappy contest, continued in a prosperous and flourishing state. The quakers predominate in this colony, both by their influence and their numbers; but all those who acknowledge the existence and providence of one Supreme Being, and shew their respect to that Being, either by external worship, or at least by the regularity of their conduct, are admitted to the rights and privileges of citizens in this happy republic. The large province that constitutes its territory, was called Pennsylvania, from the name of its proprietor; and its capital city was named Philadelphia, from the spirit of union and fraternal love that reigned at first, and is still supposed to prevail, more or less, among its inhabitants.

The following abstract from the propositions of our countryman, the eminent Barclay, will perhaps exhibit as clear a summary of their opinions as can well be comprised within the limits allowed to this article. 1. The height of all happiness is placed in the true knowledge of God. 2. The true knowledge of God is alone to be obtained by the revelation of the Spirit of God. 3. The revelation of the spirit of God to the saints has produced the scriptures of truth. 4. From whence it appears, that mankind in general is fallen and degenerated. 5. That God, out of his infinite love, hath offered universal redemption by Christ, who tasted death for every man. 6. That there is an evangelical and saving light and grace in all. 7. That as many as resist not this light, but receive the same, in them are produced holiness, righteousness, purity, and the fruits which are acceptable to God. 8. Even so as to arrive at a state of freedom from actual sinning and transgressing the law of God. 9. Yet with a possibility of sinning. 10. That as all true knowledge in things spiritual is received by the Spirit of God, so by it every true minister of the gospel is ordained and prepared for the ministry; and as they have freely received, so are they freely to give. 11. That the true worship of God is in spirit and in truth; not limited to place or time, or subject to the intervention of any person; but is to be performed under the moving of the Holy Spirit in our hearts, yet without derogating from the necessity and utility of public united worship, (in which their sufferings and constancy have been most remarkable). 12. That baptism is a pure and spiritual thing, the baptism of the spirit by fire. 13. That the communion of the body and blood of Christ is inward and spiritual. 14. That it is not lawful for any human authority to force the consciences of others on account of difference in worship or opinion, except such opinions tend to the prejudice of his neighbour in his life or estate, or are inconsistent with human society. 15. That as the end of religion is to redeem man from the spirit of this world, and to lead him into inward communion with God; therefore, all vain customs and habits are to be rejected, which tend to divert the mind from a sense of the fear of God, and that evangelical spirit wherewith Christians ought to be leavened. Such are the sentiments of this people as proposed to the public by their apologist, who has largely commented on these topics, in a work that has passed through many editions in English, and has been printed in most of the modern languages.

As to discipline and polity, the affairs of the community are managed by rules established with common consent, and this principally at their meetings, whereof they have many kinds; as monthly, quarterly, yearly, meetings for sufferings, and meetings of ministers and elders. The monthly meetings are, in general, composed of several single congregations, or particular meetings. The business of the monthly meetings comprises the care of the poor (the quakers every where maintaining their own); allowing and recording marriages; recording births, burials, and sufferings; granting certificates of unity to those who travel as ministers, and of membership to all who change their place of residence. Here also notice is taken of disorderly conduct, appointments are made to visit the delinquents, who, if unreclaimed by the endeavours of their brethren, are by these meetings disunited from the society. Here appointments are also made to confer with such persons as incline to join them. From these meetings, answers to certain queries are sent, in writing, to the quarterly meetings. The subjects of inquiry are,

Q U A

the education of youth; the adherence of the members to the principles of their profession; justice in dealing; clearness from paying tythes, or receiving impropriate ones; from defrauding the king of his revenue, or bearing arms, or being concerned in privateers or armed vessels, or dealing in prize goods, as such; the attendance of their religious meetings; and the general care to maintain good order. The quarterly meeting for each county consists of representatives from the monthly meetings therein. Its business is to digest the accounts received from the monthly meetings, and to prepare a general account to be sent to the yearly meeting in the like form of answers to queries. To this meeting any person thinking himself aggrieved by the judgment of the monthly meeting, may appeal for redress. It is proper to remark, that these people do not suffer their members to go to law with each other; but enjoin that all differences among themselves be settled by arbitration.

The yearly meeting is held in London. It consists of representatives from the several quarterly meetings, approved ministers, elders, and the members of the meeting for sufferings. This assembly makes rules for the government of the society; orders collections for general service; hears appeals from the judgment of quarterly meetings, and finally confirms or reverses them; gives advice and directions to the inferior meetings, and the body at large. The yearly meeting is held in that called Whitsun-week; not, say they, from any superstitious regard to that time, but because it is the most convenient season that can be fixed upon. The meeting for sufferings consists of correspondents, appointed by the several places corresponding with the yearly meeting. In this meeting also approved ministers have a seat. Its original institution was to provide for the numerous exigencies of the times of persecution; and it now administers advice to those who are prosecuted for non-payment of tythes, &c. and solicits their relief from prosecution. This meeting is held weekly in London, and hath the general care of the society's affairs during the intervals of the yearly meeting; keeps the society's stock, and hath the care of the expenditure thereof; which is for publishing books to give away, wages of a clerk, and defraying the expence of the passage of ministers who visit their brethren beyond sea.

Besides the meetings already mentioned, there are select meetings of ministers and elders. The care of revising manuscripts intended to be published on behalf of the society, is committed to the meeting of ministers and elders, which meets every week in London. The women have distinct monthly and quarterly meetings, in which they attend to the wants of the poor of their own sex. The quakers have always been peaceable and inoffensive subjects of the governments under which they live, which their principles forbid them to resist; nevertheless they think it lawful to remonstrate whenever their civil or religious liberties are invaded. They hold slavery to be incompatible with the doctrines of Christianity, and accordingly are not concerned in the slave-trade, and have abolished amongst them the practice of keeping slaves.

The doctrines of the quakers are laid down in a well written apology, addressed to king Charles II. by Robert Barclay, before-mentioned; and are also explained in the numerous writings of William Penn, Isaac Pennington, and others of their sect. William Sewell, a Dutchman, published, in 1717, the history of this people. He was one of their persuasion, a man of learning, and known to the public by his Dictionary of the Dutch and English languages. He had access to all their records, corresponded with the most eminent, lived at the time when the facts he recorded were recent, and we have not heard that any part of his history has been controverted: and as we are informed that it has been published by the approbation of the quakers, we may therefore consider it as an authentic history of their rise, progress, and principal opinions. A history of this people was also published by Gerard Croese, anno 1695; but that author is by them accused of having misrepresented facts, and in many respects done them injustice. They also complain, that the learned Dr. Mosheim, in his Ecclesiastical History, has not shewn his usual accuracy and candour in the account he has given of them; having, as they alledge, greatly misrepresented their principles and practices; in which he has been followed by Dr. Forney, and by John Wesley, in a late extract of that celebrated work.

Perhaps this is the only society in the world that have allowed any share in the management of their affairs to the female sex; which they do upon the principle that the male and female are one in Christ. Accordingly we find them in every department of their institution. They have women preachers, for whom the celebrated Locke made an excellent apology. When we reflect what a number of individuals of both sexes are kept in good order by the police of this society, how few of them are brought into the courts of justice as delinquents, how peaceable their behaviour, and how exemplary their conduct, we cannot but think their principles deserve a more accurate examination than has hitherto been attempted, owing perhaps to the vulgar prejudices circulated against them. We shall close this article with observing, that, according to the best of our information, neither their ministers, nor those who have the principal care of the society, enjoy any pecuniary emolument or advantages. A few clerks only receive salaries for keeping their records; so that perhaps there is not a religious so-

cietiy now existing, where principle has a greater influence in promoting the ends of their institution.

It is remarkable, that all the settlements of the Europeans in America, except the quaker settlement of Pennsylvania, were made by force of arms, with very little regard to any prior title in the natives. The kings of Spain, Portugal, France, and Britain, together with the States of Holland, then the only maritime powers, gave grants of such parts of America as their people could lay hold on, studying only to avoid interference with their European neighbours. But Mr. Penn, being a quaker, did not think his powers from king Cha. II. a sufficient title to the country, since called Pennsylvania: he therefore assembled the sachems or princes then in that country, and purchased from them the extent of land that he wanted. The government of this province is mostly in the hands of the quakers who never have any quarrels with the natives. When they desire to extend their settlements, they purchase new lands of the sachems, never taking any thing from them by force. How unlike is this conduct to that of the Spaniards, who murdered millions of the natives of Mexico, Terra Firma, Peru, Chili, &c.

The editor is indebted for the compilation of this article (very few additions excepted) to a gentleman of the profession described in it; whose judgment and liberality every reader must, he is persuaded, approve and commend.

QUALIFICATION, *for killing Game*. See **GAME**.

QUALITY, *qualitas*, that affection of a thing, whence it is denominated such; or that which occasions a thing to affect our senses in this or that manner, and gives it this or that denomination. Accordingly quality is said to be an attribute, from which no substance is exempt. Thus, that power in fire, whatever it be, whereby it excites in us the sensation of heat, since it is that whence the fire is denominated hot, is called the quality of fire.

QUALITY, is also used for a kind of title, or degree of eminence, given to certain persons, in regard to their territories, signories, or other pretensions. Thus the king of Great Britain takes the quality of king of France; the king of Poland that of king of Sweden; the king of Sardinia that of king of Cyprus and Jerusalem; the czars of Russia, and kings of Spain, have whole pages of qualities. The emperor of China assumes the quality of son of the fun.

QUANTITY, *quantitas*, any thing capable of estimation or mensuration; or, which being compared with another thing of the same kind, may be said to be greater or less than it; equal, or unequal, to it. Mathematics is the science or doctrine of quantity.

Physical or Natural QUANTITY, is of two kinds: 1. That which nature furnishes us with in matter, and its extension. And 2. In the powers and properties of natural bodies; as gravity, motion, light, heat, cold, rarity, density, &c.

QUANTITIES, in algebra, are intermediate numbers, or things referred to unity in general. See **NUMBER**. Quantities are properly the subject of algebra; which is wholly conversant in the computation of such quantities. See the **SYSTEM**, Sect. I. throughout.

Positive or Affirmative QUANTITIES, are those which are greater than nothing; and which are affected with the sign + prefixed; or supposed to be so. See the **System** under Article **DEFINITIONS**.

Negative or Privative QUANTITIES, for the rules for the addition, subtraction, multiplication, and division of quantities in algebra, see the **SYSTEM**, Sect. II.

Multiplication and Division of QUANTITIES. See **MULTIPLICATION**.

QUANTITY, in grammar, denotes the measure and magnitude of the syllables; or that which determines them to be called long, or short; or it is the measure of time requisite for the distinct pronunciation of a syllable. This quantity is the object of **PROSODY**; and it is the regard to this that distinguishes verse from prose. See the **SYSTEM**, Part II. Chap. II.

QUARANTAIN, or **QUARENTINE**, is more particularly used for the term of forty days, which vessels, coming from places suspected of contagion, are obliged to wait in certain places appointed to air themselves before they come into port. By the stat. 20. Geo. II. cap. 6, explained and amended by 29 Geo. II. cap. 8. the method of performing quarantine, or forty days probation, by ships coming from foreign countries, is put in a much more regular and effectual order than formerly; and masters of ships coming from infected places, and disobeying the directions there given, or having the plague on board, and concealing it, are guilty of felony without the benefit of clergy. The same penalty also attends persons escaping from the **LAZARETTOS**, and officers and watchmen neglecting their duty, and persons conveying goods or letters from ships performing quarantine.

QUARTAN, in medicine, the name of a species of intermittent fever, which returns upon the patient every fourth day, including the days of both the paroxysms, with a cold fit succeeded by a hot one. For description, prognosis, causes, and cure, see the **SYSTEM**, Genus 2.

QUARTER, the fourth part of a whole, or integer divided into four equal portions. In working of fractions, the quarter is expressed by $\frac{1}{4}$; three quarters by $\frac{3}{4}$. See the **System** of **ARITHMETIC**, Article XI.

QUARTER, in astronomy, the moon's period, or lunation, the fourth

Q U A

Q U A

fourth part of which is divided into four stages, or quarters; containing each from seven to eight days. The first quarter is from the new moon to the quadrature; the second thence to the full moon, &c. See the System, Sect. VIII.

QUARTER, in heraldry, is sometimes used for an escutcheon, or coat of arms. See the System, Sect. II. and Plate II.

QUARTER is also applied to the parts or members of the first division of a coat that is quartered, or divided into four quarters. See the System, Sect. II. and Plate II.

Franc QUARTER, is a quarter single, or alone; which is to possess one fourth part of the field. This makes one of the honourable ordinaries of a coat. See the System, Sect. VI. Art. II. and Plate IV.

QUARTER of a Ship, is that part of the ship's side which lies towards the stern; or which is comprehended between the aftmost end of the main chains, and the sides of the stern, where it is terminated by the quarter pieces. See Treatise on NAVAL AFFAIRS, Sect. IV. and the representation of a first rate at anchor.

QUARTER, in war, the place allotted to certain forces to live, lodge, and encamp upon, during a siege, or the like. See CAMP.

QUARTER-DECK of a ship, is that aloft the steerage, reaching to the round-house. See the Treatise on NAVAL AFFAIRS, according to the above reference.

QUARTERING the Men, in sea-language, the disposing of the ship's company at the time of an engagement in such a manner that each may readily know where his station is, and what he is to do. See Treatise on NAVAL AFFAIRS, Sect. III.

QUARTERING, in heraldry, the act of dividing a coat into four or more quarters, or quarterings, by parting, coupling, &c. i. e. by perpendicular and horizontal lines, &c. See **QUARTER**. The king of Great Britain quarters with Great-Britain, France, Ireland, Brunswick, &c. See the System of PEERAGE, Plate I.

QUARTERLY, in heraldry. A person is said to bear quarterly, when he bears arms quartered. The king of Great Britain bears quarterly of four; in the first quarter gules, &c. Great Britain; in the second azure, &c. Ireland, &c.

General QUARTER-SESSIONS of the Peace, a court that must be held in every county, once in every quarter of a year; which, by stat. 2. Hen. V. c. 4. is appointed to be in the first week after Michaelmas day; the first week after the Epiphany; the first week after the close of Easter; and on the 7th of July. This court is held before two or more justices of the peace, one of whom must be of the *quorum*. See **QUORUM**. The jurisdiction of this court by 34 Ed. III. c. 1. extends to the trying and determining of all felonies and trespasses whatsoever; though they seldom, if ever, try any greater offence than small felonies within the benefit of clergy; their commission providing, that if any case of difficulty arises, they should not proceed to judgment, but in the presence of one of the justices of the court of king's bench or common pleas, or one of the judges of assize. And, therefore, murders, and other capital felonies, are usually remitted for a more solemn trial, to the assizes. They cannot also try any new created offence, without express power given them by the statute which creates it. But there are many offences, and particular matters, which, by particular statutes belong properly to this jurisdiction, and ought to be prosecuted in this court: as the smaller misdemeanours against the public or commonwealth, not amounting to felony; and especially offences relating to the games, highways, alehouses, bastard children, the settlement and provision for the poor, vagrants, servants wages, and apprentices. Some of these are proceeded upon by indictment, and others in a summary way by motion and order thereupon; which order may, for the most part, unless guarded against by particular statutes, be removed into the court of king's bench, by writ of *Certiorari facias*, and be there either quashed or confirmed. The records or rolls of the sessions are committed to the custody of a special officer denominated the *custos rotulorum*. In most corporation towns there are quarter sessions kept before justices of their own, within their respective limits; which have exactly the same authority as the general quarter sessions of the county, except in very few instances: one of the most considerable of which is, the matter of appeals from orders of removal of the poor, which, though they be from the orders of corporation justices, must be to the sessions of the county, by 8 and 9 W. III. c. 30. In both corporations and counties at large, there is sometimes kept a special or petty session, by a few justices, for dispatching smaller business in the neighbourhood, between the times of the general sessions; as for licensing alehouses, passing the accounts of parish officers, and the like. Blackst. Com. b. iv. p. 268, &c.

QUAVER, in music, a measure of time, equal to one half of the crotchet, or one-eighth of the semi-breve.

The quaver is marked by the character 

The English quaver makes what the French call *crochus*, crotchet, because of the hook at bottom. See **CROTCHET**.

The quaver is divided into two demiquavers, noted 

and four demisemi-quavers, marked 

QUEEN, *regina*, a woman who holds the crown of a realm, singly, and by right of blood. The name queen is also given, by

way of courtesy, to her that is married to the king; called, by way of distinction, *queen consort*. In respect whereof the former is called *queen regnant*, or regent. The widow of a king is also called queen, but with the addition of *dowager*. In the first sense, queen is, in all construction, the same with king; and has the same power and prerogative, in all respects that the king has. The *queen consort* is inferior, and a person distinct from, and a subject of the king. In England, though she be a femme covert, yet may she sue, and be sued, in her own name; and may make leases, and grants, &c. as a femme sole. She has several other prerogatives. Though an alien, she may purchase lands in fee-simple, without either naturalization, or denization; she may present to a benefice; nor is plenarty a bar against her more than against the king. She is also capable of taking a grant from the king, which no other wife can do from her husband; and she may have a separate property in goods as well as in lands, and has a right to dispose of them by will. She pays no toll, and shall not be amerced, if she be nonsuited in any action; and may not be impeached till first petitioned. To conspire her death, or violate her chastity, is high treason. She has an ancient peculiar revenue, called *queen-gold*; besides a very large dower, with a royal court, and officers, apart.

The *queen-dowager*, as the widow of the king, enjoys most of the privileges belonging to her as *queen consort*. But it is not high treason to conspire her death, or to violate her chastity, because the succession to the crown is not thereby endangered. Yet still, *pro dignitate regali*, no man can marry a *queen dowager* without special licence from the king, on pain of forfeiting his lands and goods. She has also this particular, that she loses not her dignity, though she marry a private gentleman. Thus, Queen Catherine, widow of Henry V. being married to Owen ap Tudor, Esq. maintained her action as queen of England. Much less does a *queen regnant* follow her husband's condition, or is subject to other queens; but she is sovereign to her own husband, as queen Mary was to king Philip, and queen Anne to prince George of Denmark; unless it be otherwise appointed by parliament.

QUERCUS, the OAK-TREE; a Genus of the Polyandria order, belonging to the Monoecia class of plants. The most useful species of this genus are, 1. The suber, or cork-tree, grows 30 or 40 feet high, having a thick, rough, fungous, cleft bark, and oblong oval undivided serrated leaves, downy underneath. This species furnishes that useful material cork; it being the bark of the tree, which becoming of a thick fungous nature, under which, at the same time, is formed a new bark, and the old being detached for use, the tree still lives, and the succeeding young bark becomes also of the same thick spongy nature in six or seven years, fit for barking, having likewise another fresh bark forming under it, becoming cork like the others in the like period of time; and in this manner these trees wonderfully furnish the cork for our use, and of which is made the corks for bottles, bungs for barrels, and numerous other useful articles. The tree grows in great plenty in Spain and Portugal, and from which countries we receive the cork. 2. The robur, or common English oak, grows from about 60 or 70 to 100 feet high, with a prodigious large trunk, and monstrous spreading head; oblong leaves, broadest towards the top, the edges acutely sinuated, having the angles obtuse. This species claims precedence as a timber-tree, for its prodigious height and bulk, and superior worth of its wood. Every possessor of considerable estates ought therefore to be particularly assiduous in raising woods of them, which is effected by sowing the acorns either in a nursery, and the plants transplanted where they are to remain, or sowed at once in the places where they are always to stand. All the sorts will prosper in any middling soil and open situation, though in a leamy soil they are generally more prosperous: however, there are but few soils in which oaks will not grow; they will even thrive tolerably in gravelly, sandy, and clayey land, as may be observed in many parts of this country, of the common oak. The propagation of the stripe-leaved varieties of the common oak, and any particular variety of the other species, must be effected by grafting, as they will not continue the same from seed; the grafting may be performed upon any kind of oakling-stocks raised from the acorns, and train them for standards like the others. The oak is remarkable for its slowness of growth, bulk, and longevity. It has been remarked, that the trunk has attained to the size of fourteen inches in diameter, and some to 20, in the space of 80 years.

As to bulk, we have an account of an oak belonging to Lord Powis, growing in Broomfield wood, near Ludlow, in Shropshire, in the year 1764, the trunk of which measured 68 feet in girth, 23 in length, and which reckoning 90 feet for the larger branches, contained in the whole 1455 feet of timber, round measure, or 29 loads and five feet, at 50 feet to a load. And, with respect to longevity, Linnæus gives account of an oak 260 years old; but we have had some traditions of some in England (how far to be depended upon we know not) that have attained to more than double that age. Besides the grand purposes to which the timber is applied in navigation and architecture, and the bark in tanning of leather, there are others of less consequence, to which the different parts of this tree have been referred. The Highlanders use the bark to dye their yarn of a brown colour, or, mixed with coppers, of a black colour. They call the oak *the king of all the trees in the forest*; and the herdsman would think himself and his flock unfortunate

QUE

fortunate if he had not a staff of it. The saw-dust from the timber, and even the leaves of the tree, have been found capable of tanning, though much inferior to the bark for that purpose. The bark, also, after being used for tanning, is employed in gardening for making bark-beds, forming the most eligible kind of hot-beds for the culture of the pine-apple and all other tender exotics of the hot-house temperature. So great is the astringency of the bark, that, in a larger dose, like the Peruvian kind, it has been known to cure the ague. The expressed juice of the galls or oak-apples (excrecences occasioned by a small insect called *cynipis*) mixed with vitriol and gum-arabic, will make ink. The leaves of the oak are very subject to be covered with a sweet viscous juice called *honey-dew*, which bees and other insects are very fond of. The acorns are a good food to fatten swine and turkeys; and, after the severe winter of the year 1709, the poor people in France were constrained to eat them themselves. There are, however, acorns produced from another species of oak, which are eaten to this day in Spain and Greece, with as much pleasure as chestnuts, without the dreadful compulsion of hunger.

QUEUE, in heraldry, the tail of a beast. If a lion has a forked tail, he is blazoned by *double queued*.

QUICK Lime. See **LIME**.

QUICKSILVER, a very ponderous fluid mineral, by the chymists called *mercury*. For the method of gaining, preparing it, &c. with its properties, uses, &c. see **MERCURY**. See also the **System of CHYMISTRY**, Chap. II. Sect. V.

QUINDECAGON, in geometry, a plain figure, which has fifteen sides and fifteen angles. See the **System**, Part I. Sect. I.

QUINQUINA. See **CINCHONA**.

QUINTESSENCE, *quintaessentia*, in chymistry, a preparation consisting of the essential oil of some vegetable substance mixed and incorporated with spirit of wine. Thus, on a proper quantity e. gr. of essential oil of iessel, pouring twelve times the quantity of pure alcohol prepared *per se*, they instantly unite into one similar liquor, which is the quintessence of that plant.

QUINTESSENCE of Wine, a term used by Glauber to express an essential oil of wine, which he directs to be made by a careful distillation; and which he is very fond of, as having a power to meliorate, improve, and even to specificate the poorer wines into the nature of those from which it was to be obtained. This is one of the schemes of Glauber, generally esteemed an impracticable one, though very plausible in theory: but though in general there is a disagreeable flavour in the quintessence drawn after his method, which is different from the true flavour of the wine, and spoils the liquor it is added to, yet, by proper care, there is a possibility of succeeding so far as to render this extraneous flavour almost imperceptible, and produce an oil that will mend poor wines extremely, and give a true vinous flavour to such as are in themselves tasteless. But whatever may be done by this method, may also be done with much more certainty, and much less trouble, by the concentration of wines by freezing. This may be easily practised in the wine countries; and by this means, Burgundy, Champagne, and other the most valuable wines, may be reduced into thick extracts and robs, by the means of which wines may be made in England; a very small quantity of these concentrated wines being sufficient to convert the whole of any of the poor tasteless and insipid wines, which are of themselves of little or no value, into the very wine from which the rob was made; and that in such perfection, that the nicest judge cannot find out the difference. These robs of wine, made and preserved upon the spot, would also be of infinite use in the wine countries, as they might be kept to improve the wines of bad years. Stahl. De Concentr. Vin Shaw's Chem. Ess.

QUINZY, or **QUENSEY**, a disease which stops the freedom of respiration and deglutition. For description, causes, prognosis, and cure, see the **System of MEDICINE**, Genus II.

QUORUM, a term frequently mentioned in our statutes, and often used in commissions, both of peace and others. It is thus called from the words in the commission: *Quorum A. B. unum esse volumus*. For an example: Where a commission is directed to seven persons, or to any three of them, whereof A. B. and C. D. are to be two; there A. B. and C. D. are said to be of the quorum, because the rest cannot proceed without them. So a justice of the peace and quorum is one without whom the rest of the justices, in some cases, cannot proceed.

QUOTATION, in literature, a citation; or a passage rehearsed expressly in one author from another. Quotations are used to be distinguished by inverted commas. The manner of quoting by book, and chapter, or section, is chiefly affected by men of erudition; but it is abused: this method ought only to obtain where the whole chapter or section is expressly on the subject. On other occasions, quoting by page is more commodious; except in classics, and other ancient writings, whereof there are many editions in different forms; where this method is of little use, unless the edition be also specified. The quotations from the *Old Testament*, found in the New, have occasioned infinite doubt, dispute, and criticism. The apostles are frequently referring to the Old Testament, and quoting passages and prophecies thence, as fulfilled in our Saviour; yet these passages, thus quoted, are frequently either not found in the Old Testament at all, or they are not urged in the New, according to the literal and obvious sense they seem to bear in the Old. A late ingenious author, in an Essay upon the Truth

QUO

of the Christian religion, frankly owns that the evangelists sometimes apply to the Messiah passages of the Old Testament, which, as they lie in our present copies, plainly relate to some other person, or thing. That is evident, e. gr. in the passage, Matthew, ii. 15. *Out of Egypt have I called my son*; which is quoted from Hosea ix. where it is plainly understood of the coming of the Israelites out of Egypt. This proves to many a heavy obstacle in the way of Christianity, which the divines, commentators, critics, &c. have long laboured to remove, though by very different means. The generality chuse, therefore, to have recourse to an allegorical, typical, or spiritual meaning in the prophecies, &c. and suppose them to have been thus understood among the Jews, thus fulfilled in our Saviour, and thus applied by the apostles. In effect, the Jewish rabbins, it is allowed, took great liberty in quoting and interpreting Scripture; and it is supposed the apostles might follow these rules in their quotations.

Accordingly, M. Surenhusius, Hebrew professor at Amsterdam, has endeavoured to retrieve these rules, long since lost, in an express treatise on this subject, published in 1713. This author observes a great deal of difference applied in the different forms of quoting used by the sacred writers: as *It has been said*; *it is written*, *that it might be fulfilled which was spoken by the prophets*; *the Scripture says*; *see what is said*; *the Scripture foretelling*; *it is written*, &c. He adds, that the books of the Old Testament having been disposed in a different order at different times, and having had different names, it is thence, that one book or writer is sometimes confounded with another. For the rules of quoting and interpreting practised among the rabbins, he gives us ten; recovered with much study from the Talmud, and the ancient Jewish doctors: instances whereof he gives us in the writings of the apostles; and by those rules he endeavours to explain and justify all the quotations made from the Old Testament in the New. The rules are, 1. Reading the words not according to the points placed under them, but according to others substituted in their stead, as is done by St. Peter, Acts iii. 23. by Stephen, Acts vii. 43. and by Paul, 1 Cor. xv. 54. 2 Cor. viii. 15, &c. The second is by changing the letters; as is done by Paul, Rom. ix. 33. 1 Cor. xi. 9. Heb. viii. 9. and x. 5. and by Stephen, Acts vii. 43. The third is by changing both letters and points; as is done by Paul, Acts viii. 41. and 2 Cor. viii. 15. The fourth is by adding some letters, and taking away others. The fifth is by transposing words and letters. The sixth is by dividing one word into two. The seventh, adding other words to make the sense more clear. The eighth, changing the order of the words. The ninth, changing the order of the words and adding other words. Both of which are done by the apostles. Lastly, changing the order of words, adding words, and retrenching words, which is a method often used by St. Paul.

Some authors, as bishop Kidder, M. Le Clerc, Mr. Sykes, &c. solve the difficulty another way. That usual form of quotation among the evangelists. "That it might be fulfilled which was spoken by the prophets," according to these authors, means no more than an accommodation of the prophet's words to the case in hand. The word *fulfilled*, does not necessarily determine us to such a sense, as if the evangelists designed to speak of a prediction of future events accomplished; but may barely express an accommodation of borrowed words. In effect, says bishop Kidder, a Scripture may be said to be fulfilled two ways; properly, as when that which was foretold comes to pass; and improperly, by way of accommodation, as when an event happens to any place or people like to that fell out some time before. And thus it is that St. Matthew says, on occasion of the murder of the innocents, that "then was fulfilled what was spoken by the prophet Jeremy, *In Rama was a voice heard*," &c.

This interpretation is confirmed by M. Le Clerc, who observes, that the Jews, in their language, used to say, that a passage of Scripture was fulfilled, as often as any thing happened which it might be applied to: so that the evangelist Matthew, who was a Hebrew, and wrote, as is commonly supposed, in that language, intended no more in the passage just cited, but that a thing happened, to which one might apply what Jeremy formerly said on another occasion. Accordingly, says Mr. Sykes, the evangelists, in citing that passage of Isaiah, *Behold, a virgin shall be with child*, &c. only use it as words of that prophet remarkably agreeing to the miraculous birth of Jesus, and not as a prophecy of his birth. It may be added, that this way of speaking was not unknown among the heathen writers. Thus, in Ælian, Diogenes Sinopenis used continually to say of himself, that he fulfilled and underwent all the curses of tragedy.

QUOTIDIAN, *quotidiana*, in medicine, an intermitting fever, or ague, the access whereof returns every day. For description and causes, see the **System**, Genus 3. For prognosis and cause, see Genus 1 and 2.

QUOTIENT, *quotiens*, formed from the Latin *quoties*, q. d. *how often is such a number contained in such another*, in arithmetic, the number resulting from the division of a greater number by a smaller; and which shews how often the smaller is contained in the greater, or how often the divisor is contained in the dividend. In division, as the divisor is to the dividend, so is unity to the quotient. Thus the quotient of 12 divided by 3 is 4; which is thus disposed, 3) 12(4 quotient. See the **System**, Chap. II. Sect. V.

R, or *r*, a liquid consonant, being the 17th letter of our alphabet. In Greek words it is frequently aspirated with an *h*, as in *rhapsody*, *rhetoric*, &c. otherwise it is always followed by a vowel at the beginning of words and syllables. In the prescriptions of physicians, *R* or *R* stands for *recipe*, *i. e.* "take."

RABBI, or **RABBIN**, a doctor of the Jewish law. The word in its original signifies *master*. The word *rabbi* and *rabbin* have the same signification; yet is there some difference in their use. When we speak absolutely, and without applying the term to any proper name, we say *rabbin* not *rabbi*. Thus, we say, it would be unjust to attribute to the ancient *rabbins* all the notions of the modern ones. On the other hand, when we prefix the term to the proper name of some Jewish doctor, we say *rabbi* not *rabbin*; *rabbi* Solomon Jarchi is of this opinion. Yet *rabbi* having no plural, we say, the *rabbins* *Juda Chigi*, and *Juda ben Chabin*, are the authors of two ancient Hebrew grammars. The title *rabbi* is said to have been first assumed, as a distinguishing title of honour, by men of learning, about the time of the birth of Christ; though it had been anciently given to several magistrates and officers of state, and to those who were of superior rank and condition in life. See *Esther*, i. 8. *Jer.* xli. 1. *Job*, xxxii. 9. It has been disputed, chiefly between *Vitringer* and *Selden*, whether our Lord had taken the degree and title of *rabbi* in the Jewish schools; *Vitringer* maintains the affirmative, and *Selden* the negative. See *Jennings's Jewish Ant.* vol. i. p. 400, &c. The modern *rabbins* are entitled to a considerable respect among the Jews; they have the first places in the synagogues; they determine all matters and controversies of religion, and very frequently pronounce upon civil affairs. They have even a power to excommunicate the disobedient. They retain a vast number of superstitious traditions, from the writings of their predecessors; which they observe as scrupulously as they do the law of *Moses*. The ancient rabbins were infinite dealers in allegories. Their writings are almost wholly allegorical, particularly their comments and interpretations of the scripture. They had a great number of rules, and forms of interpreting and quoting, which some modern writers suppose to have been followed by the apostles, in their interpretation and quotation of the prophecies of the Old Testament, in the New. See **QUOTATION**.

RABBIT, the English name of a species of the genus *Lepus*, in the system of **MAMMALIA**. For description, see **LEPUS**. For classification, see the **System**. For representation, see **Plate VII. Genus XXII. Species 2**.

RACE, in general, signifies running with others, in order to obtain a prize, either on foot, or by riding on horseback, in chariots, &c. Racing was one of the exercises among the ancient Grecian games, which was performed in a course, containing one hundred and twenty-five paces; and those who contended in these foot-races were frequently clothed in armour. Chariot and horse-races also made a part of these ancient GAMES.

RACE, in genealogy, a lineage, or extraction, continued from father to son. The word is French, formed from the Latin *radix*, root; as intimating the root of the genealogical tree. In several orders of knighthood, as in that of Malta, &c. the candidates must prove a nobility of four races or descents. In some republics the magistrates are to prove themselves of plebeian race, to be qualified. The French reckon their kings by races; as, the first race, the second race, the third race. We also say the race of the Ottomans, the *Arfacidæ*, the *Ptolemies*, &c.

RACING, the riding heats for a plate or other premium. Horses for this use should be as light as possible, large, long, and well-shaped, nervous, of great mettle, and good wind, with small legs, and neat small shaped feet.

Horse-races were a species of amusement known in England in very early times. *Fitz-Stephen*, who wrote in the days of Henry II. records the great delight which the citizens of London took in the diversion. Races appear likewise to have been in vogue in the reign of Queen Elizabeth, and to have been carried to such excess as to have injured the fortunes of the nobility. Lord Herbert of Cherbury, (see his life by Mr. Walpole, p. 51.) enumerates these among the sports which he thought unworthy of a man of honour. "The exercise (says he) I do not approve of is running of horses, there being much cheating in that kind; neither do I see why a brave man should delight in a creature whose chief use is to help him to run away." *Jarvis Markham*, who wrote on the management of horses in 1599, mentions running horses; but at this time there were only private matches made between gentlemen, who were their own jockies, and rode their own horses. However, in the following reign of James I. public races were established; and Garterly in Yorkshire, Croydon near London, and sometimes Theobald's near Enfield-chace, where the king resided, were the courses in which they were performed. The horses at this time were prepared for running by the discipline of food, physic, airing, and sweats and cloathing, which compose the present system. The weight also which each horse was to carry was rigidly adjusted; the usual weight of the riders being stated at ten stones; who were put into scales, and weighed before they started. Most of the celebrated races in the kingdom were called bell-courses, the prize and reward of the conquering horses being a bell. To this purpose Camden says, that in 1607 there were races near

York, and the prize was a little golden bell. Upon this *Benjenet* offers a conjecture, whether the phrase of bearing the bell, which implies being comparatively the best or most excellent, and corresponds with the expression of bearing the palm among the ancients, as a reward decreed to the swiftest horse in a race, is not more aptly deduced from this custom than from the method of tying a bell round the neck of a sheep which leads the flock; and is, therefore, counted the best. About the latter end of the reign of Charles II. it was customary to have races performed in Hyde Park. See the comedy of the *Merry Beggars*, or *Jovial Crew*, written in 1641, in *Doddsley's* collection of old plays. Racing was much encouraged by Charles II. after his restoration: he gave public rewards and prizes, and appointed races for his own amusement at *Datchet Mead*, when he resided at *Windfor*. But the most distinguished spot for these exercises was *Newmarket*, which was at first frequented for the purpose of hunting, and seems not to have been destined to be a horse-course till some time before the troubles of the reign of Charles I. when races were discontinued; but they were revived soon after the Restoration. The king attended in person, and established a house for his accommodation, and kept and entered horses in his own name. Instead of bells, a silver bowl or cup, of the value of a hundred guineas, was allotted for a prize; and upon this royal gift the exploits of the successful horse, and his pedigree, were generally engraved. The sum of a hundred guineas is now given in lieu of the silver bowl. When *William III.* was advanced to the throne, he not only added to the plates given to different places in the kingdom, but founded an academy for riding. *Queen Anne* continued the bounty of her predecessors, with the addition of several plates. *George I.* towards the end of his reign, discontinued the plates, and gave the sum of a hundred guineas in their room. We shall here add, that at *Newmarket* there are two courses, the long and the round: the first is exactly four miles and about three hundred and eighty yards, *i. e.* 7420 yards. The second is 6640 yards. *Childers*, the swiftest horse ever known, has run the first course in seven minutes and a half, and the second in six minutes forty seconds; which is at the rate of more than forty-nine feet in a second. But all other horses take up at least seven minutes and fifty seconds in completing the first and longest course, and seven minutes only in the shortest, which is at the rate of more than forty-seven feet in a second, and it is commonly supposed, that these couriers cover, at every bound, a space of ground in length about twenty-four English feet.

RACK, an engine of torture, furnished with cords, &c. for extorting confession from criminals. The duke of *Exeter*, constable of the Tower under Henry VI. with the duke of *Suffolk*, and others, having a design to introduce the civil law into England; for a beginning, the rack, or break, allowed in many cases by the civil law, was first brought to the Tower, where it is still preserved; in those days the rack was called the duke of *Exeter's* daughter. It was occasionally used as an engine of state, not of law, more than once in the reign of *Queen Elizabeth*. But when upon the assassination of *Villiers* duke of *Buckingham*, by *Felton*, it was proposed in the privy council to put the assassin to the rack, in order to discover his accomplices; the judges being consulted, declared unanimously, to their own honour, and the honour of the English law, that no such proceeding was allowable by the laws of England.

RACKOON, the English name of a species of the genus *ursus* in the system of **MAMMALIA**. For description, see **URSUS**; for representation, see **Plate VI. Genus XVI. Species 3**.

RADIALIS Internus, a long muscle, very like in shape to the *ulnaris externus*, but situated more obliquely. See **FLEXOR carpi radialis** in the **System of ANATOMY**. For its origin, insertion, and use, see **Part II. Table of Muscles, Art. 22**.

RADIANT Point, or **RADIATING Point**, is any point of a visible object, whence rays proceed. Every radiant point diffuses innumerable rays all round, but only those radiants are visible, from which right lines may be drawn to the pupil; because the rays are all right lines. All the rays proceeding from the same radiant continually diverge; the crystalline collects or reunites them again. Every ray is supposed to carry with it a species or image of the radiant. See the **System of OPTICS, Part II. Sect. I**.

RADIATED Leaf, among botanists. See the **System, Sect. IV. Plate I**. The term is also used in speaking of medals, and in heraldry, where the ancient crowns are called radiated crowns. See the **System of HERALDRY, Sect. VII. Art. I. Plate VI**.

RADIATION, in physics, the action of a body diffusing rays of light as from a centre. Every visible body is a radiating body; it being only by means of its rays that it affects the eye. The surface of a radiating body may be conceived as consisting of radiant points.

RADICAL, *radicalis*, in physic, &c. something serving as a basis or foundation; or which, like a root, is the source or principle whence any thing arises. In grammar, we use the term radical words, for roots and primitives; in opposition to compounds and derivatives.

RADICAL Sign, in algebra, the sign or character of the root of a quantity, $\sqrt{\quad}$ is the character of radicality, and expresses the square; $\sqrt[3]{\quad}$ the cube root, &c. See the **System, Sect. I. Def. 10**.

RADICATION, in physics, the action whereby plants take

root, or shoot out roots. The French Royal Academy of Sciences have made a great number of curious observations on the germination and radication of plants.

RADICLE, *radicula*, *little root*, in botany, denotes that part of the seed of a plant, which, upon its vegetation, becomes a little root, by which the tender plant at first receives its nourishment before the after-root is formed. This is that part of the seed which, in making malt, shoots forth, and is called the come or comb.

RADII Pinnarum, in ichthyology, the little slender bones supporting the membrane, forming the fins in fishes, and running from the base to the summit in form of rays. See the System, Sect. IV.

RADISH, the English name of the genus *raphanus*, in botany, a genus of the *tetradynamia filiquosa* class. See **RAPHANUS**.

Radishes are opening, attenuating, and antiscorbutic, and are much eaten in the spring; but afford little nourishment, and are very windy. They provoke urine, and are good for the stone and gravel. They are but seldom used in the shops. The parts useful in medicine are the roots and seed, which have been employed in wasting and expelling the stone; in provoking urine and the menses; and in opening obstructions of the liver and spleen. For the cultivation of radishes, see the Treatise on GARDENING, Article *Kitchen GARDEN*, months of January, February, March, May, July, and August.

Horse-Radish impregnates both water and spirit by infusion and distillation, very richly with its active matter; in distillation with water it yields a small quantity of essential oil, exceedingly penetrating and pungent. As a medicine, horse-radish is moderately stimulating, aperient, and antiseptic: it sensibly promotes perspiration, urine, and the expectoration of viscid phlegm, and excites appetite when the stomach is relaxed, without being so liable to produce immoderate heat, or inflammatory symptoms, as the stimulants of the aromatic kind. It is principally used in paralytic and rheumatic complaints, in scurvy and scorbutic impurities of the humours, in cachectic disorders, and in dropsies, particularly in those which follow intermitting fevers. In considerable quantities it promotes vomiting. Lewis.

RADIUS, RAY, in geometry, the semidiameter of a circle; or a right line drawn from the centre to the circumference. See the System, Part I. Sect. I.

RADIUS, in anatomy, is a long slender bone of the arm descending along with the ulna from the elbow to the wrist. See the System, Part I. Sect. IV. Plate I. fig. 1. letter f.

RAFFLING, a sort of game with three dice, wherein he who throws the greatest pair or pair royal, in three casts, wins the prize or stake. The word probably comes from the base Latin, *rieflare*, to rifle, plunder, take all away. The raffle is properly the doublet or triplet; a raffle of aces or deuces carries it against mere points.

RAFFLING is also used when a company of persons club to the purchase of a commodity; and he that throws the highest on three dice takes it.

RAGS. In some counties of England, particularly in Oxfordshire, it is a common thing to use old woollen rags by way of manure upon land. Taylor's shreds answer this purpose in some degree; but the old rags of cloaths, which have been worn by men and women, are much better, which is owing to the salts they have imbibed from the perspiration of the body they used to cover. See the System of AGRICULTURE, Sect. II.

RAGOUT, or **RAGOO**, a sauce, or seasoning, intended to raise or recover the appetite when languishing, or lost. The term is French, but naturalized. It is also used for any high-seasoned dish, prepared of flesh, fish, greens, or the like, by stewing them with the addition of bacon, salt, pepper, cloves, and the like high-flavoured ingredients. We have ragouts of beef, of cray-fish, of giblets, of asparagus, of endive, of cocks-combs, of gammon, of celery, &c.

RAGULED, or **RAGGED**, in heraldry, is applied to an ordinary, e.g. a cross whose out-lines are jagged or knotted. He beareth sable, a cross raguled, or, by the name of Sloway.

RAJAH, denoting king, an appellation given in Hindostan or the empire of the Mogul to princes descended from those that ruled there before the conquest of the Moguls; who exercise all rights of sovereignty, only paying a tribute to the Great Mogul, and observing the treaties by which their ancestors recognized his superiority.

There are some *rajahs* who still retain a more independent sovereignty in the mountains; the Indians call them *rai*; the Persians plurally, *raian*; our travellers *rajahs*, or *ragias*. These have under their command soldiers, called *rajah-poots*, or persons descended from *rajahs*, who are a robust and brave people, and who enter into the service of those who will pay them. The Great Mogul has several of these *rajahs* in his service. The chief lords of the Moguls, viz. the vice-roys, governors of provinces, and chief ministers of state, F. Catrow observes, are called *ombras*; and the idolatrous *rajahs*, or Indian lords, who governed petty states before the conquest of their country, hold the same rank at court with the *ombras*.

RAJA, the *Ray-Fish*, in ichthyology; a genus belonging to the order of *amphibia nantes*. There are five *apiracula* below towards the peak; the body compressed; and the mouth is situated

under the head. The most remarkable species are, 1. The *batis*, or skate; this species is the thinnest in proportion to its bulk of any of the genus, and also the largest, some weighing near 200 pounds. 2. The *oxyrinchus*, or sharp-nosed ray; in length near seven feet, and breadth five feet two inches; when just brought on shore, it makes a remarkable snorting noise. 3. The torpedo, cramp-fish, or electric ray, is frequently in Torbay; has been once caught off Pembroke, and sometimes near Waterford in Ireland. It is generally taken, like other flat fish, with the trawl; but there is an instance of its taking the bait, with its particular description and electrical properties, see System of ELECTRICITY, the conclusive part. 4. The clavata, or thornback, is easily distinguished from the others by the rows of strong sharp spines disposed along the back and tail. The thornback begins to be in season in November, and continues so later than the skate, but the young of both are good at all times of the year. 5. The *pastinaca*, or sting-ray, does not grow to the bulk of the others. The weapon with which nature has armed this fish, hath supplied the ancients with many tremendous fables relating to it. Pliny, Elian, and Opius, have given it a venom that affects even the inanimate creation. But in respect to its venomous qualities, there is not the least credit to be given to the opinion, though it was believed (as far as it affected the animal world) by Rondeletius, Aldrovand, and others, and even to this day by the fishermen in several parts of the kingdom. It is in fact the weapon of offence belonging to the fish, capable of giving a very bad wound, and which is attended with dangerous symptoms when it falls on a tendinous part, or on a person in a bad habit of body. As to any fish having a spine charged with actual poison, it seems very dubious, though the report is sanctified by the name of Linnæus. He instances the *pastinaca*, the *torpedo*, and the *tetodon lineatus*. The first is incapable of conveying a greater injury than what results from the mere wound; the second from its electric effluvia; and the third, by imparting a pungent pain like the sting of nettles, occasioned by the minute spines on its abdomen. For the classification, see the System, Order II. Genus II.

RAIL, in ornithology, the English name of the genus *Rallus*. See **RALLUS**.

RAIN, a very frequent and useful meteor, descending from above in form of drops of water. Rain is, apparently, a precipitated cloud; as clouds are nothing but vapours raised from moisture, waters, &c.; and vapours are demonstratively nothing else but little bubbles or vesiculæ detached from the waters by the power of the solar or subterraneous heat, or both. These vesiculæ, being specifically lighter than the atmosphere, are buoyed up thereby, until they arrive at a region where the air is in a just balance with them; and here they float, till by some new agent they are converted into clouds, and thence either into rain, snow, hail, mist, or the like.

It is universally agreed, that rain is produced by the water previously absorbed by the heat of the sun, or otherwise from the terraqueous globe, into the atmosphere; but very great difficulties occur, when we begin to explain why the water, once so closely united with the atmosphere, begins to separate from it. We cannot ascribe this separation to cold, since rain often takes place in very warm weather. For some time the suppositions concerning the cause of rain were exceedingly insufficient and unsatisfactory. It was imagined, that when various congeries of clouds were driven together by the agitation of the winds, they mixed, and run into one body, by which means they were condensed into water. The coldness of the upper parts of the air also was thought to be a great means of collecting and condensing the clouds into water; which, being heavier than the air, must necessarily fall down through it in the form of rain. The reason why it falls in drops, and not in large quantities, was said to be the resistance of the air; whereby being broken, and divided into smaller and smaller parts, it at last arrives to us in small drops. But this hypothesis is entirely contrary to almost all the phenomena; for the weather, when coldest, that is, in the time of severe frost, is generally the most serene; the most violent rains also happen where there is little or no wind to condense the clouds; and the drops of rain, instead of being divided into smaller and smaller ones as they approach the earth, are plainly increased in size as they descend.

Mr. Derham accounted for the precipitation of the drops of rain from the vesiculæ being full of air, and meeting with an air colder than they contained, the air they contained was of consequence contracted into a smaller space; and consequently the watery shell rendered thicker, and thus specifically heavier, than the common atmosphere. But under the article EVAPORATION it has been shewn, that the vesiculæ, if such they are, of vapour, are not filled with air, but with fire, or heat; and consequently, till they part with this latent heat, the vapour cannot be condensed. Now cold is not always sufficient to effect this, since in the most severe frosts the air is very often serene, and parts with little or none of its vapour for a very considerable time. Neither can we admit the winds to have any considerable agency in this matter, since we find that blowing upon vapour is so far from condensing it, that it unites it more closely with the air, and wind is found to be a great promoter of evaporation. According to Robault, the great cause of rain is the heat of the air; which, after continuing for some time near the earth, is raised on high by a wind; and there thawing the snow

snowy willi or flocks of half-frozen vesiculæ, reduces them to drops; which, coalescing, descend. Here, however, we ought to be informed by what means these vesiculæ are suspended in their half-frozen state; since the thawing of them can make but little difference in their specific gravity, and it is certain that they ascended through the air not in a frozen but in an aqueous state. Dr. Clarke and others ascribe this descent of the rain rather to an alteration of the atmosphere than of the vesiculæ; and suppose it to arise from a diminution of the elastic force of the air. This elasticity, which, they say, depends chiefly or wholly upon terrene exhalations, being weakened, the atmosphere sinks under its burden, and the clouds fall. Now the little vesicles being once upon the descent, will continue therein, notwithstanding the increase of resistance they every moment meet with. For, as they all tend to the centre of the earth, the farther they fall, the more coalitions they will make; and the more coalition, the more matter will there be under the same surface; the surface increasing only as the squares, but the solidity as the cubes; and the more matter under the same surface, the less resistance will there be to the same matter.

Thus if the cold, wind, &c. act early enough to precipitate the ascending vesicles before they are arrived at any considerable height, the coalitions being but few, the drops will be proportionably small; and thus is formed a dew. If the vapours be more copious, and rise a little higher, we have a mist or fog. A little higher still, and they produce a small rain; if they neither meet with cold nor wind, they form a heavy thick dark sky. This hypothesis is equally unsatisfactory with the others; for, granting that the descent and condensation of the vapours are owing to a diminution of the atmosphere's elasticity, by what is this diminution occasioned? To say that it is owing to terrene exhalations, is only solving one difficulty by another; since we are totally unacquainted both with the nature and operation of these exhalations. Besides, let us suppose the cause to be what it will, if it acts equally and at once upon all the vapour in the air, then all the vapour must be precipitated at once; and thus, instead of gentle showers continuing for a considerable length of time, we should have the most violent water-spouts, continuing only for a few minutes, or perhaps seconds, which, instead of refreshing the earth, would drown and lay waste every thing before them.

Since philosophers have admitted the electric fluid to such a large share in the operations of nature, almost all the natural phenomena have been accounted for by the action of that fluid; and rain, among others, has been reckoned an effect of electricity. But this word, unless it is explained, makes us no wiser than we were before; the phenomena of artificial electricity having been explained on principles which could scarce apply in any degree to the electricity of nature; and therefore all the solution we can obtain of the natural appearances of which we speak, comes to this, that rain is occasioned by a moderate electrification, hail and snow by one more violent, and thunder by the most violent of all; but in what manner this electrification is occasioned, hath not yet been explained.

Other writers, in the progress of this part of philosophical science, have considered rain as an electrical phenomenon; or at least they have supposed, that the powers of electricity may concur with other causes in producing it. See EVAPORATION. Signior Becaria, whose observations on the general state of electricity in the atmosphere have been more extensive and accurate than those of any other person, reckons rain, hail, and snow among the effects of a moderate electricity in the atmosphere. Clouds that bring rain, he thought, were produced in the same manner as thunder-clouds, only by a moderate electricity. He describes them at large, and the resemblance which all their phenomena bear to those of thunder-clouds is very striking. He notes several circumstances attending rain without lightning, which render it probable, that it is produced by the same cause as when it is accompanied with lightning. Light has been seen among the clouds by night in rainy weather; and even by day rainy clouds are sometimes seen to have a brightness evidently independent of the sun. The uniformity with which the clouds are spread, and with which the rain falls, he thought were evidences of an uniform cause like that of electricity. The intensity also of electricity in his apparatus generally corresponded very nearly to the quantity of rain that fell in the same time. Sometimes all the phenomena of thunder, lightning, hail, rain, snow, and wind, have been observed at one time; which shews the connection they all have with some common cause. Signior Becaria, therefore, supposes, that, previous to rain, a quantity of electric matter escapes out of the earth, in some place where there was a redundancy of it; and in its ascent to the higher regions of the air, collects and conducts into its path a great quantity of vapours. The same cause that collects, will condense them more and more; till, in the places of the nearest intervals, they come almost into contact, so as to form small drops; which, uniting with others as they fall, come down in rain. The rain will be heavier in proportion as the electricity is more vigorous, and the cloud approaches more nearly to a thunder-cloud. He imitated the appearance of clouds that bring rain by insulating himself between the rubber and conductor of his electrical machine; and with one hand dropping colophonia into a spoon fastened to the conductor, and holding a burning coal, while his

other hand communicated with the rubber. In these circumstances, the smoke spread along his arm, and, by degrees, all over his body, till it came to the other hand that communicated with the rubber. The lower surface of this smoke was every where parallel to his cloaths, and the upper surface was swelled and arched like clouds replete with thund-r and rain. In this manner, he supposes, the clouds that bring rain diffuse themselves from over those parts of the earth which abound with electric fire to those parts which are exhausted of it; and by letting fall their rain, restore the equilibrium between them. Signior Becaria also thought, that the electricity communicated to the air, which both receives and parts with it slowly, would account for the retention of vapours in a clear sky; for small disjointed clouds not dispersed into rain; for the smaller and lighter clouds in the higher regions of the air, which are but little affected by electricity; and also for the darker, heavy, and sluggish clouds in the lower regions, which retain more of it. He even imagined, that some alteration in the weight of the air might be made by this electricity of it; the phenomena of rain, he thought, favoured the supposition, that the electric matter in the air did, in some measure, lessen its pressure; for when the electric matter is actually in the air, collecting and condensing the vapours, the barometer is lowest. When the communication is made between the earth and the clouds by the rain, the quicksilver begins to rise: the electric matter which supported part of the pressure being discharged. Lettere dell Eletticismo. Priestley's Hist. &c. of Electricity, vol. i. p. 427, &c. 8vo.

As to the use of rain, we may observe, that it moistens and softens the earth, and thus fits it for affording nourishment to plants; by falling on high mountains, it carries down with it many particles of loose earth, which serve to fertilize the surrounding valleys, and purifies the air from noxious exhalations, which tend in their return to the earth to meliorate the soil; it moderates the heat of the air; and is one means of supplying fountains and rivers. However, vehement rains in many countries are found to be attended with barrenness and poorness of the lands, and miscarriage of the crops in the succeeding year; and the reason is plain; for these excessive storms wash away the fine mould into the rivers, which carry it into the sea, and it is a long time before the land recovers itself again. The remedy to the famine, which some countries are subject to from this sort of mischief, is the planting large orchards and groves of such trees, as bear esculent fruit; for it is an old observation, that in years, when grain succeeds worst, the trees produce most fruit of all. It may partly be owing to the thorough moistening of the earth, as deep as their roots go, by these rains, and partly to their trunks stopping part of the light mould carried down by the rains, and by this means furnishing themselves with a coat of new earth. Phil. Trans. N^o 90.

RAINBOW, *iris*, or, simply, the bow, a meteor in form of a partly-coloured arch, or semicircle, exhibited in a rainy sky, opposite to the sun, by the refraction of his rays in the drops of falling rain.

There is also a secondary, or fainter bow, usually seen investing the former at some distance. Among naturalists, we also read of lunar rainbows, marine rainbows, &c. The rainbow, Sir Isaac Newton observes, never appears but where it rains in the sun-shine; and it may be represented artificially, by contriving water to fall in little drops, like rain, through which the sun shining exhibits a bow to a spectator placed between the sun and the drops; especially if a dark body, e. g. a black cloth, be disposed beyond the drops. For the magnitude, position, and colours of the rainbow, see the System of OPTICS, Part III. Sect. II. Plate II. fig. 74.

RAISINS, grapes prepared by suffering them to remain on the vine till they are perfectly ripe, and then drying them in the sun, or by the heat of an oven. The difference between raisins dried in the sun, and those dried in ovens, is very obvious: the former are sweet and pleasant; but the latter have a latent acidity with the sweetness, that renders them much less agreeable. The raisins of the sun, and jar-raisins, are all dried by the heat of the sun; and these are the sorts used in medicine. However, all the kinds have much the same virtues: they are all nutritive and balsamic; they are allowed to be attenuant, are said to be good in nephritic complaints, and are an ingredient in pectoral decoctions; in which cases, as also in all others where astringency is not required of them, they should have the stones carefully taken out.

RAISIN-Brandy, a name given by our distillers to a very clean and pure spirit, procured from raisins fermented only with water. Thus treated, they yield a spirit scarce at all distinguishable from some of the wine spirits; for there are as many kinds of wine spirits as there are of grapes. The coarser the operation of distilling is performed in this case, the nearer will be the resemblance of the wine spirit; that is, there will be most of this flavour in the spirit, when as much as can be of the oil is thrown up with a galloping heat. The distillers are very fond of the wine-spirit, with which they hide and disguise the taste of their nauseous malt and other spirits; and in defect of that spirit, this of raisins, made in this coarse manner, will go almost as far. It is indeed surprising how extensive the use of these flavouring spirits is, ten gallons of raisin-spirit, or somewhat less of the wine-spirit, being often sufficient for a whole pipe of malt-spirit, to take off its native flavour, and give it an agreeable vinosity. It is no wonder, therefore, that the distillers, and ordinary rectifiers, are so fond of

of this, as it is a good cloak for their defects, and the imperfection of their processes. When raisin-brandy is intended for common use, the fire should be kept slower and more regular in the distillation; and the spirit, though it hath less of the high flavour of the grape, will be more pleasant and more pure.

RAKE of a Ship, is so much of her hull as overhangs at both ends of her keel. That part of it which was before, is called the *rake forward on*; and that part which is at the setting on of the stern-post, is called her *rake aft*, or *afterward-on*. See the Treatise on NAVAL AFFAIRS, Article *Horizontal Plane*. Part II. Sect. I. and Plate II. fig. 3.

RAMADAN, a fast of lent observed by the Mahometans, in obedience to the express command of the Koran. See the article MAHOMETANS.

RAMIFICATIONS, in anatomy, are the divisions of the arteries, veins, and nerves, arising from some common trunk. For the respective branches of the Arteries, see the System, Part IV. Sect. I. For those of the Veins, see Part IV. Sect. II. For those of the Nerves, see the Article NERVES, and the System, Part VI. Sect. VI. For representation, see the plates under the respective heads, with their several explanations.

RAMPANT, in heraldry, is applied to a lion, bear, leopard or other beast, in climbing, or standing upright upon his hind-legs, and rearing up his fore feet; shewing only half his face, as one eye, and one ear. See the System, Sect. VI. Art. III. and Plate V.

RAMPART, or **RAMPIER**, in fortification, a massy bank, or elevation of earth about the body of a place, to cover it from the direct fire of the enemy. See the System, article DEFINITIONS, and Plate II. Fig. 1. Letters y, x.

RAMPHASTOS, in ornithology, a genus belonging to the order of picæ. The bill is very large, convex, and serrated outwardly; the nostrils are situated behind the base of the beak; the feet in most species are toed. There are eight species; of which the most remarkable is the toucan, whose bill is almost as large as the rest of its body. There are four or five varieties, but we shall only describe that which has a red beak. This is about the size of a jack-daw, and shaped like that bird, with a large head to support its monstrous bill. It is reported by travellers, that this bird, though furnished with so formidable a beak, is harmless and gentle, being so easily made tame, as to sit and hatch its young in houses. It feeds chiefly upon pepper, which it devours very greedily, gorging itself in such a manner, that it voids it crude and unconcocted. This, however, is no objection to the natives from using it again: they even prefer it before that pepper which is fresh gathered from the tree; and seem persuaded that the strength and heat of the pepper is qualified by the bird, and that all its noxious qualities are thus exhausted. There is no bird secures its young better from external injury than the toucan. It has not only birds, men, and serpents, to guard against; but a numerous tribe of monkeys, still more prying, mischievous, and hungry, than all the rest. The toucan, however, scoops out its nest into the hollow of some tree, leaving only a hole large enough to go in and out at. There it sits, with its great beak, guarding the entrance; and if the monkey ventures to offer a visit of curiosity, the toucan gives him such a welcome, that he presently thinks proper to pack off, and is glad to escape with safety. This bird is only found in the warm climates of South America, where it is in great request, both for the delicacy of its flesh, which is tender and nourishing, and for the beauty of its plumage, particularly the feathers of the breast. The skin of this part the Indians pluck off, and, when dry, glue to their cheeks; and this they consider as an irresistible addition to their beauty.

RANA, the **FROG**, in amphibiology, a genus belonging to the order of amphibia reptili. The body is naked, furnished with four feet, and without any tail. There are 17 species. The most remarkable are, 1. The temporaria, or common frog. This is an animal so well known, that it needs no description; but some of its properties are very singular. While in a tadpole state, it is entirely a water animal; the work of generation is performed in that element, as may be seen in every pond during spring, when the female remains oppressed by the male for a number of days. The work of propagation is extremely singular, it being certain that the frog has not a *penis intrans*. There appears a strong analogy in this case between a certain class of the vegetable kingdom and those animals; for it is well known, that when the female frog deposits its spawn, the male instantaneously impregnates it with what we may call a *farina fecundans*, in the same manner as the palm tree conveys fructification to the flowers of the female, which would otherwise be barren. As soon as the frogs are released from their tadpole state, they immediately take to land; and if the weather has been hot, and there fall any refreshing showers, you may see the ground for a considerable space perfectly blackened by myriads of these animals, seeking for some secure lurking places. Some philosophers, not giving themselves time to examine into this phenomenon, imagined them to have been generated in the clouds, and showered on the earth; but had they, like our Derham, but traced them to the next pool, they would have found a better solution of the difficulty. The croaking of frogs is well known; and from that in fenny countries they are distinguished by ludicrous titles: thus they are stiled Dutch nightingales, and Boston waites. Dur-

ing winter, frogs and toads remain in a torpid state; the last of which will dig into the earth, and cover themselves with almost the same agility as the mole. 2. The esculenta, or edible frog, differs from the former, in having a high protuberance in the middle of the back, forming a very sharp angle. Its colours are also more vivid, and its marks more distinct; the ground colour being a pale or yellowish green, marked with rows of black spots from the head to the rump. This, and (Mr. Pennant thinks) the former, are eaten. He has seen in the markets at Paris whole hampers full, which the venders were preparing for the table, by skinning and cutting off the fore-parts, the loins and legs only being kept; but his strong dislike to these reptiles, prevented a close examination into the species. 3. In the country of Pennsylvania, and some other parts of North America, there is a very large species of frogs called the bull-frog. These make a monstrous roaring noise like a bull, only somewhat more hoarse. Their size is superior to that of any other of the genus, and they can spring forward three yards at a leap. By this means they will equal in speed a very good horse in its swiftest course. Their places of abode are ponds, or bogs with stagnant water; but they never frequent streams. When many of them are together, they make such a horrid noise, that two people cannot understand each other's speech. They croak all together, and then stop for a little and begin again. It seems as if they had a captain among them; for when he begins to croak, all the others follow; and when he stops, they all become silent. When this captain gives the signal for stopping, you hear a note like poop coming from him. In the day-time they seldom make any great noise unless the sky is covered; but in the night-time they may be heard at the distance of a mile and an half. When they croak, they are commonly near the surface of the water, under the bushes, and have their heads out of the water. By going slowly, therefore, one may get up almost quite close to them before they go away. As soon as they are quite under water, they think themselves safe, though it be ever so shallow. These creatures kill and eat young ducklings and goslings, and sometimes carry off chickens that come too near the water; when beaten, they cry out almost like little children. As soon as the air begins to grow a little cool in autumn, they hide themselves under the mud in the bottom of stagnant waters, and lie there torpid during the winter. As soon as the weather grows mild towards summer, they begin to get out of their holes and croak. 4. The toad, or toad, is the most deformed and hideous of all animals. The body is broad; the back flat, and covered with a pimply dusky hide; the belly large, swagging, and swelling out; the legs short, and its pace laboured and crawling; its retreat gloomy and filthy; in short, its general appearance is such as to strike one with disgust and horror. Yet it is said by those who have resolution to view it with attention, that its eyes are fine: to this it seems that Shakespeare alludes, when he makes his Juliet remark,

Some say the lark and loathed toad change eyes:

As if they would have been better bestowed on so charming a songster than on this rancorous reptile. But the hideous appearance of the toad is such as to make this one advantageous feature overlooked, and to have rendered it in all ages an object of horror, and the origin of most tremendous inventions. Ælian makes its venom so potent, that basilisk-like, it conveyed death by its very look and breath; but Juvenal is content with making the Roman ladies who were weary of their husbands, form a potion from its entrails, in order to get rid of the good man. This opinion begat others of a more dreadful nature; for in after-times superstition gave it preternatural powers, and made it a principal ingredient in the incantations of nocturnal hags.

As to the notion of its being a poisonous animal, it is probable, that its excessive deformity, joined to the faculty it has of emitting a juice from its pimples, and a dusky liquid from its hind parts, is the foundation of the report. That it has any noxious qualities there seem to have been no proofs in the smallest degree satisfactory, though we have heard many strange relations on that point. On the contrary, there have been many who have taken them in their naked hands, and held them long without receiving the least injury: it is also well known that quacks have eaten them, and have besides squeezed their juices into a glass and drank them with impunity. We may say also, that these reptiles are a common food to many animals; to buzzards, owls, Norfolk plovers, ducks, and snakes, who would not touch them were they in any degree noxious. So far from having venomous qualities, they have of late been considered as if they had beneficent ones; particularly in the cure of the most terrible diseases, the cancer, by suction. But, from all circumstances, they seem only to have rendered a horrible complaint more loathsome.

The most full information concerning the nature and qualities of this animal is contained in the following letters from Mr. Arscott and Mr. Pittfield to Dr. Milles. "It would give me great pleasure (says Mr. Arscott) to be able to inform you of any particulars worthy Mr. Pennant's notice, concerning the toad who lived so many years with us, and was so great a favourite. The greatest curiosity in it was its becoming so remarkable tame. It had frequented some steps before the hall-door some years before my acquaintance commenced with it, and had been admired by my father for its size (which was the largest I ever met with), who constantly paid it a visit every evening. I knew it myself above 30 years; and by constantly feeding it, brought it to be so tame, that it always came to

the candle, and looked up as if expecting to be taken up and brought upon the table, where I always fed it with insects of all sorts; it was fondest of flesh maggots which I kept in bran.

"You may imagine that a toad, generally detested, (although one of the most inoffensive of all animals) so much taken notice of and befriended, excited the curiosity of all comers to the house, who all desired to see it fed; so that even ladies so far conquered the horrors instilled into them by nurses, as to desire to see it.

"I once from my parlour window observed a large toad I had in the bank of a bowling-green, about twelve at noon, a very hot day, very busy and active upon the grafs: so uncommon an appearance made me go out to see what it was, when I found an innumerable swarm of winged ants had dropped round his hole, which temptation was as irresistible as a turtle would be to a luxurious alderman. There are 30 males to one female, 12 or 14 of whom I have seen clinging round a female: I have often disengaged her, and put her to a solitary male, to see with what eagerness he would seize her. They impregnate the spawn as it is drawn out in long strings, like a necklace, many yards long, not in a large quantity of jelly, like frogs spawn. Had it not been for a tame raven, I make no doubt but it would have been now living; who one day seeing it at the mouth of its hole, pulled it out, and although I rescued it, pulled out one eye, and hurt it so, that notwithstanding its living a twelvemonth, it never enjoyed itself, and had a difficulty of taking its food, missing the mark for want of its eye; before that accident, it had all the appearance of perfect health."

Mr. Demours, in the memoirs of the French Academy, as translated by Dr. Templeman, vol. i. p. 371, has been very particular in respect to the male toad as acting the part of an accoucher; his account is curious, and claims a place here. "In the evening of one of the long days in summer, Mr. Demours, being in the king's garden, perceived two toads coupled together at the edge of an hole, which was formed in part by a great stone at the top. Curiosity drew him to see what was the occasion of the motions he observed, when two facts equally new surprized him. The first was the extreme difficulty the female had in laying her eggs, inasmuch that she did not seem capable of being delivered of them without some assistance. The second was, that the male was mounted on the back of the female, and exerted all his strength with his hinder feet in pulling out the eggs, whilst his fore feet embraced her breast. In order to apprehend the manner of his working in the delivery of the female, the reader must observe, that the paws of these animals, as well those of the fore feet as of the hinder, are divided into several toes, which can perform the office of fingers. It must be remarked likewise, that the eggs of this species of toads are included each in a membranous coat that is very firm, in which is contained the embryo; and that these eggs, which are oblong and about two lines in length, being fastened one to another by a short but very strong cord, form a kind of chaplet, the beads of which are distant from each other about the half of their length. It is by drawing this cord with his paw that the male performs the functions of a midwife, and acquires himself in it with a dexterity that one would not expect from so lumpish an animal.

"The presence of the observer did not a little discompose the male: for some time he stopped short, and threw on the curious impertinent a fixed look, that marked his disquietness and fear; but he soon returned to his work with more precipitation than before, and a moment after he appeared undetermined whether he should continue it or not. The female likewise discovered her uneasiness at the sight of the stranger, by motions that interrupted sometimes the male in his operation. At length, whether the silence and steady posture of the spectator had dissipated their fear, or that the case was urgent, the male resumed his work with the same vigour, and successfully performed his function."

RANDOM-Shot, a shot made when the muzzle of a gun is raised above the horizontal line, and is not designed to shoot directly or point-blank. See the Treatise on PROJECTILES, Part I. Problem I. &c.

RANGE, in gunnery, the path of a bullet, or the line it describes from the mouth of the piece to the point where it lodges. See the Treatise on PROJECTILES, Part II. Art. VIII.

RANK, in military discipline, denotes a series or row of soldiers placed side by side; a number of which ranks form the depth of the Squadron or battalion, as a number of files does the width. See the Treatise on MILITARY AFFAIRS, Sect. II.

RANK, in the army and navy, is used for the order of precedence: thus, the admiral or commander in chief of his majesty's fleet has the rank of a field-marshal; admirals with the flags on the top-mast-head, rank with generals of horse and foot; vice-admirals, with lieutenant-generals; rear-admirals, as major-generals; commodores with broad pendants, as brigadier-generals; captains of post-ships, after three years from the date of their first commission, as colonels; other captains commanding post-ships, as lieutenant-colonels; captains not taking post, as majors; and lieutenants, as captains.

RANT, in the drama, an extravagant flight of passion, overshooting nature and probability. Lee's tragedies abound with rants; yet the wildest of them, it is observed, frequently meet with applause on the stage. We have instances of rants, even in our severest poets. Such, e. gr. is that in the beginning of Ben Jonson's *Catiline*, where the parricide, in speaking to Rome,

No. 135.

says, *I'd plow up rocks steep as the Alps in dust; and lave the Tyrrhene waters into clouds, but I would reach thy head.*

RANUNCULUS, CROWFOOT, in botany, a genus of the polygamia order, belonging to the polyandria class of plants. For the cultivation and preservation of Ranunculuses, see the Treatise on GARDENING, months, January, March, June, and September.

RAPACIOUS Animals, in the general, are such as live upon prey. Some naturalists, as Pennant, Latham, and others, divide birds into *rapacious*, *carnivorous*, and *frugivorous*. Rapacious birds have a membranous stomach; and not a muscular one, or a gizzard, such as birds have which live on grain. They are very sharp-sighted, and gather not in flocks; but, generally speaking, are solitary; though vultures will fly fifty or sixty in a company. See the System of COMPARATIVE ANATOMY, Chap. II. Sect. II. and III.

RAPE, in law, the carnal knowledge of a woman forcibly and against her will. The civil law punishes the crime of ravishment with death and confiscation of goods; under which it includes both the offence of forcible abduction, or taking away a woman from her friends, and also the present offence of forcibly dishonouring her; either of which, without the other, is in that law sufficient to constitute a capital crime. Rape was punished by the Saxon laws, particularly those of king Athelstan, with death; which was also agreeable to the old Gothic or Scandinavian constitution. But this was afterwards thought too hard; and in its stead another severe, but not capital punishment was inflicted by William the Conqueror, viz. castration and loss of eyes; which continued till after Bracton wrote, in the reign of Henry the Third.

In the 3 Edward I. by the statute Westm. 1. c. 13. the punishment of rape was much mitigated: the offence itself of ravishing a damsel within age, (that is, twelve years old,) either with her consent or without, or of any other woman against her will, being reduced to a trespass, if not prosecuted by appeal within 40 days, and subjecting the offender only to two years imprisonment, and a fine at the king's will. But this lenity being productive of the most terrible consequences, it was, in ten years afterwards, 13 Edward I. found necessary to make the offence of forcible rape felony by statute Westm. 2. c. 34. And by statute 18 Eliz. c. 7. it is made felony without benefit of clergy; as is also the abominable wickedness of carnally knowing or abusing any woman child under the age of ten years; in which case the consent or non-consent is immaterial, as by reason of her tender years she is incapable of judgment and discretion. Sir Matthew Hale is indeed of opinion, that such profligate actions committed on an infant under the age of twelve years, the age of female discretion by the common law, either with or without consent, amount to rape and felony; as well since as before the statute of Queen Elizabeth.

A male infant, under the age of fourteen years, is presumed by law incapable to commit a rape, and therefore it seems cannot be found guilty of it. For though in other felonies "malitia supplet aetatem;" yet, as to this particular species of felony, the law supposes an imbecility of body as well as mind. The civil law seems to suppose a prostitute or common harlot incapable of any injuries of this kind: not allowing any punishment for violating the chastity of her, who had indeed no chastity at all, or at least hath no regard to it. But the law of England does not judge so hardly of offenders, as to cut off all opportunity of retreat even from common strumpets, and to treat them as never capable of amendment. It therefore holds it to be felony to force even a concubine or harlot; because the woman may have forsaken that unlawful course of life; for, as Bracton well observes, "licet meretrix fuerit antea, certe tunc temporis non fuit, cum reclamando nequitiae ejus consentire noluit." As to the material facts requisite to be given in evidence and proved upon an indictment of rape, they are of such a nature, that though necessary to be known and settled, for the conviction of the guilty and preservation of the innocent, and therefore are to be found in such criminal treatises as discourse of these matters in detail, yet they are highly improper to be publicly discussed, except only in a court of justice. We shall therefore merely add upon this head a few remarks from Sir Matthew Hale, with regard to the competency and credibility of witnesses; which may, *salvo pudore*, be considered.

And, first, the party ravished may give evidence upon oath, and is in law a competent witness; but the credibility of her testimony, and how far forth she is to be believed, must be left to the jury upon the circumstances of fact that concur in that testimony. For instance; if the witness be of good fame; if she presently discovered the offence, and made search for the offender; if the party accused fled for it; these and the like are concurring circumstances, which give greater probability to her evidence. But, on the other side, if she be of evil fame, and stand unsupported by others; if she concealed the injury for any considerable time after she had opportunity to complain; if the place where the fact was alledged to be committed was where it was possible she might have been heard, and she made no outcry; these and the like circumstances carry a strong but not conclusive presumption that her testimony is false or feigned. There may be, in many cases of this nature, witnesses who are competent, that is, who may be admitted to be heard; and yet, after being heard, may prove not to be credible, or such as the jury is bound to believe.

*

T t t

For

For one excellence of the trial by jury is, that the jury are triers of the credit of the witnesses, as well as of the truth of the fact.

"It is true, (says this learned judge,) that rape is a most detestable crime, and therefore ought severely and impartially to be punished with death; but it must be remembered, that it is an accusation easy to be made, hard to be proved, but harder to be defended by the party accused, though innocent." He then relates two very extraordinary cases of malicious prosecution for this crime, that had happened within his own observation; and concludes thus: "I mention these instances, that we may be the more cautious upon trials of offences of this nature, wherein the court and jury may with so much ease be imposed upon, without great care and vigilance; the heinousness of the offence many times transporting the judge and jury with so much indignation, that they are overhastily carried to the conviction of the person accused thereof, by the confident testimony of sometimes false and malicious witnesses.

RAPE, a well known plant, from the seed of which oil is expressed. For a further account, see the System of AGRICULTURE, Sect. XI.

RARE, in physics, denotes a body that is very porous, whose parts are at a great distance from one another, and which contains but little matter under a great deal of bulk. In this sense *rare* stands opposed to *dense*.

RAREFACTION, *rarefactio*, in physics, the act whereby a body is rendered rare; that is, is brought to possess more room, or appear under a large bulk, without accession of any new matter. Rarefaction is opposed to condensation. Our more accurate writers restrain rarefaction to that expansion of a mass into a larger bulk, which is effected by means of heat. All expansions from other causes they call dilatation. It is by rarefaction that gunpowder has its effect; and to the same principle also we owe our æolipiles, thermometers, &c. The degree to which the air is rarefiable exceeds all imagination; Merfennus, long ago, by means of an intense heat, found that air might be rarefied so as to possess more than 70 times its former space. Mr. Boyle afterwards found, that air, by its own elasticity, and without the help of any heat, would dilate itself so as to take up nine times its former space; then 31 times; then 60; then 150; at length, by many degrees, he found it would reach to 8000 times, then 10,000, and finally to 13,679. Such is the rarefaction of common air, from its own principle of elasticity, and without any previous condensation; but if it be compressed, the same author found its greatest space when most rarefied, is to its least when most condensed, as 55,000 to 1. Such an immense rarefaction, Sir Isaac Newton shews, is inconceivable on any other principle than that of a repelling force inherent in the air, whereby its particles mutually fly from one another. This repelling force, he observes, is much more considerable in air than in other bodies, as being generated from the most fixed bodies, and that with much difficulty, and scarce without fermentation; those particles being always found to fly each other with the most force, which, when in contact, cohere the most firmly. See AIR.

RAT, the English name of a species of the genus *MUS* in the System of MAMMALIA. See *MUS*.

RATE, a standard or proportion, by which either the quantity or value of a thing is adjusted.

RATE of a Ship of War, is, its order, degree, or distinction as to magnitude, burden, force, &c. The British fleet is accordingly distributed into six rates, exclusive of the inferior vessels that usually attend on naval armaments; as sloops of war, armed ships, bomb-ketches, fire-ships, and cutters or schooners, commanded by lieutenants. Ships of the *first rate* mount a hundred cannon, and some more; having forty-two pounders on the lower deck, twenty-four pounders on the middle deck, twelve pounders on the upper deck, and six pounders on the quarter deck and fore-castle. They are manned with eight hundred and fifty men, including their officers, seamen, marines, and servants. For representation of a first rate ship of war with all her appurtenances, see the Treatise on NAVAL AFFAIRS, and the Plate annexed, fig. 2. For a section of a first rate ship of war, from stem to stern, see fig. 1. For explanation of each representation, see the Treatise, Sect. IV.

RATIFICATION, an act, approving of, and confirming something done by another in our name. A treaty of peace is never secure till the princes have ratified it. All procuratorship imports a promise of ratifying and approving what is done by the proxy, or procurator; after treating with a procurator, agent, factor, &c. a ratification is frequently necessary on the part of his principal.

RATIFICATION, is particularly used in our laws, for the confirmation of a clerk in a benefice, prebend, &c. formerly given him by the bishop, &c. where the right of patronage is doubted to be in the king.

RATIFICATION, is also used for an act confirming something we ourselves have done in our own name. An execution by a major, of an act passed in his minority, is equivalent to a ratification.

RATIO, in geometry, that relation of homogenous things which determines the quantity of one from the quantity of another, without the intervention of any third. See the System, Part I. Sect. IV.

RATIONAL, or *true Horizon*, is that whose plane is conceived to pass through the centre of the earth; and which therefore

divides the globe into two equal portions, or hemispheres. See HORIZON, and Treatise on the GLOBES. It is called the rational horizon, because only conceived by the understanding, in opposition to the sensible or apparent horizon, which is visible to the eye.

RATIONAL Integer, or *whole number*, is that whereof unity is an aliquot part.

RATIONAL mixt number, in algebra, is that consisting of an integer and a fraction; or of unity, and a broken number. See the System, Sect. I. DEFINITION XXII.

RAVELIN, in fortification, was anciently a flat bastion, placed in the middle of a curtain. Ravelin is now a detached work, composed only of two faces, which make a salient angle, without and sometimes with flanks; and raised before the curtain on the counter-scarp of the place; serving to cover it and the joining flanks from the direct fire of an enemy. For the construction of Ravelins, see the System, Sect. I. No. 2. and Plate I. FIG. I.

RAVEN, in ornithology, the English name of the Genus *CORVUS*. See *CORVUS*.

RAY, in optics, a beam or line of light, propagated from a radiant point, through any medium. For a copious description and explanation of the respective rays in optics, see the System throughout.

READING, the art of delivering written language, with propriety, force, and elegance.

READINGS, in criticism. *Various READINGS, variæ lecti-ones*, are the different manners of reading the text of authors in ancient manuscripts: where a diversity has arisen from the corruption of time, or the ignorance of copyists. A great part of the business of the critics lies in settling the readings by confronting the various readings of the several manuscripts, and considering the agreement of the words and sense. The various readings in the bible, and in the classic authors, are almost innumerable.

REASON, a faculty or power of the soul, whereby it distinguishes good from evil, and truth from falsehood. Or, reason is that principle, whereby, comparing several ideas together, we draw consequences from the relations they are found to have. Some of the latter school-philosophers define reason to be the comprehension of many principles which the mind can successively conceive, and from which conclusions may be drawn. Others conceive reason as no other than the understanding itself, considered as it discourses. Reason, Mr. Locke observes, comprehends two distinct faculties of the mind; viz. sagacity, whereby it finds intermediate ideas; and illation, whereby it orders and disposes of them, as to discover what connection there is in each link of the chain, whereby the extremes are held together; and thereby, as it were, draws into view the truth sought for. Illation, or inference, consists in nothing but the perception of the connection there is between the ideas in each step of the deduction, whereby the mind comes to see either the certain agreement or disagreement of any two ideas; as in demonstration, in which it arrives at knowledge; or other probable connection; on which it gives or with-holds its assent; as in opinion. Sense and intuition reach but a little way: the greatest part of our knowledge depends upon deductions, and intermediate ideas. In those cases, where we must take propositions for true, without being certain of their being so, we have need to find out, examine, and compare, the grounds of their probability: in both cases, the faculty which finds out the means, and rightly applies them to discover certainty in the one, and probability in the other, is that which we call reason.

Hence we may be able to form an idea of that ordinary distinction of things, into such as are according to, those that are above, and those contrary to reason. Those according to reason are such propositions, whose truth we can discover by examining and tracing those ideas we have from sensation and reflection, and by natural deduction find to be true or probable. Those above reason are such propositions, whose truth or probability we cannot by reason derive from those principles. Those contrary to reason are such propositions as are inconsistent with, or irreconcilable to, our clear and distinct ideas. Thus, the existence of one God is according to reason; the existence of more than one God is contrary to reason; and the resurrection of the body after death, above reason. Above reason may also be taken in a double sense; viz. above probability, or above certainty. They who dispute most against the power and privileges of human reason, do it because their own reason persuades them to that belief; and so, whether the victory be on their or our side, they are equally defeated. They seek to terrify us with the example of many great wits, who, by following this *ignis fatuus* (so they call the only pole-star God has given us to direct our course by) have fallen into wild and ridiculous opinions, and increased the catalogue of heresies to so great a number; but these men either followed not their reason, but made it follow their will; or else they first hoodwinked it by interest and prejudice, and then bade it shew them the way; or were wanting in those necessary diligences required for so doubtful a passage: or if, without any of these, the weakness of their understanding had deceived them, the error is neither hurtful to themselves, nor would be to others, if this doctrine of governing ourselves by our own reason, and not by authority and example, were generally established. It is not the use of such liberty, but the

the appropriating it to ourselves, that is the cause of all the disorders charged thereon; for those who lay a restraint on other men's reason, have first made use of their own to settle them, and then make use of it in this very restraining of others.

REASON, in matters of religion, is used in opposition to faith. This use of the word, Mr. Locke takes to be in itself very improper; for faith is nothing but a firm assent of the mind; which, if it be regulated, as it is our duty, cannot be afforded to any thing but upon good reason, and so cannot be opposite to it. He that believes without having any reason for believing, may be in love with his own fancies; but he neither seeks truth as he ought, nor pays the proper obedience due to his Maker, who would have him use those discerning faculties he has given him, to keep him out of mistake and error. But since reason and faith are by some men opposed, it may be necessary to consider them together. Reason, as contradistinguished to faith, is the discovery of the certainty or probability of such propositions, or truths, which it has got by the use of its natural faculties: viz. by sensation, or reflection. Faith, on the other hand, is the assent to any proposition upon the credit of the proposer, as coming immediately from God; which we call revelation.

REASONING, *ratiocination*, the exercise of that faculty of the mind called reason: or it is reason deduced into discourse. For an accurate definition of reasoning in general, and the several parts of which it consists, together with the benefit of Logic to reasoning, see the System, Part III. Sect. I. II. III. IV. and V.

REBUS, an enigmatical representation of some name, &c. by using figures or pictures instead of words or parts of words. Camden mentions an instance of this absurd kind of wit in a gallant who expressed his love to a woman named Rose Hill, by painting in the border of his gown a rose, a hill, an eye, a loaf, and a well; which in the style of the rebus, reads, "Rose Hill I love well." This kind of wit was long practised by the great, who took the pains to find devices for their names. It was, however, happily ridiculed by Ben Johnson, in the humorous description of Abel Druggier's device in the Alchemist; by the Spectator, in the device of Jack of Newbery; at which time the rebus, being raised to sign posts, was grown out of fashion at court.

RECAPITULATION, in oratory, &c. a part of the peroration or conclusion. Recapitulation is a summary of the preceding discourse; or a concise, transient enumeration of the principal things insisted on at large therein; whereby the memory of the hearers is refreshed, and the force of the whole collected into one view. See the Treatise, Part II. Sect. VI.

RECEIVER of an Air pump, in pneumatics, is part of its apparatus; being a glass vessel placed on the top of the plate, out of which the air is to be exhausted. To an air-pump belong various receivers, of various forms and sizes, and serving for various purposes. See the System, Sect. II. and Plate III. Fig. 9.

RECEPTACULUM Chyli, RECEPTACULUM Commune, or *cisterna chyli*, in anatomy, a reservoir or cavity near the left kidney, into which the lacteal vessels all discharge their contents. See the System, Part III. Sect. XIV.

RECEPTACULUM Seminum, or RECEPTACLE of the Seed, in botany, the name given by naturalists to the base of the flower and fruit of plants, which connects the other six parts of fructification. See the System, Sect. II.

RECIPROCAL, *reciprocus*, something that is mutual, or which is returned equally on both sides, or affects both parties alike. The end of human society is to afford each other reciprocal aid: there are reciprocal duties between the prince and his subjects, the husband and wife, &c. There is a reciprocal action between the agent and patient. The *lex talionis* establishes a kind of reciprocation of justice.

RECIPROCAL, in grammar, is applied to certain verbs and pronouns in some of the modern languages; in regard of their turning or reflecting the noun, or person, upon himself. See the System, Part II. Chap. III. Part III. and V.

RECIPROCAL Figures, in geometry, are such as have the antecedents and consequents of the same ratio in both figures. See the System, Sect. IV.

RECIPROCAL Proportion, is when in four numbers the fourth is less than the second, by so much as the third is greater than the first, and *vice versa*. See the System of GEOMETRY, Sect. IV. Great use is made of this reciprocal proportion, by Sir Isaac Newton, and others, in demonstrating the laws of motion.

RECKONING, in navigation, the art of estimating the quantity of a ship's way; or of the distance run between one place and another. For copious rules for correcting a ship's reckoning, see the System, Sect. V.

RECLINATION of a Plane, in dialling, is the angle which it makes with a vertical plane. See the Treatise, Part II. Sect. III.

RECLINER, or RECLINING Dial, is a dial whose plane inclines from the perpendicular; i. e. leans from you when you stand before it. When this reclination is equal to the height of the pole, the dial is said to be equinoctial. See the Treatise, Sect. VII. Art. XIII.

RECOIL, the refilition of a body, chiefly a fire-arm; or the motion whereby, upon explosion, it starts or flies backwards; the cause of which is the impelling force of the powder, which acts equally on the breech and on the ball; so that if the piece and ball were of equal weight, and other circumstances the same, the

piece would recoil with the same velocity as that with which the ball is discharged; but the heavier any body is, the less will its velocity be, when the force impelling it continues the same.

RECOLLECTION, a mode of thinking, whereby those ideas, fought after by the mind, are with pain and endeavour found, and brought again to view. See MEMORY and IMAGINATION.

RECORD, in law, an authentic testimony of any thing in writing, contained in rolls of parchment, and preserved in a court of record.

RECORDER, *recordator*, a person whom the mayor, or other chief magistrate of any city, or town corporate, having jurisdiction, and a court of record, within their precincts, does associate with him, for his better direction, in matters of justice, and proceedings according to law. He is usually a counsellor, or other person, versed and experienced in the law. In some towns, which have their particular assizes within themselves, and no mayor, the recorder is the judge. The recorder of London is one of the justices of oyer and terminer, and a justice of peace of the *quorum*, for putting the laws in execution for preserving the peace and government of the city; and being the mouth of the city, he delivers the sentences and judgments of the courts therein, and also certifies and records the city-customs, &c. He is chosen by the lord mayor and aldermen, and attends the business of the city, on any warning by the lord mayor, &c.

RECOVERY, in a legal sense, an obtaining of any thing by judgment, or trial at law.

RECTANGLE, in geometry, called also oblong, and long square, a quadrilateral rectangular figure. See the System, Part I. Sect. I.

RECTANGLED, RIGHT-ANGLED, *triangle*, is a triangle, one of whose angles is right, or equal to 90°. See the System, Part I. Sect. I.

RECTIFICATION, compounded of *rectus*, right, direct, and *facio*, I become, the act of rectifying, i. e. of correcting, remedying, or redressing, some defect or error, in respect either of nature, art, or morality.

RECTIFICATION, in chymistry, is the repeating of a distillation or sublimation several times, in order to render the substance purer, finer, and freer from aqueous and earthy parts. Rectification is a reiterated depuration of a distilled matter, e. g. brandy, spirits, or oils, by distilling them over again, to render them more subtle, and exalt their virtues. See the Treatise on DISTILLATION, Article RECTIFICATION.

RECTIFYING of the Globe or Sphere, is a previous adjusting of the globe or sphere, to prepare it for the solution of problems. For the method of doing it, see Treatise on the GLOBES; for the terrestrial, Problem X. under that article; for the celestial, see Problem I. under that article.

RECTILINEAR, *right-lined*, in geometry, is applied to figures whose perimeter consists of right-lines. See the System, Part I. Sect. I.

RECTITUDE, in matters of philosophy, refers either to the act of judging, or of willing; and therefore, whatever comes under the denomination of rectitude is either what is true, or what is good; these being the objects about which the mind exercises its two faculties of judging and willing. *Rectitude of the mind*, considered as it judges, i. e. rectitude of the faculty of judgment, consists in its agreement and conformity to the nature and reason of things, and in its determining and deciding about them according to what their constitutions, properties, uses, &c. really are. *Rectitude of the mind*, considered as it wills, called also *moral rectitude*, or *uprightness*, consists in the choosing and pursuing of those things which the mind, upon due inquiry and attention, clearly perceives to be good; and avoiding those that are evil.

RECTOR of a Parish, the parson, or he who has the charge or cure of a parish church. If the predial tythes of the parish be impropriated, or appropriated, i. e. either in lay hands, or in those of some ecclesiastical community, then instead of rector, the parson is called vicar. In England are reckoned 3485 rectories.

RECTORY, or RECTORATE, *rectoria*, a parish church, parsonage, or spiritual living, with all its rights, glebes, and tythes.

RECTUM, in anatomy, denotes the third and last of the large intestines, or guts. It is thus called, because it passes straight from the os sacrum to the anus; without making any turns or circumvolutions, as all the other guts do. See the System, Part V. Sect. VI. Plate III. fig. 4. letter S.

RECTUS, in anatomy, a name common to several muscles, on account of the straightness of the course of their fibres, from their origin to their insertion; having particular denominations from the parts to which they minister; such are the *rectus abdominis*, *rectus femoris*, *rectus capitis lateralis*, *major externus*, *minor externus*, *major internus*, *minor internus*, and *rectus palpebrae*. For the origin, insertion, and uses of these several muscles, see the System of ANATOMY, Part II. Table of Muscles under the several articles to which the names of those parts they belong to are affixed. For representation, see the Plate of MYOLOGY.

RECURVIROSTRA, in ornithology, a genus belonging to the order of grallæ. The beak is subulated, bent back, sharp, and flexible at the point; the feet are webbed, and furnished with three toes.

REF

toes. There is but one species, viz. the avocetta, a native of the southern parts of Europe. For representation, see the plates, Genus 80.

RECUSANTS, such persons as acknowledge the pope to be the supreme head of the church, and refuse to acknowledge the king's supremacy; who are hence called popish recusants.

RED, one of the colours called simple or primary; being one of the shades into which the light naturally divides itself when refracted through a prism. See *System of OPTICS*, Part I. Sect. I. Prop. VIII.

RED, in dying, is one of the five simple or mother colours of the dyers. See the *Treatise*, Sect. II.

RED, in heraldry. See *GULES*.

RED Lead. See *MINIUM* and *LEAD*.

REDOUBT, or **REDOUTE**, in fortification, a small square fort, without any defence but in front, used in trenches, lines of circumvallation, contravallation, and approach; as also for the lodging of corps de garde, and to defend passages. See the *System*, Sect. I. No. 10. and Plate I. Fig 9. Letter B.

REDUCTION, in arithmetic, is the converting of moneys, weights, or measures, into the same value in other denominations; e. gr. pounds into shillings and pence; or shillings and pence into pounds. See the *System*, Chap. II. Sect. V.

REDUCTION of Equations, in algebra, is the clearing them from all superfluous quantities, bringing down the quantities to their lowest terms, and separating the known quantities from the unknown ones, till at length only the unknown quantity is found on one side, and known ones on the other. See the *System*, Sect. VI. throughout.

REDUNDANCY, or **REDUNDANCE**, a fault in discourse, consisting in the use of a superfluity of words. Words perfectly synonymous are redundant, and ought to be retrenched. Redundancy necessarily makes the style weak and languid.

REDUNDANT Interval, in music, is used for an interval exceeding the truth by a comma. Some apply redundant to an interval exceeding a diatonic interval by a semitone minor; but this is more usually called a superfluous interval. See the *System*, under the Article *DEFINITIONS*, &c.

RE-EXCHANGE, in commerce, a second payment of the price of exchange, or rather the price of a new exchange, due upon a bill of exchange that comes to be protested; and to be refunded the bearer, by the drawer or indorser. See *EXCHANGE*.

REFERENCE, in writing, &c. a mark relative to another similar one in the margin, or at the bottom of the page, where something, omitted in the text, is added; and which is to be inserted either in reading or copying. A copyist must be very expert at taking references. References are also used in books, where things being but imperfectly handled, the reader is directed to some other part or place where they are more amply explained. Dictionaries are full of references denoted by *see* or *vide*. By means of these references the dictionary-writer settles a correspondence between the several parts of his work, and may give his dictionary most of the advantages of a continued treatise.

REFINING, the art or act of purifying a thing; or of rendering it finer, clearer, and purer. Refining is chiefly used in speaking of metals, sugar, and salt.

The **REFINING of Gold** is performed three ways; either with antimony, with sublimate, or with aqua fortis; which last method, much the most usual and least dangerous of the three, is called *departing* or *parting*. Gold and silver may be refined by several methods, which are all founded on the essential properties of these metals, and acquire different names according to their kinds. Thus, for instance, gold, having the property which no other metal, not even silver, has, of resisting the action of sulphur, of antimony, of nitrous acid, of marine acid, may be purified by these agents from all other metallic substances, and consequently may be refined. These operations are distinguished by proper names, as *purification of gold by antimony*, *parting*, *concentrated parting*, *dry parting*. In a similar manner, as silver has the property, which the imperfect metals have not, of resisting the action of nitre, it may be refined by this salt: but the term refining is chiefly applied to the purification of gold and silver by lead in the cupel. This is performed by the destruction, vitrification, and scorification, of all the extraneous and destructible metallic substances with which they are all alloyed. As none but the perfect metals can resist the combined action of air and fire, without losing their inflammable principle, and being changed into earthy or vitreous matters, incapable of remaining any longer united with substances in a metallic state, there is then a possibility of purifying gold and silver from all alloy of imperfect metals merely by the action of fire and air; only by keeping them fused till all the alloy be destroyed: but this purification would be very expensive, from the great consumption of fuel, and would be exceedingly tedious. Silver alloyed with copper, has been exposed longer than 60 hours to a glass-house fire, without being perfectly refined: the reason of which is, that when a small quantity only of imperfect metal remains united with gold or silver, it is covered and protected from the action of the air, which is necessary for the combustion of the imperfect metals, as of all combustible matters. This refining of gold and silver merely by the action of fire, which was the only method anciently known, was very long, difficult, expensive, and imperfect: but a much shorter and more advanta-

REF

geous method has been discovered. This method consists in adding to the alloyed gold and silver a certain quantity of lead, and in exposing afterwards this mixture to the action of the fire. Lead is one of the metals which loses most quickly and easily a sufficient quantity of its inflammable principle to cease to be in a metallic state; but at the same time, this metal has the remarkable property of retaining, notwithstanding the action of the fire, enough of this inflammable principle to be very easily melted into a vitrified and powerfully vitrifying matter, called *litharge*.

The lead then which is to be added to the gold and silver to be refined, or which happens naturally to be mixed with these metals, produces in their refining the following advantages: 1. By increasing the proportion of imperfect metals, it prevents them from being so well covered and protected by the perfect metals. 2. By uniting with these imperfect metals, it communicates to them a property it has of losing very easily a great part of its inflammable principle. 3. By its vitrifying and fusing property which it exercises with all its force upon the calcined and naturally refractory parts of the other metals, it facilitates and accelerates the fusion, the scorification, and the separation of these metals. These are the advantages procured by lead in the refining of gold and silver. The lead, which in this operation is scorified, and scorifies along with it the imperfect metals, separates from the metallic mass, with which it is then incapable of remaining united. It floats upon the surface of the melted mass; because by losing part of its phlogiston, it loses also part of its specific gravity, and lastly it vitrifies. These vitrified and melted matters accumulating more and more upon the surface of the metal while the operation advances, would protect this surface from the contact of air which is so absolutely necessary for the scorification of the rest, and would thus stop the progress of the operation, which could never be finished, if a method had not been contrived for their removal. This removal of the vitrified matter is procured either by the nature of the vessel in which the melted matter is contained; and which being porous, absorbs and imbibes the scorified matter as fast as it is formed; or by a channel cut in the edge of the vessel through which the matter flows out.

The vessel in which the refining is performed is flat and shallow, that the matter which it contains may present to the air the greatest surface possible. This form resembles that of a cup, and hence it has been called *cupel*. The furnace ought to be vaulted, that the heat may be applied upon the surface of the metal during the whole time of the operation. Upon this surface a crust of dark-coloured pellicle is continually forming. In the instant when all the imperfect metal is destroyed, and consequently the scorification ceases, the surface of the perfect metals is seen, and appears clean and brilliant. This forms a kind of fulguration or coruscation. By this mark the metal is known to be refined. If the operation be so conducted that the metal only sustains the precise degree of heat necessary to keep it fused before it be perfectly refined, we may observe that it fixes or becomes solid all at once in the very instant of the coruscation; because a greater heat is required to keep silver or gold in fusion, when they are pure, than when alloyed with lead. The operation of refining may be performed in small or in large quantities, upon the same principles, but only with some differences in the management. As the refining of small quantities of perfect metals is performed in the same manner as these metals are assayed, the assay being only a very accurate refining, we refer to the article *ASSAY*. Large quantities of silver are thus purified, after the operations by which that metal is obtained from its ores. This silver, being always much alloyed, is to be mixed with a sufficient quantity of lead to complete its purification, unless lead has been added in its first fusion from the ore, or unless it has been extracted from an ore which also contains lead; in which latter case, it is alloyed naturally with a sufficient quantity, or more than sufficient, for the refining of it.

REFLECTING, or **REFLECTIVE Dial**, is a sort of dial, which shews the hour by means of a thin piece of looking-glass plate, duly placed to cast the sun's rays to the top of a ceiling, on which the hour-lines are drawn. See the *Treatise on DIALLING*, Sect. VII. Article XXV.

REFLECTION, or **REFLEXION**, in mechanics, the return, or regressive motion of a moveable, occasioned by the resistance of a body, which hindered its pursuing its former direction. See the Article *MOTION*.

REFLECTION of the Rays of Light, in optics, is a motion of the rays, whereby, after impinging on the solid parts of bodies, or rather after a very near approach thereto, they recede, or are driven therefrom. See the *System*, Part II. throughout.

REFLECTION is also used figuratively for an operation of the mind, whereby, turning as it were back upon itself, it makes itself, and its own operation, its object; and considers or contemplates the manner, order and laws which it observes in perceiving, reasoning, willing, judging, doubting, believing, &c. and frames itself new ideas of the relation discovered therein.

REFORMATION, in general, an act of reforming or correcting an error or abuse in religion, discipline, or the like. By way of eminence the word is used for that great alteration and reformation in the corrupted system of Christianity, begun by Luther, in the city of Wirtemberg in Saxony, in the year 1517. The various corruptions in religion, the oppressions and usurpations of the clergy,

clergy, and the extreme insolence of the popes, are fully recorded in the annals of history.

It is sufficient therefore to observe, that before the period of the reformation, the pope had in the most audacious manner declared himself the sovereign of the whole world. The parts of it which were inhabited by those who were not christians, he accounted to be inhabited by savages: and if christians took it into their heads to possess any of those countries, he gave them full liberty to make war upon the inhabitants without any provocation, and to treat them with no more humanity than they would have treated wild beasts. The countries, if conquered, were to be parcelled out according to the pope's pleasure; and dreadful was the situation of that prince who refused to obey the will of the holy pontiff, of which many instances will occur to the reader in the various parts of this work. In consequence of this extraordinary authority which the pope had assumed, he at last granted to the king of Portugal all the countries to the eastward of Cape Non in Africa, and to the king of Spain all the countries to the westward of it. In this, according to the opinions of some, was completed in his person the character of *Antichrist sitting in the temple of God, and shewing himself as God*. He had long before, say they, assumed the supremacy belonging to the Deity himself in spiritual matters; and now he assumed the same supremacy in worldly matters also, giving the extreme regions of the earth to whom he pleased. The reformation, therefore, they consider as the immediate effect of divine power, taking vengeance on this and all other deviations from the system of truth; while others consider it merely as an effect of natural causes, and which might have been foreseen and prevented, without abridging the papal power in any considerable degree.

Be this as it will, the abovementioned partition was the last instance of insolence which the pope ever had, or in all probability ever will have in his power to exercise, in the way of parceling out the globe to his adherents. Every thing was quiet, every heretic exterminated, and the whole Christian world supinely acquiesced in the enormous absurdities which were inculcated upon them; when, in 1517, the empire of superstition began to decline, and has continued to do so ever since. The person who made the first attack on the extravagant superstitions then prevailing was Martin Luther.

By some it is pretended, that the only motive which Luther had in beginning the reformation was his enmity to the Dominican friars, who had excluded his order (the Augustines) from all share in the gainful traffic of indulgences. But this does not seem at all probable, if we consider that such a motive would not naturally have led him to deny the virtue of indulgences, as such conduct could not but exclude him for ever from any chance of a share in the traffic, which otherwise perhaps he might have obtained. Besides, the extreme contrariety of this traffic to the common principles of reason and honesty was so great, that we cannot wonder at finding one man in the world who had sense enough to discern it, and virtue enough to oppose such an infamous practice. In all probability, however, the insignificance of the first reformer was the reason why he was not persecuted and exterminated at his first beginning, as others had been before him. Another reason probably might be, that he did not at once attack the whole errors of popery, but brought about his reformation gradually, probably as it occurred to himself.

There are many other circumstances which concurred at this time to bring about that happy reformation in religion, which rescued one part of Europe from the papal yoke, mitigated its rigour in the other, and produced a revolution in the sentiments of mankind, the greatest as well as the most beneficial that has happened since the publication of Christianity. We shall here observe, that the same corruptions in the church of Rome which Luther condemned, had been attacked long before his appearance, and the same opinions which he propagated, had been published in different places, and supported by the same arguments. Waldus in the 12th century, Wickliff in the 14th, and Huss in the 15th, had inveighed against the errors of popery with great boldness, and confuted them with more ingenuity and learning than could have been expected in those illiterate ages in which they flourished. But all these premature attempts towards a reformation proved abortive.

Many powerful causes contributed to facilitate Luther's progress, which either did not exist, or did not operate with full force in their days; the principal of these we shall here enumerate. The long and scandalous schism which divided the church, during the latter part of the fourteenth, and the beginning of the fifteenth centuries, had a great effect in diminishing the veneration with which the world had been accustomed to view the papal dignity. The proceedings of the councils of Constance and Basle spread this disrespect for the Romish see still wider, and by their bold exertion of authority in deposing and electing popes, taught the world that there was in the church a jurisdiction superior even to the papal power, which they had long believed to be supreme. The wound given on that occasion to the papal authority was scarcely healed, when the pontificate of Alexander VI. and Julius II. both able princes, but detestable ecclesiastics, raised new scandal in Christendom. Besides, many of the dignified clergy, secular as well as regular, neglected the duties of their office, and indulged themselves,

without reserve, in all the vices to which great wealth and idleness naturally give birth: and gross ignorance and low debauchery rendered the inferior clergy as contemptible as the others were odious. So that we find, long before the sixteenth century, many authors of reputation give such a description of the dissolute morals of the clergy, as seems almost incredible in the present age. The scandal of these crimes, which very generally prevailed, was greatly increased by the facility with which such as committed them obtained pardon. The exorbitant wealth of the church, the vast personal immunities of ecclesiastics, and their encroachments on the jurisdiction of the laity, and their various devices to secure their usurpations, created much dissatisfaction among the people, and disposed them to pay particular attention to the invectives of Luther. Besides these causes of his rapid progress, we may also reckon the invention of the art of printing, about half a century before his time, the revival of learning at the same period, and the bold spirit of inquiry which it excited in Europe; so that many were prepared to embrace his doctrines, who did not really wish success to his undertaking. In the writings of Reuchlin, Hutter, and the other revivers of learning in Germany, the corruptions of the church of Rome are censured with an acrimony of style little inferior to that of Luther himself. The railery and oblique censures of Erasmus, in particular, upon the errors of the church, as well as upon the ignorance and vices of the clergy, prepared the way for Luther's invectives and more direct attacks. To all which we may add, that the theological doctrines of popery were so repugnant to the spirit of Christianity, and so destitute of any foundation in reason, in the word of God, or in the practice of the church, that this circumstance combined in favouring the progress of Luther's opinion, and in weakening the resistance of his adversaries. The rise of the reformation in Switzerland was at least as early as in Germany; for Ulrich Zuinglius had, in the year 1516, begun to explain the scriptures to the people, and to censure, though with great prudence and moderation, the errors of a corrupt church. He had very noble and extensive ideas of a general reformation, at the time when Luther retained almost the whole system of popery, indulgences excepted, and he had actually called in question the authority and supremacy of the pope, before the name of Luther was known in that country.

In Germany, Luther made great advances, without being in the least intimidated by the ecclesiastical censures which were thundered against him from all quarters, he being continually protected by the German princes, and particularly the elector of Saxony, either from religious or political motives, so that his adversaries could not accomplish his destruction as they had done that of others. Many other men of eminence also forwarded the work of Luther; and in all probability the Popish hierarchy would have soon come to an end, in the northern parts of Europe at least, had not the emperor Charles V. given a severe check to the progress of reformation in Germany. In order to pursue the schemes dictated by his ambition, he thought it necessary to ingratiate himself with the pope; and the most effectual method of doing this was by destroying Luther. The pope's legates insisted that Luther ought to be condemned by the diet of Worms without either trial or hearing; as being a most notorious, avowed, and incorrigible heretic. However, this appeared unjust to the members of the diet, and he was summoned to appear; which he accordingly did without hesitation. There is not the least doubt that his appearance there had been his last in this world, had not the astonishing respect that was paid him, and the crowds who came daily to see him, deterred his judges from delivering the church from the author of such a pestilent heresy: which they were strongly solicited by the pope's party to do. He was therefore permitted to depart with a safe conduct for a certain time; after which he was in the state of a proscribed criminal, to whom it was unlawful to perform any of the offices of humanity.

During the confinement of Luther in a castle near Warburg, the reformation advanced rapidly; almost every city in Saxony embracing the Lutheran opinions. At this time an alteration in the established forms of worship was first ventured upon at Wittemberg, by abolishing the celebration of private masses, and by giving the cup as well as the bread to the laity in the Lord's supper. In a short time, however, the new opinions were condemned by the university of Paris, and a refutation of them was attempted by Henry VIII. of England. But Luther was not to be thus intimidated. He published his animadversions on the opinions of the university of Paris, and other learned bodies, with as much acrimony as if he had been refuting the meanest adversary; and a controversy managed by such capital antagonists drew a general attention, and the reformers daily gained new converts both in France and England.

To intestine divisions on account of religion, were added the horrors of a civil war, occasioned by oppression on the one hand, and enthusiasm on the other. In 1525, a great number of seditious fanatics arose on a sudden in different parts of Germany, took arms, united their forces, and made war against the empire, laying waste the country with fire and sword, and committing every where the greatest cruelties. The greatest part of this furious mob was composed of peasants and vassals, who groaned under heavy burdens,

dens, and declared that they were no longer able to bear the despotic government of their chiefs; and hence the sedition had the name of *the rustic war*, or *the war of the peasants*.

In the meantime Frederic surnamed the Wise, elector of Saxony, and Luther's great patron, departed this life, and was succeeded by his brother John. Frederic, though he had protected and encouraged Luther, yet was at no pains to introduce the reformed religion into his dominions. But with his successor it was otherwise; for he, convinced that Luther's doctrine must soon be totally destroyed and suppressed unless it received a speedy and effectual support, ordered Luther and Melancthon to draw up a body of laws relating to the form of ecclesiastical government, the method of public worship, &c. which was to be proclaimed by heralds throughout his dominions. This example was followed by all the princes and states of Germany who renounced the papal supremacy; and a like form of worship, discipline, and government, was thus introduced into all the churches which dissented from that of Rome. This open renunciation of the Romish jurisdiction soon changed the face of affairs; and the patrons of Popery soon intimidated, in a manner not at all ambiguous, that they intended to make war on the Lutheran party: which would certainly have been put into execution, had not the troubles that took place in Europe disconcerted their measures. On the other hand, the Lutherans, apprized of these hostile intentions, began also to deliberate on a proper plan of defence against that superstitious violence with which they were in danger of being assailed. The diet of the empire assembled at Spire, in the year 1526; where the emperor's ambassadors were desired to use their utmost endeavours to suppress all disputes about religion, and to insist upon the rigorous execution of the sentence which had been pronounced against Luther and his followers. The greatest part of the German princes opposed this motion with the utmost resolution, declaring that they could not execute that sentence, nor come to any determination with regard to the doctrines by which it had been occasioned, before the whole matter was submitted to the decision of a council lawfully assembled; alleging farther, that the decision of controversies of this nature belonged properly to it, and to it alone. This opinion, after long and very warm debates, was adopted by a great majority, and at length consented to by the whole assembly; for it was unanimously agreed to present a solemn address to the emperor, intreating him to assemble, without delay, a free and general council; while in the mean time it was also agreed, that the princes of the empire should, in their respective dominions, be at liberty to manage ecclesiastical affairs in the manner they should think most proper; yet so as to be able to give to God and the emperor a proper account of their administration when it should be required of them.

These resolutions proved extremely favourable to the cause of reformation, neither had the emperor any leisure for some time to give disturbance to the reformed. The war which at this time ensued between him and the pope, gave the greatest advantage to the friends of the reformed, and considerably augmented their number. Several princes, whom the fear of persecution and punishment had hitherto prevented from lending their assistance, publicly renounced the Romish superstition, and introduced among their subjects the same forms of religious worship, and the same system of doctrine, that had been received in Saxony. Others, though placed in such circumstances as discouraged them from acting in an open manner against the interests of the Roman pontiff, were, however, far from discovering the smallest opposition to those who withdrew the people from his despotic yoke; nor did they molest the private assemblies of those who had separated themselves from the church of Rome. And in general, all the Germans, who, before these resolutions of the diet of Spire had rejected the papal discipline and doctrine, were now, in consequence of the liberty they enjoyed, wholly employed in bringing their schemes and plans to a certain degree of consequence, and in adding vigour and firmness to the cause in which they were engaged. But this tranquility and liberty was of no long duration. In 1529, a new diet was assembled at the same place by the emperor, after he had quieted the troubles in various parts of his dominions, and concluded a peace with the pope. The power which had been granted to princes of managing ecclesiastical affairs till the meeting of a general council, was now revoked by a majority of votes; and every change declared unlawful that should be introduced into the doctrine, discipline, or worship of the established religion, before the determination of the approaching council was known. This decree was considered as iniquitous and intolerable by the elector of Saxony, the landgrave of Hesse, and other members of the diet, who were persuaded of the necessity of a reformation. The promise of speedily assembling a general council, they looked upon to be an artifice of the church of Rome; well knowing, that a free and lawful council would be the last thing to which the pope would consent. When, therefore, they found that all their arguments and remonstrances made no impression upon Ferdinand the emperor's brother, who presided in the diet, Charles himself being then at Barcelona, they entered a solemn protest against this decree on the 19th of April, and appealed to the emperor and a future council. Hence arose the denomination of Protestants, which from this period has been given to those who separated

from the communion of the church of Rome. The princes of the empire who entered this protest were, John, Elector of Saxony; George, elector of Brandenburg; Ernest and Francis dukes of Lunenburg; the landgrave of Hesse; and the prince of Anhalt. These were seconded by 13 imperial towns, viz. Strasbourg, Ulm, Nuremberg, Constance, Rottingen, Windheim, Memmingen, Nortlingen, Lindaw, Kempten, Heilbron, Wilsenburgh, and St. Gall.

Hitherto indeed it was not easy for the emperor to form a clear idea of the matters in debate, since there was no regular system as yet composed, by which it might be known with certainty what were the true causes of Luther's opposition to the pope. The elector of Saxony, therefore, ordered Luther, and other eminent divines, to commit to writing the chief articles of their religious system, and the principal points in which they differed from the church of Rome. Luther, in compliance with this order, delivered to the elector at Torgaw, 17 articles which had been agreed upon in a conference at Sultzbach in 1529; from whence these received the name of the articles of Torgaw. But though these were deemed by Luther a sufficient declaration of the sentiments of the reformers, yet it was judged proper to enlarge them, in order to give perspicuity to their arguments, and strength to their cause. In this work Melancthon was employed, in which he shewed a proper deference to the counsels of Luther, and expressed his sentiments and doctrine with the greatest elegance and perspicuity; and thus came forth to view the famous confession of Augsberg.

On the 15th of June 1530, Charles arrived at Augsberg, and the diet was opened five days after. The Protestants received a formal permission to present an account of their tenets to the diet on the 25th of the same month; in consequence of which, at the time appointed, Christian Bayer, chancellor of Saxony, read, in the German language, before the emperor and the princes assembled, the confession of Augsberg above mentioned. It contained 28 chapters, of which 21 were employed in representing the religious opinions of the Protestants, and the other seven in pointing out the errors and superstitions of the church of Rome. The princes heard it with the deepest attention and recollection of mind: it confirmed some in the principles they had embraced; surprised others; and many, who before this time had little or no idea of the religious sentiments of Luther, were now not only convinced of their innocence, but delighted with their purity and simplicity. The copies of this confession, which after being read, were delivered to the emperor, were signed by Jon elector of Saxony, George marquis of Brandenburg, Ernest duke of Lunenburg, Philip landgrave of Hesse, Wolfgang prince of Anhalt, and by the imperial cities of Nuremberg and Reutlingen.

Matters now began to draw towards a crisis. There were only three ways of bringing to a conclusion these religious differences. 1. To grant the Protestants a toleration, and privilege of serving God as they thought proper. 2. To compel them to return to the church of Rome by the violent methods of persecution; or, 3. That a reconciliation should be made, upon fair, candid, and equitable terms, by engaging each of the parties to temper their zeal with moderation, to abate reciprocally the rigour of their pretensions, and remit something of their respective claims. The third expedient was most generally approved of, being peculiarly agreeable to all who had at heart the welfare of the empire; nor did the pope seem to look upon it either with aversion or contempt. Various conferences therefore were held between persons eminent for piety and learning on both sides; and nothing was omitted that might have the least tendency to calm the animosities, and heal the divisions which reigned between the contending parties. But the differences were too great to admit of a reconciliation: and therefore the votaries of Rome had recourse to the powerful arguments of imperial edicts, and the force of the secular arm.

In the year 1530 and 1531 the elector of Saxony and confederate princes met at Smalcald, and afterwards at Francfort, where they formed a solemn alliance and confederacy, with the intention of defending vigorously their religion and liberties against the dangers and encroachments with which they were threatened by the edict of Augsberg, without attempting, however, any thing offensive against the votaries of Rome; and into this confederacy they invited the kings of England, France, Denmark, &c. leaving no means unemployed that might corroborate and cement this important alliance. This confederacy was at first opposed by Luther, from an apprehension of the calamities and troubles which it might produce: but, at last, perceiving the necessity of it, he consented; though he uncharitably, as well as imprudently, refused to comprehend in it the followers of Zuinglius among the Swiss, together with the German states and cities who had adopted the sentiments and confession of Bucer. In consequence of an address to H. VIII. of England, whom the confederate princes were willing to declare the head and protector of their league; the king desired that they would send over two learned men to confer with him, in order to promote a religious union between him and the confederates. However, he declared himself of their opinion with regard to the meeting of a free general council, and promised to join with them in all such councils for the defence of the true doctrine; but thought the regulation of the ceremonial part of religion, being a matter of in-

difference, ought to be left to the choice of each sovereign for his own dominions. After this the king gave him a second answer, more full and satisfactory; but after the execution of queen Anne, this negotiation came to nothing. On the one hand, the king grew cold when he perceived that the confederates were no longer of use to him in supporting the validity of his marriage; and, on the other hand, the German princes became sensible that they could never succeed with Henry unless they allowed him an absolute dictatorship in matters of religion.

Many schemes of accommodation were afterwards proposed both by the emperor and the Protestants; but, by the artifices of the church of Rome, all of them came to nothing. The pope ordered his legate to declare to the diet of Spire, assembled in 1542, that he would, according to the promise he had already made, assemble a general council, and that Trent should be the place of its meeting, if the diet had no objection to that city. Ferdinand, and the princes who adhered to the cause of the pope, gave their consent to this proposal; but it was vehemently objected to by the Protestants, both because the council was summoned by the authority of the pope only, and also because the place was within the jurisdiction of the pope; whereas they desired a free council, which should not be biased by the dictates, nor awe by the proximity, of the pontiff. But this protestation produced no effect. Paul III. persisted in his purpose, and issued out his circular letters for the convocation of the council, with the approbation of the emperor. In justice to this pontiff, however, it must be observed, that he shewed himself not to be averse to every reformation. He appointed four cardinals, and three other persons eminent for their learning, to draw up a plan for the reformation of the church in general, and of the church of Rome in particular. The reformation proposed in this plan was indeed extremely superficial and partial: yet it contained some particulars which could scarcely have been expected from those who composed it. They complained of the pride and ignorance of the bishops, and proposed that none should receive orders but learned and pious men; and that therefore care should be taken to have proper masters for the instruction of youth. They condemned translations from one benefice to another, grants of reservation, non-residence, and pluralities. They proposed that some convents should be abolished; that the liberty of the press should be restrained and limited; that the colloquies of Erasmus should be suppressed; that no ecclesiastic should enjoy a benefice out of his own country; that no cardinal should have a bishopric; that the questors of St. Anthony and several other saints should be abolished; and, which was the best of all their proposals, that the effects and personal estates of ecclesiastics should be given to the poor. They concluded with complaining of the prodigious number of indigent and ragged priests who frequented St. Peter's church; and declared, that it was a great scandal to see the whores lodged so magnificently at Rome, and riding through the streets on fine mules, while the cardinals and other ecclesiastics accompanied them in the most courteous manner. This plan of reformation was turned into ridicule by Luther and Sturm; and indeed it left unredressed the most intolerable grievances of which the Protestants complained. The emperor had long been labouring to persuade the Protestants to consent to an accommodation on a plan proposed by the pope, at the council of Trent; but, when he found them fixed in their opposition to this measure, he began to listen to the sanguinary measures of the pope, and resolved to terminate the disputes by force of arms. But, before the horrors of war commenced, the great reformer Luther died in peace at Ayselben, the place of his nativity, in 1546. The emperor and the pope had mutually resolved on the destruction of all who should dare to oppose the council of Trent. The meeting of it was to serve as a signal for taking up arms, and accordingly its deliberations were scarcely begun in 1546, when the Protestants perceived undoubted signs of the approaching storm, and of a formidable union betwixt the emperor and pope, which threatened to crush and overwhelm them at once.

The two armies met near Muhlberg on the Elbe, on the 24th of April 1547; and after a bloody action, the elector was entirely defeated, and himself taken prisoner. Maurice, who had so basely betrayed him, was now declared elector of Saxony; and by his intreaties, Philip landgrave of Hesse, the other chief of the Protestants, was persuaded to throw himself on the mercy of the emperor, and to implore his pardon. To this he consented, relying on the promise of Charles for obtaining forgiveness and being restored to liberty; but, notwithstanding these expectations, he was unjustly detained prisoner by a scandalous violation of the most solemn convention.

The affairs of the Protestants now seemed to be desperate. In the diet of Augsbourg, which was soon after called, the emperor required the Protestants to leave the decision of these religious disputes to the wisdom of the council which was to meet at Trent. The greatest part of the members consented to this proposal, being convinced by the powerful argument of an imperial army which was at hand to dispel the darkness from the eyes of such as might otherwise have been blind to the force of the emperor's reasoning. However, this general submission did not produce the effect which was expected from it. During this interval, therefore, the emperor judged it necessary to fall upon some method of accommodating the religious differences, and maintaining

peace, until the council, so long expected, should be finally obtained.

In the year 1549, the pope (Paul III.) died; and was succeeded by Julius III. who, at the repeated solicitations of the emperor Charles, consented to the re-assembling of a council at Trent. A diet was again held at Augsbourg, under the canon of an imperial army, and Charles laid the matter before the princes of the empire. Most of those present gave their consent to it, and, among the rest, Maurice, elector of Saxony; who consented on the following conditions: 1. That the points of doctrine which had already been decided there, should be re-examined. 2. That this examination should be made in presence of the Protestant divines. 3. That the Saxon Protestants should have a liberty of voting as well as of deliberating in the council. 4. That the pope should not pretend to preside in that assembly, either in person or by his legates. This declaration of Maurice was read in the diet, and his deputies insisted upon its being entered into the registers, which the archbishop of Mentz obstinately refused. The diet was concluded in the year 1551; and, at its breaking up, the emperor desired the assembled princes and states to prepare all things for the approaching council, and promised to use his utmost endeavours to procure moderation and harmony, impartiality, and charity, in the transactions of that assembly.

On the breaking up of the diet the Protestants took such steps as they thought most proper for their own safety; and the elector, perceiving that Charles the emperor had formed designs against the liberties of the German princes, resolved to take the most effectual measures for crushing his ambition at once. He therefore entered with the utmost secrecy and expedition into an alliance with the king of France, and several of the German princes, for the security of the rights and liberties of the empire; after which, assembling a powerful army in 1552, he marched against the emperor, who lay with a handful of troops at Inspruck, and did not expect an attack. By this sudden and unforeseen accident Charles was so much dispirited, that he was willing to make peace almost on any terms. The consequence of this was, that he concluded a treaty at Passau, which by the Protestants is considered as the basis of their religious liberty. By the first three articles of this treaty it was agreed, that Maurice and the confederates should lay down their arms, and lend their troops to Ferdinand to assist him against the Turks; and that the landgrave of Hesse should be set at liberty. By the fourth it was agreed, that the Rule of Faith, called the *Interim*, should be considered as null and void; that the contending parties should enjoy the free and undisturbed exercise of their religion, until a diet should be assembled to determine amicably the present disputes, which diet was to meet in the space of six months, and that this religious liberty should continue always, in case it should be found impossible to come to an uniformity in doctrine and worship. It was also determined, that all those who had suffered banishment, or any other calamity, on account of their having been concerned in the league of war of Smalcald, should be reinstated in their privileges, possessions, and employments; that the Imperial chamber at Spire should be open to the Protestants as well as to the Catholics; and that there should always be a certain number of Lutherans in that high court. To this peace Albert, marquis of Brandenburg, refused to subscribe; and continued the war against the Roman Catholics, committing such ravages in the empire, that a confederacy was at last formed against him. At the head of this confederacy was Maurice elector of Saxony, who died of a wound he received in a battle fought on the occasion in 1553.

The assembling of the diet, promised by Charles, was prevented by various incidents; however, it met at Augsbourg in 1555, where it was opened by Ferdinand, his brother, in name of the emperor; and terminated those deplorable calamities which had so long desolated the empire. After various debates, the following acts were passed on the 25th of September: that the Protestants who followed the Confession of Augsbourg should be for the future considered as entirely free from the jurisdiction of the Roman pontiff, and from the authority and superintendence of the bishops; that they were left at perfect liberty to enact laws for themselves, relating to their religious sentiments, discipline, and worship; that all the inhabitants of the German empire should be allowed to judge for themselves in religious matters, and to join themselves to that church, whose doctrine and worship they thought the most pure and consonant to the spirit of true Christianity; and that all those who should injure or persecute any person under religious pretences, and on account of their opinions, should be declared and proceeded against as public enemies of the empire, invaders of its liberty, and disturbers of its peace.

Thus was the Reformation established in many parts of the German empire, where it continues to this day; nor have the efforts of the Popish powers at any time been able to suppress it, or even to prevent it from gaining ground; and thus terminated those deplorable scenes of bloodshed, desolation, and discord, that had so long afflicted both church and state, by that religious peace, as it is commonly called, which secured to the Protestants the free exercise of their religion, and established this inestimable liberty upon the firmest foundations.

During these transactions in Germany, the dawn of truth arose upon other nations. The light of the reformation spread itself far and wide; and almost all the European states welcomed its salutary

tary beams, exulted in the prospect of an approaching deliverance from the yoke of superstition and spiritual despotism. Some of the most considerable provinces of Europe had already broke their chains, and openly withdrawn themselves from the discipline of Rome and the jurisdiction of its pontiff. The reformed religion was propagated in Sweden soon after Luther's rupture with Rome, by Olaus Petri, one of his disciples, who was countenanced and encouraged by the valiant and public spirited prince Gustavus Vasa Ericson, to whose firmness and magnanimity it was owing, that from the year 1527 the papal empire in Sweden was entirely overturned, and Gustavus declared head of the church. The light of the reformation was also received in Denmark so early as the year 1521, in consequence of the ardent desire discovered by Christian or Christiern II. for purposes of mere ambition, of having his disciples instructed in the doctrines of Luther. His successor, Frederic duke of Holstein and Silesia, contributed greatly to the progress of the reformation, by his successful attempts in favour of religious liberty, at the assembly of states that was held at Odensee, in the year 1527, when he procured the publication of the famous edict which declared every subject of Denmark free, either to adhere to the tenets of the church of Rome, or to embrace the doctrine of Luther; that no person should be molested on account of his religion; that a royal protection should be granted to the Lutherans, and that ecclesiastics of every order should be allowed to marry. But the honour of accomplishing this glorious work was reserved for Christiern III. a prince equally distinguished by his piety and prudence. The religious doctrine, discipline, and worship of this kingdom, were settled according to a plan laid down by Burgenhagius. And the assembly of the states at Odensee, in 1539, gave a solemn sanction to all these transactions; and thus the work of reformation was brought to perfection in Denmark. In France, the auspicious patronage of Margaret, queen of Navarre, sister to Francis I. encouraged several pious and learned men, whose religious sentiments were the same with her own, to propagate the principles of the reformation, and even to erect several Protestant churches in that kingdom. It appears that, so early as the year 1523, there were many, and even persons of rank, and some of the episcopal order, who had conceived the utmost aversion both against the doctrine and tyranny of Rome. But the wavering and inconsistent conduct of Francis I. rendered the situation of the Protestants in this country always precarious, often distressed. The French Protestants were called Huguenots, by their adversaries, by way of contempt. Their fate was very severe, being persecuted with unparalleled fury; and though many princes of the blood, and of the first nobility, had embraced their sentiments, yet in no part of the world did the reformers suffer so much. At last all commotions were quelled by the fortitude and magnanimity of Henry IV. who in the year 1598 granted all his subjects full liberty of conscience by the famous edict of Nantz, and seemed to have thoroughly established the reformation throughout his dominions. During the minority of Louis XIV. however, this edict was revoked by cardinal Mazarine, since which time the Protestants have often been cruelly persecuted; nor was the profession of the reformed religion in France by any means so safe as in most other countries of Europe, but since the Revolution an universal toleration has taken place. Upon the whole, we may observe, that before the diet of Augsburg, the doctrine of Luther had made a considerable, though perhaps a secret progress in Spain, Hungary, Bohemia, Poland, and the Netherlands, and had in all these countries many friends, of whom several repaired to Wirtemberg, to improve their knowledge, and enlarge their views under such an eminent master.

In England the principles of the reformation began to be adopted as soon as an account of Luther's doctrines could be conveyed thither. In that kingdom there were still great remains of the sect called *Lollards*, whose doctrine resembled that of Luther: and among whom, of consequence, the sentiments of our reformer gained great credit. Henry VIII. king of England, at that time was a violent partisan of the church of Rome, and had a particular veneration for the writings of Thomas Aquinas. Being informed that Luther spoke of his favourite author with contempt, he conceived a violent prejudice against the reformer, and even wrote against him. Luther did not hesitate at writing against his majesty, overcame him in argument, and treated him with very little ceremony. The first step towards public reformation, however, was not taken till the year 1539. Great complaints had been made in England, and of a very ancient date, of the usurpations of the clergy; and by the prevalence of the Lutheran opinions, these complaints were now become more general than before. The House of Commons finding the occasion favourable, passed several bills, restraining the impositions of the clergy; but what threatened the ecclesiastical order with the greatest danger were the severe reproaches thrown out almost without opposition in the House against the dissolute lives, ambition, and avarice of the priests, and their continual encroachments on the privileges of the laity. The bills for regulating the clergy met with opposition in the House of Lords; and bishop Fisher imputed them to want of faith in the Commons, and to a formed design proceeding from heretical and Lutheran principles of robbing the church of her patrimony, and overturning the national religion. The Commons, however, complained to the king, by their speaker Sir Thomas

Audley, of these reflections thrown out against them; and the bishop was obliged to retract his words.

Though Henry had not the least idea of rejecting any, even of the most absurd Romish superstitions, yet as the oppressions of the clergy suited very ill with the violence of his own temper, he was pleased with every opportunity of lessening their power. In the parliament of 1531, he shewed his design of humbling the clergy in the most effectual manner. An obsolete statute was revived, from which it was pretended that it was criminal to submit to the legatine power which had been exercised by cardinal Wolsey. By this stroke the whole body of clergy were declared guilty at once. They were too well acquainted with Henry's disposition, however, to reply, that their ruin would have been the certain consequence of their not submitting to Wolsey's commission, which had been given by royal authority. Instead of making any defence of this kind, they chose to throw themselves on the mercy of their sovereign; which, however, it cost them 118,840l. to procure. A confession was likewise extorted from them, that the king was protector and supreme head of the church of England; though some of them had the dexterity to get a clause inserted, which invalidated the whole submission, viz. *in so far as is permitted by the law of Christ*. The king, having thus begun to reduce the power of the clergy, kept no bounds with them afterwards. He did not indeed attempt any reformation in religious matters; nay, he prosecuted most violently such as did attempt this in the least. Indeed, the most essential article of his creed seems to have been his own supremacy; for, whoever denied this, was sure to suffer the most severe penalties, whether Protestant or Papist.

Having sued for a divorce from Catharine of Arragon, his brother's widow, at the court of Rome, for almost six years, during which period Clement VII. negotiated, promised, retracted, and concluded nothing; he determined to apply to another tribunal for that decree, which he had unsuccessfully solicited at Rome. Cranmer, archbishop of Canterbury, by a sentence founded on the authority of universities, and doctors, who had been consulted with respect to the point, annulled the king's marriage with Catharine; and Anna Boleyn, whose charms had captivated the king, was acknowledged as queen of England. Clement, apprehensive lest England should revolt from the holy see, determined to give Henry such satisfaction as might still retain him within the bosom of the church. But the violence of the cardinals precipitated him, in 1534, to issue a bull rescinding Cranmer's sentence, confirming Henry's marriage with Catharine, and declaring him excommunicated, if, within a time specified, he did not abandon the wife he had taken, and return to her whom he had deserted. Enraged at this unexpected decree, Henry kept no longer any measures with the court of Rome; his subjects seconded his resentment; an act of parliament was passed, abolishing the papal power and jurisdiction in England; by another the king was declared supreme head of the church, and all the authority of which the popes were deprived was vested in him; the monasteries were suppressed, and their revenues applied to other purposes. Henry, however, with a caprice peculiar to his character, continued to defend the doctrines of the Romish church as fiercely as he attacked their jurisdiction. He alternately persecuted the Protestants for rejecting the former, and the Catholics for acknowledging the latter. Nevertheless his subjects having been encouraged by his example to break some of their fetters, were so impatient to shake off all that remained, that in the following reign, under his son Edward VI. with the general applause of the nation, a total separation was made from the church of Rome in articles of doctrine as well as in matter of discipline and jurisdiction. In 1553 his death retarded the progress of the reformation; and his sister Mary, who succeeded him, imposed a new the arbitrary laws and tyrannical yoke of Rome upon the people of England. But the execution of a great number of persons, who were burnt for the Protestant faith in the five years of her persecuting and bloody reign, so alienated the people from popery, that queen Elizabeth, her sister, found it no hard matter to deliver her subjects from the bondage of Rome, and to establish that form of a religious doctrine and ecclesiastical government which still subsists in England.

The seeds of the reformation were very early sown in Scotland by several noblemen of that nation, who had resided in Germany during the religious disputes that divided the empire. The first and most eminent opposer of the papal jurisdiction was John Knox, a disciple of Calvin, who set out from Geneva for Scotland in 1559, and in a little while prevailed with the greatest part of the Scotch nation entirely to abandon the superstitions of Rome, and to aim at nothing less than the total extirpation of popery. From that period to the present times, the form of doctrine, worship, and discipline, that had been established at Geneva by the ministry of Calvin, has been maintained in Scotland with invincible obstinacy and zeal, and every attempt to introduce into that kingdom the rites and ceremonies of the church of England, has proved impotent and unsuccessful. See PRESBYTERIANS.

The cause of the reformation in Ireland underwent the same vicissitudes that had attended it in England. When Henry VIII. after the abolition of the papal authority, was declared supreme head of the church of England, George Brown, a native of England, and a monk of the Augustin order, whom that monarch had created, in the

the year 1333, archbishop of Dublin, began to act with the utmost vigour in consequence of this change in the hierarchy. He purged the churches of his diocese from superstition in all its forms, pulled down images, destroyed relics, abolished absurd and idolatrous rites, and by the influence as well as authority he had in Ireland, caused the king's supremacy to be acknowledged in that nation. Henry shewed soon after that this supremacy was not a vain title, for he banished the monks out of that kingdom, confiscated their revenues, and destroyed their convents. In the reign of Edward VI. further progress was made in the reformation, but the accession of Mary retarded it, in consequence of which Brown and other Protestant bishops were deprived of their dignities in the church. When Elizabeth ascended the throne, the Irish were again obliged to submit to the form of worship and discipline established in England. The reformation had not long been established in Britain, when the Belgic provinces, united by a respectable confederacy, which still subsists, withdrew from their spiritual allegiance to the Roman pontiff. The means which Philip II. king of Spain, used to obstruct the reformation, promoted it: the nobility formed themselves into an association, in the year 1566, and roused the people; who, under the heroic conduct of William of Nassau, prince of Orange, seconded by the succours of England and France, delivered this state from the Spanish yoke: in consequence of which, the reformed religion, as it was professed in Switzerland, was established in the United Provinces; and, at the same time, an universal toleration granted to those whose religious sentiments were of a different nature, whether they retained the faith of Rome, or embraced the reformation in any other form, provided that they made no attempts against the authority of the government, or the tranquillity of the public. See, on the subject of this article, Robertson's Hist. of Charles V. vol. ii. p. 113, &c. vol. iii. p. 44, &c. Mosheim's Eccl. Hist. Eng. ed. 8vo. vol. iii. p. 284, &c. Burnet's Hist. of the Reformation, passim.

REFRACTION of Light, in Optics, is an inflection or deviation of the rays from their rectilinear course, upon falling obliquely out of one medium into another, of a different density. See the System throughout.

REGALIA, in law, the royal rights or prerogatives of a king. See **PREROGATIVES**.

REGADANT, in heraldry, is understood of a lion, or other beast of prey, borne in the posture of looking behind him, with his face towards his tail. See the System, Sect. VI. Art. III. and Plate V.

REGENERATION, in theology, the act of being born again by a spiritual birth, or becoming a child of God: or it is that change experienced by a person who forsakes a course of vice, and sincerely embraces a life of piety and virtue.

REGENT, one who governs a kingdom during the minority or absence of the king. In France, prior to the revolution, the queen-mother had the regency during the minority of the king, under the title of *queen-regent*. In England, the methods of appointing this guardian or regent have been so various, and the duration of his power so uncertain, that from hence alone it may be collected that his office is unknown to the common law; and therefore (as Sir E. Coke says, 4 Inst. 58.) the surest way is to have him made by authority of the great council in parliament. The Earl of Pembroke by his own authority assumed in very troublesome times the regency of Henry III. who was then only nine years old; but was declared of full age by the pope at 17, confirmed the great charter at 18, and took upon him the administration of the government at 20. A guardian and council of regency were named by Edward III. by the parliament, which deposed his father; the young king being then 13, and not assuming the government till 18 years after. When Richard II. succeeded at the age of 11, the duke of Lancaster took upon him the management of the kingdom, till parliament met, which appointed a nominal council to assist him. Henry V. on his death-bed named a regent, and a guardian for his infant son Henry VI. then nine months old: but the parliament altered his disposition, and appointed a protector and council, with a special limited authority. Both these princes remained in a state of pupillage till the age of 23. Edward V. at the age of 13, was recommended by his father to the care of the duke of Gloucester; who was declared protector by the privy council. The statutes 25 Hen. VIII. c. 12, and 28 Hen. VIII. c. 7, provided, that the successor, if a male and under 18, or if a female and under 16, should be till such age, in the governance of his or her natural mother (if approved by the king) and such other councillors as his majesty should by will or otherwise appoint; and he accordingly appointed his 16 executors to have the government of his son Edward VI. and the kingdom, which executors elected the earl of Hertford protector. The statutes 24 Geo. II. c. 24; in case the crown should descend to any of the children of Frederic late prince of Wales under the age of 18, appointed the princess dowager;—and that of 5 Geo. III. 27, in case of a like descent to any of his present Majesty's children, empowers the king to name either the queen or princess dowager, or any descendant of king George II. residing in this kingdom;—to be guardian and regent, till the successor attains such age, assisted by a council of regency; the powers of them all being expressly defined and set down in the several acts.

REGENT also signifies a professor of arts and sciences in a college, who has a set of pupils under his care; but here regent is generally restrained to the lower classes, as, regent of rhetoric, regent of logic, &c. those of philosophy are rather called *professors*.

REGICIDE, or *King-killer*. The term is also used for the act itself of murdering a king; of *rex, king*, and *cædo, I slay*.

REGIMEN, the regulation of diet, and, in a more general sense, of all the non-naturals, with a view to preserve or restore health. See **ABSTINENCE**, **ALIMENT**, **FOOD**, **DIET**, **DRINK**, and **MEDICINE**.

The vicissitude of exercise and rest forms also a necessary part of regimen. See **EXERCISE**. It is beneficial to be at rest now and then, but more so frequently to use exercise; because inaction renders the body weak and listless, and labour strengthens it. But a medium is to be observed in all things, and too much fatigue to be avoided: for frequent and violent exercise overpowers the natural strength, and wastes the body; but moderate exercise ought always to be used before meals. Now, of all kinds of exercise, riding on horseback is the most convenient: or if the person be too weak to bear it, riding in a coach, or at least in a litter: next follow fencing, playing at ball, running, walking. But it is one of the inconveniences of old age, that there is seldom sufficient strength for using bodily exercise, though it be extremely requisite for health: wherefore frictions with the flesh-brush are necessary at this time of life, which should be performed by the person himself, if possible; if not by his servants. See this further explained at the conclusion of the System of Medicine, on the method of preserving **HEALTH**.

REGIMEN, or *Government*, in grammar, is that part of syntax or construction, which regulates the dependency of words, and the alterations which one occasions in another. See the System, Part II. Chap. IV.

REGIMENT, in war, a body consisting of several troops of horse, or companies of foot, commanded by a colonel, lieutenant-colonel, and major. See the Treatise on **MILITARY AFFAIRS**, Sect. III. and IV.

REGION, in physiology. Authors divide the atmosphere into three stages, called the *upper, middle, and lower regions*. The lower region is that wherein we breathe, and is bounded by the reflection of the sun's rays, that is, by the height to which they rebound from the earth. The middle region is that wherein the clouds reside, where meteors are formed, &c. extending from the extremity of the lowest, to the tops of the highest mountains. The upper region commences from the tops of the mountains, and reaches to the utmost limits of the atmosphere. In this reigns a perpetual, equable calmness, clearness, and serenity.

REGION, in anatomy, a division of the human body, otherwise called cavity, of which anatomists reckon three, viz. the upper region, or that of the head; the middle region, that of the thorax or breast; and the lower the abdomen, or belly. For description of the several parts see the System; for representation see the Plates.

REGISTER of a parish church, is a book wherein the yearly baptisms, marriages, and burials, of each parish, are orderly registered. See **MARRIAGE**. This practice was laudably instituted by that great but unfortunate person Thomas Cromwell, earl of Essex, anno 1538, while he was vicar general to king Henry VIII. These parish registers are to be subscribed by the minister and church-wardens; and the names of the persons shall be transmitted yearly to the bishop: and it has been enforced by canon 70, and by statute, &c.

REGULUS, in chymistry, denotes the finest and purest part of a metal or mineral, which sinks or precipitates to the bottom of the crucible, or furnace, in melting the mineral or ore.

REINS, in anatomy, the kidneys; or that part of an animal whereby the urine is separated from the blood. See the System, Part III. Sect. XI.

RELATION, in philosophy, the mutual respect of two things; or what each is with regard to the other. The idea of relation we acquire, when the mind so considers any thing, that it doth, as it were, bring it to, and set it by, another, and carry its view from the one to the other. Hence the denominations given to things intimating this respect, are called *relatives*; and the things so brought together, are said to be related. Any of our ideas, Mr. Locke observes, may be the foundation of relation. Though, where languages have failed to give correlative names, the relation is not easily taken notice of; as in *concubine*, which is a relative name, as well as wife.

RELATIVE, in grammar, is a word or term which in the construction answers to some word foregoing, called the *antecedent*. All relatives are said to reciprocate, or mutually infer each other; and therefore, they are often expressed by the genitive case. See the System, Part I. Chap. I. Sect. II.

RELAXATION, *relaxatio*, in medicine, &c. the act of loosening or slackening the tone or tension of the fibres, nerves, muscles, &c.

RELICS, *reliquiæ*, in the Romish church, certain remains of the body or cloaths of some saint or martyr, devoutly preserved in honour of his memory, carried at processions, kissed, revered, &c. The Romanists alledge antiquity in behalf of their relics. Indeed, folly and superstition crept into religion but too early. This practice

REL

practice of honouring the relics of saints, on which the church of Rome, in succeeding ages, founded her superstitious and lucrative use of them, as objects of devotion, as a kind of charms or amulets, and as instruments of pretended miracles seems to have originated in a very ancient custom, that prevailed among christians, of assembling at the cœmities or burying-places of the martyrs, for the purpose of commemorating them, and of performing divine worship. When the profession of Christianity obtained the protection of the civil government under Constantine the Great, stately churches were erected over their sepulchres, and their names and memories were treated with every possible token of affection and respect. In process of time, this reverence of the martyrs exceeded all reasonable bounds; and those prayers and religious services were thought to have a peculiar sanctity and virtue, which were performed over their tombs. Hence probably proceeded the practice, which obtained in the fourth century, of depositing relics of the saints and martyrs under the altars in all their churches. This practice, however, was then thought of such importance, that St. Ambrose would not consecrate a church, because it had no relics; and the council of Constantinople in Trullo ordained, that those altars should be demolished, under which there were found no relics. The rage of procuring relics for this and other purposes of a similar nature became so excessive, that, in 386, the emperor Theodosius the Great was obliged to pass a law, forbidding the people to dig up the bodies of the martyrs, and to traffic in their relics. Such was the commencement of that respect for sacred relics, which, in after ages, was perverted into a formal worship of them, and became the occasion of innumerable processions, pilgrimages, and miracles, from which the church of Rome hath derived incredible advantage. Besides the arguments from antiquity to which the Papists refer, in vindication of their worship of relics; Bellarmine appeals to scripture in support of it, and cites the following passages, viz. Exod. xiii. 19. Deut. xxxiv. 6. 2 Kings xiii. 21. 2 Kings xxiii. 16, 17, 18. Isaiah xi. 10. Matthew xi. 20, 21, 22. Acts v. 12, 15. Acts xix. 11, 12. See **POPERY**.

RELIGION, that worship and homage which is due to God, considered as our creator, preserver, and most bountiful benefactor. As our affections depend on our opinions of their objects, it seems to be among the first duties we owe to the Author of our being, to form the least imperfect, since we cannot form perfect, conceptions of his character and administration; for such conceptions will render our religion rational, and our dispositions refined. If our opinions are diminutive and distorted, our religion will be superstitious, and our temper abject. Thus, if we ascribe to the deity that false majesty which consists in the unbenevolent and sullen exercise of mere will or power, or suppose him to delight in the prostrations of servile fear, or of servile praise, he will be worshiped with mean adulation and a profusion of compliments. If he be looked upon as a stern and implacable being, delighting in vengeance, he will be adored with pompous offerings, or whatever else may be thought proper to soothe and mollify him. But if we believe perfect goodness to be the character of the Supreme Being, and that he loves those who resemble him most in this the most amiable of his attributes, the worship paid him will be rational and sublime, and his worshippers will seek to please him by imitating that goodness which they adore. Indeed, wherever right conceptions of the deity, and his providence, prevail, when he is considered as the inexhausted source of light, and love, and joy, as acting in the joint character of a father and governor, what veneration and gratitude must such conceptions thoroughly believed, excite in the mind? how natural and delightful it must be, to one whose heart is open to the perception of truth, and of every thing fair, great, and wonderful in nature, to engage in the exercises of religion, and to contemplate and adore him, who is the first fair, first great, and first wonderful; in whom wisdom, power, and goodness, dwell vitally, essentially, and act in perfect concert? what grandeur is here, to fill the most enlarged capacity, what beauty to engage the most ardent love, what a mass of wonders, in such exuberance of perfection, to astonish and delight the human mind, through an unfailling duration! When we consider the unsullied purity and absolute perfection of the divine nature, and reflect on the imperfection and various blemishes of our own, and the ungrateful returns we have made to his goodness, we must sink, or be convinced we ought to sink, into the deepest humility and prostration of soul before him, and be conscious that it is our duty to repent of a temper and conduct so unworthy of our nature, and so unbecoming our obligations to its author; and to resolve to act a wiser and better part for the future. And if the deity is considered as the father of mercies, who loves his creatures with infinite tenderness, and, in a particular manner, all good men; nay, who delights in goodness even in its most imperfect degrees; what resignation, what dependence, what generous confidence, what hope in God, and his all-wise providence, must arise in the soul that is possessed of such amiable views of him! We must farther observe, that all those affections which regard the deity as their immediate and primary object, are vital energies of the soul, and consequently exert themselves into act, and, like all other energies, gain strength or greater activity by that exertion; it is therefore our duty, as well as highest interest, often, at stated times, and by decent and solemn acts, to adore the great original

REP

of our existence, to express our veneration and love by a devout recognition of his perfections, and to evidence our gratitude by celebrating his goodness, and thankfully acknowledging all his benefits by proper exercises of sorrow and humiliation to confess our ingratitude and folly, to signify our dependence on God, our confidence in his goodness, and our resignation to the disposals of his providence; and this not only in private, but in public worship, where the presence of our fellow-creatures, and the powerful concurrence of the social affections, conspire to kindle and spread the devout flame with greater warmth and energy.

Religion, is divided into *natural* and *revealed*. By *natural* religion is meant that knowledge, veneration, and love of God, and the practice of those duties to him, our fellow-creatures, and ourselves, which are discoverable by the right exercise of our rational faculties, from considering the nature and perfections of God, and our relation to him and to one another. (See **MORAL PHILOSOPHY**.) And by *revealed* religion is meant, natural religion explained, enforced, and enlarged, from the express declarations of God himself from the mouths or pens of his prophets, &c.

Religion, in a more contracted sense, is used for that system of faith and worship, which obtains in several countries of the world (see **CHRISTIANITY**, **MAHOMATANISM**, **JEWIS**, **MYTHOLOGY**.) And even for the various sects into which religion is divided (see **ROMAN-CATHOLICS**, **LUTHERANS**, **CALVINISTS**, &c.)

RELIGIOUS, in a general sense, something that relates to religion. We say, a religious life, religious society, &c. Churches and church-yards are religious places. A religious war is also called a *croisade*. See **CROISADE**.

RELIGIOUS is also used substantially for a person engaged by solemn vows to the monastic life; or a person shut up in a monastery to lead a life of devotion and austerity, under some rule or institution. The male religious we popularly call *monks* and *friars* the female, *nuns* and *canonesses*.

REMEMBRANCE, is when the idea of something formerly known recurs again to the mind, without the operation of a like object on the external sensory. See **MEMORY**, **REMEMBRANCE**, and **RECOLLECTION**.

REMINISCENCE, *reminiscentia*, is that power of the human mind, whereby it recollects itself, or calls again to its remembrance such ideas and notions as it had really forgot: in which it differs from memory, which is a treasuring up of things in the mind, and keeping them there, without forgetting them. Hence memory may be considered as a continual *remembrance*; and *reminiscence*, as an interrupted memory. How near a-kin soever the two faculties may seem, yet they are generally found separated; so that they who excel in the one, are generally defective in the other.

RECOUNTE, or **RECONTE**, in heraldry, is applied to animals when they shew the head in front, with both eyes, &c. or when the face stands right forward as if they came to meet the person before them.

RENITENCY, that force in solid bodies, whereby they resist the impulse of other bodies, or re-act as much as they are acted on. See **MOTION**.

RENVERSE, *inverted*, in heraldry, is when any thing is set with the head downward or contrary to its natural way of standing; thus, a chevron *renverse*, is a chevron with the point downwards.

RENUNCIATION, the act of renouncing, abdicating, or relinquishing any right, real or pretended. *Renunciations* are sometimes *express*, as by contracts, &c. sometimes *tacit*, as by contrary acts.

REPARTEE, a ready, smart reply: especially in matters of wit, humour, or raillery. The word in the original French, *repartie*, has the same signification. It is justly observed, that there is a great difference between a free, sprightly *repartie*, and an offensive *sarcasm*.

REPELLENT, *repellens*, in medicine, a remedy which repels or drives back a morbid humour into the mass of blood, from which it was unduly secreted. Repellents are medicines which prevent such an influx of the fluids to any particular part, as might raise it into a tumour, drive them back when they are collected.

REPELLING Power, in physics, is a certain power or faculty residing in the minute particles of natural bodies, whereby under certain circumstances, they mutually fly from each other. This power is the reverse of the *attractive* power. Sir Isaac Newton having established the attractive power of matter from observation and experiment, argues, that, as in algebra, where positive quantities cease, there negative ones commence; so in physics where the attractive force ceases, there a *repelling* force must begin, and adds, that there is such a force, does likewise appear from observation. As the *repelling* power seems to arise from the same principle as the attractive, only exercised under different circumstances, it is governed by the same laws: now the attractive, we find, is stronger in small bodies than in great ones, in proportion to the masses; therefore the repelling is so too. But the rays of light are of all others the most minute bodies we know of; therefore, of all others, their repelling force must be the greatest.

Sir Isaac Newton computes, that the attractive force of the rays of light is above 1000000000000000 times as strong as the force of gravity on the surface of the earth: hence arises that inconceivable

REP

REP

able velocity wherewith light must move, to reach from the sun to our earth in seven minutes. For the rays emitted from the body of the sun by the vibrating motion of its parts are no sooner got without the sphere of attraction of the sun than they come within the action of the repelling power. The elasticity or springiness of bodies, or that property whereby, after having their figure altered by an external force, they return to their former figure, follows from the repelling power.

REPENTANCE, in theology, is a change of sentiments followed by a change of conduct, or *repentance* denotes such a conviction of the evil and danger of a sinful course, as is sufficient to produce shame and sorrow in the review of it, and effectual resolutions of amendment.

REPLETION, in medicine, a plenitude or plethora. Repletion of blood is more dangerous than inanition. Bleeding and diet are the great resources when a person is incommoded with a repletion. REPLETION is sometimes also used where the stomach is overloaded with too much eating or drinking. The physicians hold all repletion prejudicial; but that of bread is of all others the worst.

REPORT, in law, is a public relation, or bringing to memory of cases judicially argued, debated, resolved, or adjudged, in any of the king's courts of justice, with the cause and reason of the same delivered by the judges. When the chancery, or any other court, refers the stating of some case, or comparing an account, &c. to a master in chancery, or other referee, his certificate therein is also called a report.

REPOSITORY, a store-house or place where things are laid up, and kept. In which sense we say, the repository of the Royal Society, &c. See MUSEUM.

REPRESENTATION, in the drama, the exhibition of a theatrical piece; including the scenes, machines, recitation, &c. Sir Richard Steele's principle is, that the design of a play is not to be read but represented; so that it is on the stage, not in the press, it is to be judged of; and that the pit, not the public, are the proper judges.

REPRESENTATIVE, one that personates or supplies the place of another, and is invested with his right and authority. The word representative is equivalent to procurator or proxy. The commons are the people's representatives in parliament. There is this defect in the constitution of our parliament; that as all who have not considerable estates ought not to be taxed without their own consent in parliament by themselves, or their representatives; copyholders, some of whom have a thousand pounds a year, have no voice in the election of knights of the shire. See PARLIAMENT.

REPRIEVE, in criminal law, (from *repandre*, "to take back,") is the withdrawing of a sentence for an interval of time; whereby the execution is suspended. This may be, first, *ex arbitrio judicis*, either before or after judgment. These arbitrary reprieves may be granted or taken off by the justices of gaol-delivery, although their session be finished, and their commission expired: but this rather by common usage than of strict right; as, where the judge is not satisfied with the verdict, or the evidence is suspicious, or the indictment is insufficient, or he is doubtful whether the offence be within clergy; or sometimes if it be a small felony, or any favourable circumstances appear in the criminal's character, in order to give room to apply to the crown for either an absolute or conditional pardon.

Reprieves may also be *ex necessitate legis*: as where a woman is capitally convicted, and pleads her pregnancy. Though this is no cause to stay judgment, yet it is to respite the execution till she be delivered. This is a mercy dictated by the law of nature, *in favorem prolis*; and therefore no part of the bloody proceedings in the reign of queen Mary hath been more justly detested than the cruelty that was exercised in the island of Guernsey, of burning a woman big with child; and, when, through the violence of the flames, the infant sprang forth at the stake, and was preserved by the bye-standers, after some deliberations of the priests who assisted at the sacrifice, they cast it into the fire as a young heretic. A barbarity which they never learned from the laws of ancient Rome; which direct, with the same humanity as our own, *quoad pregnantis mulieris damnatae poena differatur, quoad puriat*; which doctrine has also prevailed in England, as early as the first memorials of our law will reach.

REPRISALS, or REPRIZALS, in the civil law, a right which princes have to retake from their enemies such things as they unjustly detain from them; or other things equivalent thereto.

REPROBATION, in theology, a decree or resolve, which God has taken from all eternity to punish sinners, who shall die in impenitence. Reprobation stands in direct opposition to election.

Positive REPROBATION, is that whereby God is supposed to create men with a positive and absolute resolution to damn them eternally. This opinion of reprobation is countenanced by St. Augustine, and others of the fathers; and is strongly maintained by Calvin, and most of his followers. Something like it is also found in the thirty-nine articles of the church of England; but it is now generally exploded, as repugnant to the justice of God.

REPRODUCTION, the act whereby a thing is produced anew, or grows a second time. When the stock of an oak, a fruit-tree,

or the like, is cut off short, it reproduces an infinity of young shoots. By reproduction is usually understood the restoration of a thing before existing, and since destroyed.

It is very well known, that trees and plants are to be raised from slips and cuttings; and some late observations have shewn, that there are some animals which have the same property. The polype was the first instance we had of this. See MICROSCOPIC OBJECTS.

Amongst the plants which may be raised from cuttings, there are some which seem to possess this quality in so eminent a degree, that the smallest portion of them will become a complete tree again.

REPTILES, in amphibiology, a kind of animals so denominated from their creeping or advancing on the belly. Or, reptiles are distinctly a genus of animals and insects, which, instead of feet, rest on one part of the body, while they advance forward with the rest. Such are earth-worms, snakes, &c. Indeed many of the ordinary class of reptiles have feet, only those very small, and the legs short in proportion to the bulk of the body. Naturalists observe great contrivance for the motion of reptiles. Thus, particularly in the earth-worm, Dr. Willis tells us, the whole body is only a chain of annular muscles; or, as Dr. Derham says, it is only one continued spiral muscle, the orbicular fibres whereof, by being contracted, render each ring narrower and longer than before; by which means it is enabled, like the worm of an auger, to bore its passage into the earth. Its reptile motion, may also be explained by a wire wound on a cylinder, which when stripped off, and one end extended, and held fast, will bring the other nearer it. So the earth-worm having shot out or extended its body (which is formed with a wreathing) it takes hold by those small feet it hath, and so contracts the hinder part of its body. Dr. Tyson adds, that when the fore part of the body is stretched out and applied to a plane at a distance, the hind part, relaxing and shortening, is easily drawn toward it as a center. The little feet of this creature are disposed in a quadruple row the whole length of the worm; with which, as with so many hooks, it fastens down sometimes this, and sometimes that, part of the body to the plane, and at the same time stretches out, or drags after it, another. The creeping of serpents is effected after a somewhat different manner, there being a difference in their structure; in that these last have a compages of bones articulated together.

The body here is not drawn together, but, as it were, complicated, part of it being applied on the rough ground, and the rest ejaculated and shot from it; which, being set on the ground in its turn, brings the other after it. The spine of the back, variously wreathed in these creatures has the same effect in leaping, as the joints of the feet in other animals; they making their leaps by means of muscles that extend the plicæ, or folds. See the SYSTEM.

REPUBLIC, *respublica*, *commonwealth*, a popular state or government; or a nation where the body, or only a part of the people have the government in their own hands. When the body of the people is possessed of the supreme power, this is called a democracy.

When the supreme power is lodged in the hands of a part of the people, it is then an aristocracy. See GOVERNMENT.

The celebrated republics of antiquity are those of Athens, Sparta, Rome, and Carthage. At present, there is scarce any such thing as a real republic, i. e. a strictly popular state. Indeed the Venetians and Genoese call their states republics; but their government is apparently oligarchic. The Dutch come the nearest to the character of a republic; yet they are very defective, at least in the sense and severity wherewith Rome, Carthage, &c. were republics. See STATES-general.

It is a remark of M. St. Evremont, that, if the Dutch love the republican form, it is more for the sake of their trade than their liberty. Holland, which is composed of about fifty republics all different from one another, may be considered as a confederate republic; which is a convention by which several petty states agree to become members of a larger one, which they intend to establish. In this view, Germany, which consists of free cities, and of petty states, subject to different princes, and the Swiss cantons, are considered in Europe as perpetual republics.

REPUBLIC of Letters, is a phrase used in speaking collectively of the whole body of the people of study and learning. There is a journal, begun in Holland, by M. Bayle, and continued by M. Bernard, consisting of extracts of books, printed in the course of the year, called *Nouvelles de la Republique des Lettres*, News from the Republic of Letters.

REPULSION, in physics, that property of bodies whereby they recede from each other, and, on certain occasions, mutually avoid coming into contact.

REPULSION, as well as attraction, has of late been considered as one of the primary qualities of all matter, and has been much used in explaining the phenomena of nature; thus the particles of air, fire, steam, electric fluid, &c. are said to have a repulsive power with respect to one another. That this is the case with the air, and vapour of all kinds, is certain; because when they are compressed into a small space, they expand with great force; but as to fire, light, and electricity, our experiments fail; nay, the supposition of a repulsive power among the particles of the electric fluid is inconsistent with the phenomena. Even in those fluids, air and steam, where a repulsive power most manifestly exists, it is demonstrable

strable that the repulsion cannot be a primary quality, since it can be increased to a great degree by heat, and diminished by cold; but it is impossible that a primary quality of matter can be increased or diminished by any external circumstances whatever; for whatever property depends upon external circumstances, is not a primary but a secondary one. The expulsion of electrified bodies is explained under the article *ELECTRICITY*, see the *System*, Part I. Sect. I. that of others is less subject to investigation; and the most that can be said concerning it is, that in many cases it seems to be the consequence of a modification of fire, and in others of electricity.

REQUEST, in law, a supplication or petition preferred to a prince, or court of justice, begging relief, in some conscientious cases, where the common law grants no immediate redress. The term request is now, since the institution of chancery, much disused; together with the court of requests, where requests were cognizable.

Court of REQUESTS. See *Court of Conscience*.

REQUIEM, a mass sung in the Romish church for the rest of the soul of a person deceased.

RESEMBLANCE, and DISSIMILITUDE, the relations of likeness and difference among objects. The connection that man hath with the beings around him, requires some acquaintance with their nature, their powers, and their qualities, for regulating his conduct. For acquiring a branch of knowledge so essential to our well-being, motives alone of reason and interest are not sufficient: nature hath providentially superadded curiosity, a vigorous propensity, which never is at rest. This propensity alone attaches us to every new object; [See *NOVELTY*] and incites us to compare objects, in order to discover their differences and resemblances.

Resemblance among objects of the same kind, and dissimilitude among objects of different kinds, are too obvious and familiar to gratify our curiosity in any degree: its gratification lies in discovering differences among things where resemblance prevails, and resemblances where difference prevails. Thus a difference in individuals of the same kind of plants or animals, is deemed a discovery, while the many particulars in which they agree are neglected; and in different kinds, any resemblance is greedily remarked, without attending to the many particulars in which they differ.

The poets, such of them as have a just taste, draw all their similes from things that in the main differ widely from the principal subject; and they never attempt a contrast, but where the things have a common genus, and a resemblance in the capital circumstances: place together a large and a small-sized animal of the same species, the one will appear greater, the other less, than when viewed separately: when we oppose beauty to deformity, each makes a greater figure by the comparison. We compare the dress of different nations with curiosity, but without surprise; because they have no such resemblance in the capital parts as to please us by contrasting the smaller parts. But a new cut of a sleeve, or of a pocket, enchants by its novelty; and, in opposition to the former fashion, raises some degree of surprise.

That resemblance and dissimilitude have an enlivening effect upon objects of sight, is made sufficiently evident; and that they have the same effect upon objects of the other senses, is also certain. Nor is that law confined to the external senses; for characters contrasted make a greater figure by the opposition; Iago, in the tragedy of *Othello*, says,

He hath a daily beauty in his life,
That makes me ugly.

The character of a fop, and of a rough warrior, are no where more successfully contrasted than in *Shakespeare*:

Hotspur. My liege, I did deny no prisoners:

But I remember, when the fight was done,
When I was dry with rage, and extreme toil,
Breathless and faint, leaning upon my sword;
Came there a certain lord, neat, trimly dress'd,
Fresh as a bridegroom; and his chin, new reap'd,
Shew'd like a stubble-land at harvest-home.
He was perfum'd like a millener;
And 'twixt his finger and his thumb he held
A pouncet-box, which ever and anon
He gave his nose:—and still he smil'd and talk'd;
And as the soldiers bare dead bodies by,
He call'd them untaught knaves, unmannerly,
To bring a slovenly, unhandsome corse
Betwixt the wind and his nobility.
With many holiday and lady terms
He questioned me: among the rest, demanded
My prisoners, in your majesty's behalf.
I then, all smarting with my wounds; being gall'd
To be so pester'd with a popinjay,
Out of my grief, and my impatience,
Answer'd, neglectingly, I know not what:
He should, or should not; for he made me mad,
To see him shine so brisk, and smell so sweet,
And talk so like a waiting gentlewoman,
Of guns, and drums, and wounds, (God save the mark!)
And telling me the sovereign'st thing on earth
Was pumicacy, for an inward bruise;

And that it was great pity, so it was,
This villainous salt-petre should be digg'd
Out of the bowels of the harmless earth,
Which many a good, tall fellow had destroy'd
So cowardly: and but for these vile guns,
He would himself have been a soldier.

First Part, Henry IV. act 1. sc.

Passions and emotions are also enflamed by comparison. A man of high rank humbles the bye-standers even to annihilation in their own opinion: Cæsar, beholding the statue of Alexander, was greatly mortified, that now at the age of 32, when Alexander died, he had not performed one memorable action. Our opinions also are much influenced by comparison. A man whose opulence exceeds the ordinary standard, is reputed richer than he is in reality; and wisdom or weakness, if at all remarkable in an individual, is generally carried beyond the truth.

The opinion a man forms of his present distress is heightened by contrasting it with his former happiness:

Could I forget
What I have been, I might the better bear
What I am destin'd to. I'm not the first
That have been wretched: but to think how much
I have been happier. *Southern's Innocent Adultery, act 2.*

The distress of a long journey makes even an indifferent disagreeable: and, in travelling, when the road is good and the horseman well covered, a bad day may be agreeable, by making him sensible how snug he is. The same effect is equally remarkable when a man opposes his condition to that of others. A ship tossed about in a storm, makes the spectator reflect upon his own ease and security, and puts these in the strongest light. A man in grief cannot bear mirth; it gives him a more lively notion of his unhappiness, and of course makes him more unhappy. Satan, contemplating the beauties of the terrestrial paradise, has the following exclamation:

With what delight could I have walk'd the round,
If I could joy in ought, sweet interchange
Of hill and valley, rivers, woods, and plains,
Now land, now sea, and shores with forest crown'd,
Rocks, dens, and caves! but I in none of these
Find place or refuge; and the more I see
Pleasures about me, so much more I feel
Torment within me, as from the hateful siege
Of contraries: all good to me becomes
Bane, and in heav'n much worse would be my state.

Paradise Lost, book 9. l. 114.

RESERVATION, reservatio, in law, an action or clause whereby something is reserved, i. e. is retained, kept, or secured to one's self. Thus when a man lets his land, he reserves a rent to be paid to himself for his maintenance, &c.

Mental RESERVATION, is a proposition which, strictly taken, and according to the natural import of the terms, is false; but if qualified with something reserved or concealed in the mind, becomes true. Mental reservations are the great refuge of religious hypocrites, who use them to accommodate their consciences with their interests. The Jesuits are zealous advocates for mental reservations; yet are they strictly all real lies, as including an intention to deceive.

RESERVE, in law, the same with reservation. Benefices are sometimes resigned with reserve of a pension. By the canon law, no person may reserve to himself a pension out of a benefice, unless he hath served it ten years.

RESIDENT, a public minister, who manages the affairs of a king in the court of a prince, or petty state; or the affairs of a prince, or petty state, in the court of a king or prince. Thus the king of England has residents in the courts of the electors, and other princes of Germany and Italy; at the republics of Genoa and Lucca; and they, reciprocally, have residents in the court of Great Britain.

RESIDUUM of a Charge, in electricity, first discovered by Mr. Galath, in Germany, in 1746, is that part of the charge that lay on the uncoated part of a *LEYDEN* phial, which doth not let go all its elasticity at once; so that it is afterwards gradually diffused to the coating. See the *System*, Sect. IV.

RESIDUUM, in law. See *EXECUTOR*.

RESIN, resina, a fat, viscid, sulphureous juice, ousing either spontaneously, or by incision, from several kinds of trees, particularly the pine, fir, &c. Resins are employed for many purposes. The cheapest kinds are used for torches, and to cover the outsides of ships and boats. The fine transparent resins, compose varnishes. Many of them are employed medicinally; such are those which enter into the composition of ointments and plaisters; or internally, as the resins of scammony, and turpeth, which are purgative. Other resins, as benjamin and storax, are employed as perfumes. See the *System of Chemistry*, Part IV. Sect. IV.

RESISTANCE, or RESISTING Force, in physics, any power which acts contrarily to another, so as to destroy or diminish its effects. Of resistance there are various kinds, arising from the various natures and properties of the resisting bodies, and governed by various laws: as, the resistance of solids, the resistance of fluids, the resistance of the air, &c. The doctrine of each whereof may be seen

seen under the Systems of MECHANICS, HYDROSTATICS, PNEUMATICS, &c.

RESOLUTION, *resolutio*, or *solutio*, in physics, the reduction of a body into its original or natural state, by a dissolution or the separation of its aggregated parts. Thus snow and ice are said to be resolved into water; and a compound is resolved into its ingredients, &c. water resolves into vapour by heat; and vapour is again resolved into water by cold. Some of the modern philosophers, particularly Mr. Boyle, Mr. Marriotte, Boerhaave, &c. maintain that the natural state of water is to be congealed, or in ice; inasmuch as a certain degree of heat, which is a foreign and violent agent, is required to make it fluid, so that near the pole, where this foreign force is wanting, it constantly retains its fixed or icy state. On this principle, the resolution of ice into water must be allowed an improper expression.

RESOLUTION, in chymistry, is the reduction of a mass' or mixed body into its component parts, or first principles, by a proper analysis. The resolution of bodies is performed variously; by distillation, sublimation, dissolution, fermentation, &c.

RESOLUTION, in ethics, is that passion which encounters difficulties and dangers; but when it has to do more peculiarly with dangers, it is called boldness. Desire, Joy, and Sorrow, enter into its constitution, but Joy is by much the principal ingredient. When resolution degenerates into a concern to maintain our mistakes, humours, or vices, it is more properly denominated obstinacy. See PASSIONS.

RESOLUTION, in logic, is a branch of what is called METHOD. The business of resolution is to investigate or examine the truth or falsehood of a proposition, by ascending from some particular known truth, as a principle, by a chain of consequences, to another more general one in question. See that Article, Part IV. in the System.

RESOLUTION, or **SOLUTION**, in mathematics, is an orderly enumeration of several things to be done, to obtain what is required in a problem. Wolfius makes a problem to consist of three parts. The proposition (which is what we properly call the problem) the resolution and the demonstration. The general tenor of all problems is, that those being done which are enjoined by the resolution, the thing is done which was to be done. As soon as a problem is demonstrated, it is converted into a theorem; whereof the resolution is the hypothesis; and the proposition the thesis.

RESPIRATION, *respiratio*, the act of respiring, or breathing the air. Respiration is an involuntary motion of the breast, whereby the air is alternately taken in and thrown out: it therefore includes two contrary motions, the one called inspiration, whereby the fluid is received into the cavity of the lungs; the other expiration whereby it is again expelled. The principle organs of respiration are the lungs, trachea, larynx, &c. See the system of ANATOMY, Part IV. Sect. VII. and plate IV, V, VI, and VII. Fig. 5.

Respiration constitutes one of those functions which are properly termed *vital*, as being essential to life; for to live and to breathe are in fact synonymous terms. It consists in an alternate contraction and dilatation of the thorax, by first inspiring air into the lungs, and then expelling it from them in expiration. It will perhaps be easy to distinguish and point out the several phenomena of respiration; but to explain their physical cause will be attended with difficulty: for it will naturally be inquired, how the lungs, when emptied of their air, and contracted by expiration, become again inflated, they themselves being perfectly passive? How the ribs are elevated in opposition to their own natural situation? and why the diaphragm is contracted downwards, towards the abdomen? Were we to assert, that the air, by forcing its way into the cavity of the lungs, dilated them, and consequently elevated the ribs and pressed down the diaphragm, we should speak erroneously. What induces the first inspiration it is not easy to ascertain; but after an animal has once respired, it would seem likely that the blood, after expiration, finding its passage through the lungs obstructed, becomes a stimulus, which induces the intercostal muscles and the diaphragm to contract, and enlarge the cavity of the thorax, in consequence perhaps of a certain nervous influence, which we shall not here attempt to explain. The air then rushes into the lungs; every branch of the bronchial tubes, and all the cellular spaces into which they open, become fully dilated; and the pulmonary vessels being equally distended, the blood flows through them with ease. But as the stimulus which first occasioned this dilatation ceases to operate, the muscles gradually contract, the diaphragm rises upwards again, and diminishes the cavity of the chest, the ribs return to their former state, and as the air passes out in expiration, the lungs gradually collapse, and a resistance to the passage of the blood again takes place. But the heart continuing to receive and expel the blood, the pulmonary artery begins again to be distended, the stimulus is renewed, and the same process is repeated, and continues to be repeated, in a regular succession during life: for though the muscles of respiration, having a mixed motion, are (unlike the heart) in some measure dependent on the will, yet no human being, after having once respired, can live many moments without it. In an attempt to hold one's breath, the blood soon begins to distend the veins, which are unable to empty their contents into the heart, and we are able only during a very little time to resist the stimulus to in-

spiration. In drowning, the circulation seems to be stopped upon this principle; and in hanging, the pressure made on the Jugular veins may co-operate with the stoppage of respiration in bringing on death.

Dr. Priestly (Experiments and Obs. vol. v. p. 117) by a more accurate method of investigation found, that the quantity of air, which he could completely phlogistate by the respiration of two minutes, amounted to about a quart in a minute; whereas it is generally supposed, that we phlogistate, or as it has usually been termed, that we consume a gallon of air in a minute: and if by consuming he meant reducing the air to a state in which a candle will not burn in it, the estimates will be pretty near the truth. With regard to the quantity of moisture carried off by respiration, Dr. Hales, by an experiment on wood-ashes, estimates it to be equal to 17 grains in 50 expirations; and this he takes to be nearly the quantity of moisture with which 522 cubic inches of the air are impregnated, when it becomes unfit for respiration; since we breathe 50 times in 2½ minutes. And since a quantity of moisture, equal to 17 grains, was breathed off in 50 expirations, he concludes, that there will be proportionably 408 grains evaporated in the 1200 expirations of an hour, and in 24 hours 9792 grains, or 1.39 pound which, supposing the surface of the lungs to be 41635 inches, will give the quantity evaporated from the surface $\frac{1077}{10000}$ part of an inch depth. Hales's Stat. Ess. vol. i. p. 262, &c. vol. ii. p. 322, &c.

Dr. Priestley has shewn, that one of the great uses of respiration is to carry off the phlogistic or putrid particles from animal bodies, by which they are prevented from putrifying while alive, to which, without respiration, they would be as liable as though they were dead. See the system of AEROLOGY, and the articles BLOOD and PUTREFACTION.

RESPIRATION of Fishes, see the System of COMPARATIVE ANATOMY, Chap. III.

RESTITUTION, in physics, the returning of elastic bodies forcibly bent to their natural state, by some called the *motion of restitution*. See ELASTICITY.

RESTORATIVE, in medicine, a remedy proper for restoring and retrieving the strength and vigour both of the body and animal spirits. All under this class, says Quincy, are rather nutrimental than medicinal; and are more administered to repair the wastes of the constitution, than to alter and rectify its disorders.

RESURRECTION, in theology, rising again from the dead; or a person's returning to a second life, with new bodily organs adapted to the state of its new existence. One of the greatest arguments for the truth of Christianity is drawn from the resurrection of our Saviour; the circumstances of which are handed down to us in so plain and distinct a manner, by the Evangelists, as make the evidence of this important truth amount to a demonstration. Christians generally believe, that at the day of Judgment the very identical body they have now, with the same flesh, blood, and bones, will be raised from the dead. But, in opposition to this opinion, many texts of Scripture have been urged, particularly the account given of this important event by St. Paul: besides several philosophical objections, the principal of which are these: That the same substance may happen to be a part of two or more bodies: thus a fish feeding on a man, and another man afterwards feeding on the fish, part of the body of the first man becomes incorporated with the fish, and afterwards with the body of the last man. Again, instances have been known of one man's immediately feeding on the body of another: and among the cannibals in North America, who devour their enemies, the practice is frequent. Now it is alleged, where the substance of one is thus converted into the substance of another, each cannot arise with his whole body; to which then shall the common part be allotted? To this objection some answer, That as all matter is not capable of being assimilated to the body, and incorporated with it, human flesh may very probably be of this kind: and therefore what is thus eaten, may be again excreted and carried off.

But Mr. Leibnitz observes, that all that is essential to the body, is the original stamen, which existed in the semen of the father: that this may be conceived as the most minute point imaginable, and therefore not to be separated, nor any part of it united to the stamen of any other man: that all this bulk we see in the body, is only an accretion to this original stamen; and therefore there is no reciprocation of the proper matter of the human body. Another objection is, that we know, by the late discoveries in the animal economy, that the human body is continually changing, and that a man has not entirely the same body to-day as he had yesterday; and it is even computed, that in less than seven years time the whole body undergoes a change. Which of those many bodies, then, which the same person has in the course of his life, is it that shall rise? or does all the matter that has ever belonged to him rise again? or does only some particular system thereof? the body, for example he had at 20, at 40, or at 60 years old? If only this or that body arise, how shall it be rewarded or punished for what was done by the other? and with what justice does one person suffer for another?

To this it has been answered, on the principles of Leibnitz, that notwithstanding these successive changes, this stamen which is the only essential part of the body, has always remained the same; and

R E T

that, on Mr. Locke's principles, personal identity, or the sameness of a rational being, consists in self-consciousness, in the power of considering itself the same thing in different times and places. By this, every one is to himself what he calls self; without considering whether that self be continued in the same, or in several substances. It is the same self now it was then; and it was by the same self which now reflects on an action, that that action was performed. Now it is this personal identity that is the object of rewards and punishments, which it is observed may exist in different successions of matter; so that to render the rewards and punishments just and pertinent, we need only to rise again with such a body, as that we retain the consciousness of our past actions.

RETARDATION, in mechanics, the act of *retarding*; that is, of delaying the motion or progress of a body, or of diminishing its velocity. The *retardation* of moving bodies arises from two great causes, the resistance of the medium, and the force of gravity. See the System, Sect. I. See also the Article **MOTION**.

RETENTION, *retentio*, a faculty of the human mind, whereby, in order to a farther progress in knowledge, it keeps or retains those simple ideas, which it before received by sensation or reflection. This is done two ways. First, by keeping the idea which is brought into the mind for some time actually in view. This is called *contemplation*. Secondly, by reviving those ideas in our minds, which have disappeared and have been, as it were, laid out of sight. This is *memory*, which is, as it were, the repository of our ideas. See **CONTEMPLATION**, and **MEMORY**.

RETENTION is also used, in medicine, &c. for the state of contraction in the solids, or vascular parts of the body, which makes them hold fast their proper contents. In this sense, retention stands opposed to evacuation and excretion. Retention and excretion make two of the non-naturals.

RETENTION is also frequently considered as a disorder, and defined the act of retaining the excrements, humours, &c. so as they cannot be voided out of the body. It is the retention of peccant humours which causes such a disease. A retention of urine is very painful and dangerous. See the System of Medicine Genus 79.

RETICULAR Body, *corpus reticulare*, in anatomy, a very fine membrane, perforated, in the manner of a net, with a multitude of foramina. It is placed immediately under the cuticle; and when that is separated from the cutis, whether by art or accident, this adheres firmly to it, and is scarce possible to be parted from it, seeming rather to be its inner superficies than a distinct substance. In regard to this, we are to observe, first, the places in which it is found, being all those in which the sense of feeling is most acute, as in the palms of the hands, the extremities of the fingers, and on the soles of the feet. The tongue, however, is the part where it is most accurately to be observed; it is more easily distinguishable there than any where else, and its nature and structure are most evidently seen there. Its colour in the Europeans is white; but in the negroes, and other black nations, it is black; in the tawny it is yellowish; the skin itself in both is white; and the blackness and yellowness depend altogether on the colour of the membrane.

The uses of the corpus reticulare are to preserve the structure of the other parts of the integuments and keep them in their determinate form and situation. Its apertures give passage to the hairs, and set through the papillæ and excretory ducts of the skin; it retains these in a certain and determinate order, that they cannot be removed out of their places, and has some share in preserving the softness of the papillæ, which renders them fit for the sense of feeling.

RETINA, in anatomy and optics, one of the tunics of the eye; see the system of **ANATOMY**, Part VII. Sect. V. and the system of **OPTICS**, Part I. Sect. 1. and Plate II. Fig. 1.

RETORT, in chymistry, a kind of crooked matrass, or a round-bellied vessel, either of earth or glass, with a slender crooked beak or neck, to which the recipient is to be fastened. See the System under the Article *Chymical Apparatus*, and the Plate annexed, Fig. 4. Letter B.

RETREAT, in war, the retiring or moving back again of an army, or part thereof. We say, to sound a retreat, to secure a retreat, &c. What they call a retreat in the armies, is really a flight; only a flight made by design, and with conduct. The skill and ability of the general is known by his retreats more than his engagements. The retreat of the ten thousand Greeks under the command of Zenophon, has been admired in all antiquity.

RETRENCHMENT, in war, denotes any kind of work cast up to strengthen or defend a post against the enemy. Such are ditches with parapets, gabions, fascines, &c. or a covering, &c. See the System of **FORTIFICATION**, Sect. 1.

RETROGRADATION, or **RETROGRESSION**, the act or effect of a thing moving backwards.

RETROGRADATION, in astronomy, is an apparent motion of the planets, wherein they seem to go backwards in the ecliptic, and to move contrary to the order or succession of the signs. The sun and moon always appear direct. Saturn, Jupiter, Mars, Venus, and Mercury, are sometimes direct, sometimes stationary, sometimes retrograde. See the System, Sect. V. and Plate 3. Fig. 6.

RETROGRADATION of the Nodes, is a motion of the line of the nodes, whereby it continually shifts its situation from east to west,

R E V

contrary to the order of the signs; completing its retrograde circulation in the compass of about nineteen years: after which time, either of the nodes, having receded from any point of the ecliptic, returns to the same again. See the System of **ASTRONOMY**, Sect. VII.

RETROVERSIO Uteri, or *Retroversion of the Uterus*, in midwifery, a disorder to which pregnant women are occasionally subject, and commonly occurring in the early stages of pregnancy, seldom so late as the fourth month; and consisting, as the term imports, in a distorted and unnatural position of the uterus.

REVELATION, the act of revealing or making a thing public, which before was a secret, or unknown.

REVELATION is more particularly used for the discovery which God has made to the world, by the mouths of his prophets, of certain points of faith and duty, which they could not learn from natural reason. Religion is divided into natural religion and *revelation*, or *revealed religion*. The Christian *revelation* is that made by Christ and his apostles, in the New Testament. The Jewish *revelation* is that made by Moses and the prophets, in the Old Testament. See **CHRISTIAN Religion**, and **JUDAISM**.

The general foundation of all revelation is this, that God is pleased man should know something relating to himself, his own nature, dispensation, &c. which the natural faculties with which he was pleased to create him could not attain to; and that he requires some duty or service at our hands more than what necessarily follows from the relation we are under to him as our creator, preserver, &c. This is also urged by deists, to the discredit of all particular *revelations*, as derogating from the perfections of God; such supplementary informations and instructions arguing, according to them, a prior deficiency in the established oeconomy of nature, of which he is the author. But many able answers have been given to such cavils. The principal tests of the truth of any revelation are, its being worthy of God, and consistent with his known attributes, its being agreeable to the clear dictates of unprejudiced reason, and its having a tendency to refine, purify, and exalt the mind of man to an imitation of the Deity in his moral perfections.

Particular or occasional *revelations* have their particular genius, characteristics, and designs. That made by Moses and the prophets chiefly related to the nation of the Jews, considered as the descendants of Abraham; its design seems to have been to rescue that people from their slavery; to settle them in a new plantation; to give them a set of laws; to new form their manners; to support them under difficulties and dangers of their enemies, from an opinion of their being under the immediate direction and appointment of God; to keep them from intermixing again with their neighbours, from an opinion of their being a chosen people, and of a Messiah to be born among them; and thus to preserve and transmit the knowledge and hope of the Messiah, till the period of his appearance arrived. To some or other of these ends do all the Old Testament prophecies seem to tend.

The Christian revelation is founded on a part of the Jewish. The Messiah promised in the one is revealed in the other. All the rest of the Jewish revelation which related peculiarly to the Jewish people, is here set aside; and only that part of it in which the world in general was interested, and that relating to the advent, offices, and character of the Messiah, is retained. Indeed, it must be owned, the Jews ever looked on this to be as peculiar to themselves as any of the rest; the Messiah was promised to them; he was to be their deliverer, their restorer, &c. and under this character he actually appeared. But upon taking place of this new *revelation*, a new scene was opened, different from what many of them apprehended, because they misinterpreted the prophecies relating to the Messiah. The ceremonial part of their institution, local and temporary in its establishment and use, was abolished; and the Messiah appeared, not as they erroneously imagined, to be the restorer of their civil sovereignty and liberties, which were now fallen into the hands of the Romans; but to restore and re-establish mankind in general, who had lost their original righteousness, and were become slaves of sin; to preach repentance and remission; and at last to suffer death, that all who believed in him might not die, but have everlasting life.

Such is the tenor and design of the Christian *revelation*, which, in the event, was so far from being what it had been apprehended to be by the people to whom it was first promised, that it proved the very reverse; and, instead of re-establishing and confirming the other branches of their revelation, it superseded, and set them all aside. The pale was now broken down, and the being of the seed of Abraham ceased to be a privilege, all the world being invited on the same terms with the Jews. The consequence was, that the Jews, denying this to be the Messiah that had been promised to them, because their pride and prejudice prevented their discerning the accomplishment of their ancient prophecies in him, were generally excluded from the privileges of that mission which they had vainly supposed to be not only primarily, but wholly intended for themselves; and had their ruin completed from the very means whence they expected their redemption; because they expected redemption, different in its nature, from that which their own prophecies fairly interpreted, proposed.

Mr. Locke, in laying down the distinct provinces of reason and faith,

REV

REV

faith, observes, 1. That the same truths may be discovered by revelation which are discoverable to us by reason. 2. That no revelation can be admitted against the clear evidence of reason. 3. That there are many things of which we have but imperfect notions, or none at all; and others, of whose past, present, or future existence, by the natural use of our faculties we cannot have the least knowledge: and these, being beyond the discovery of our faculties, and above reason, when revealed, become the proper object of our faith. He then adds, that our reason is not injured or disturbed, but assisted and improved, by new discoveries of truth coming from the fountain of knowledge. Whatever God has revealed is certainly true; but whether it be a divine revelation or no, reason must judge, which can never permit the mind to reject a greater evidence to embrace what is less evident. There can be no evidence that any traditional revelation is of divine original, in the words we receive it, and the sense we understand it, so clear and so certain as that of the principles of reason; and, therefore, nothing that is contrary to the clear and self-evident dictates of reason has a right to be urged or assented to as a matter of faith, wherein reason has nothing to do.

REVELATION of St. John. See APOCALYPSE.

REVELS, entertainments of dancing, masking, acting comedies, farces, &c. anciently very frequent in the inns of court and in nobleman's houses, but now much disused. The officer who has the direction of the revels at court is called the *Master of the Revels*.

REVENUE, the annual income a person receives from the rent of his lands, houses, interest of money in the stocks, &c.

Royal REVENUE is that which the British constitution hath vested in the royal person, in order to support his dignity and maintain his power; being a portion which each subject contributes of his property, in order to secure the remainder.

The revenues of the English clergy were first fixed by king Ethelwulf, anno 853, who granted them for ever the tithe of all goods, and the tenth part of all the lands of England, free from all secular service, taxes, impositions, &c. Though Rapin observes, that tithes were settled on the clergy by the laws of Ina and Offa. But these laws were probably not observed, or perhaps Ethelwulf extended the law of Tithes all over England. The certain revenues of the king of England were anciently greater than those of any king in Europe: and till the time of the civil wars they enjoyed in domains and fee-farm rents almost enough to discharge all the ordinary expences of the crown, without any tax or imposition on the subject. This revenue is either *ordinary* or *extraordinary*.

The king's *ordinary* revenue is such as has either subsisted time out of mind in the crown; or else has been granted by parliament, by way of purchase or exchange for such of the king's inherent hereditary revenues, as were found inconvenient to the subject. In saying that the revenue has subsisted time out of mind in the crown, we do not mean that the king is at present in the actual possession of the whole of his revenue. Much nay the greatest part of it is at this day in the hands of subjects; to whom it has been granted out from time to time by the kings of England: which has rendered the crown in some measure dependant on the people for its ordinary support and subsistence. So that we must be obliged to recount, as part of the royal revenue, what lords of manors and other subjects frequently look upon to be their own absolute rights; because they are and have been vested in them and their ancestors for ages, though in reality originally derived from the grants of our ancient princes.

Of the king's *ordinary* revenues there are four, which are of an ecclesiastical kind. 1. The custody of the temporalities of bishops, or all the lay revenues, lands, and tenements, (in which is concluded his barony), which belong to an arch-bishop's or bishop's see, which, upon the vacancy of the bishopric, revert immediately to the king, as his right, during the vacancy. This branch of the royal revenue was formerly very considerable, but is now by customary indulgence, reduced almost to nothing; for, at present, as soon as the new bishop is consecrated and confirmed, he usually receives the restitution of his temporalities, entire and untouched, from the king, and then, but not sooner, he has a fee-simple in his bishopric, and may maintain an action for the profits.

2. The king also is entitled to a *corody*, as the law calls it, out of every bishopric; that is, to send one of his chaplains to be maintained by the bishop, or to have a pension allowed him till the bishop promotes him to a benefice. This is also in the nature of an acknowledgment to the king, as founder of the see, since he had formerly the same corody or pension from every abbey or priory of royal foundation. It is supposed to be now fallen into total disuse; though Sir Matthew Hale says, that it is due of common right, and that no prescription will discharge it.

3. The king also is intitled to all the tithes arising in extra-parochial places: though perhaps it may be doubted how far this article, as well as the last, can be properly reckoned a part of the king's own royal revenue; since a corody supports only his chaplains, and these extra-parochial tithes are held under an implied trust, that the king will distribute them for the good of the clergy in general.

4. The *first fruits* and *tenths* of all spiritual preferments in the kingdom. The following branches of the king's *ordinary* revenue are of a lay or temporal nature. The first of these consists in the rents and profits of the demesne lands of the crown, which are either the share reserved to the crown at the original distribution

of landed property, or such as came to it afterwards by forfeitures or other means, and were formerly very extensive, but are now contracted within a very narrow compass, having been almost entirely granted away to private subjects.

5. The next branch of the king's ordinary revenue (which as well as the subsequent branches, is of a lay or temporal nature) consists in the rents and profits of the demesne lands of the crown. These demesne lands *terre dominicales regis*, being either the share reserved to the crown at the original distribution of landed property, or such as came to it afterwards by forfeitures or other means, were anciently very large and extensive; comprising divers manors, honours, and lordships; the tenants of which had very peculiar privileges, when we speak of the tenure of ancient demesne. At present they are contracted within a very narrow compass, having been almost entirely granted away to private subjects. This has occasioned the parliament frequently to interpose; and particularly after king William III. had greatly impoverished the crown, an act passed, whereby all future grants or leases from the crown for any longer term than 31 years or three lives, are declared to be void. The misfortune is, that this act was made too late, after almost every valuable possession of the crown had been granted away for ever, or else upon very long leases; but may be of benefit to posterity, when those leases come to expire.

6. *Military Tenures*. The advantages which were used to arise to the king from the profits of his military tenures, to which most lands in the kingdom were subject, till the statute 12 Car. II. c. 24. were then in a great measure abolished. Hither also might have been preferred the profitable prerogative of purveyance and pre-emption: which was a right enjoyed by the crown in buying up provisions and other necessities, by the intervention of the king's purveyors, for the use of his royal household, at an appraised valuation, in preference to all others, and even without consent of the owner: and also of forcibly impressing the carriages and horses of the subject, to do the king's business on the public roads, in the conveyance of timber, baggage, and the like, however inconvenient to the proprietor, upon paying him a settled price. A prerogative which prevailed pretty generally throughout Europe during the scarcity of gold and silver, and the high valuation or money consequent thereupon. In those early times the king's household (as well as those of inferior lords, were supported by specific renders of corn, and other victuals, from the tenants of the respective demesnes; and there was also a continued market kept at the palace-gate to furnish viands for the royal use. And this answered all purposes, in those ages of simplicity, so long as the king's court continued in any certain place. But when it removed from one part of the kingdom to another, (as was formerly very frequently done), it was found necessary to send purveyors beforehand to get together a sufficient quantity of provisions and other necessities for the household: and, lest the unusual demand should raise them to an exorbitant price, the powers before-mentioned were vested in these purveyors; who in process of time very greatly abused their authority, and became a great oppression to the subject, though of little advantage to the crown; ready money in open market (when the royal residence was more permanent, and specie began to be plenty) being found upon experience to be the best provider of any. Wherefore, by degrees, the powers of purveyance have declined, in foreign countries as well as our own; and particularly were abolished in Sweden by Gustavus Adolphus, towards the beginning of the last century. And, with us in England, having fallen into disuse during the suspension of monarchy, king Charles at his restoration, consented, by the same statute, to resign entirely those branches of his revenue and power; and the parliament, in part of recompence, settled on him, his heirs, and successors, for ever, the hereditary excise of 15d. per barrel on all beer and ale sold in the kingdom, and a proportionable sum for certain other liquors. So that this hereditary excise, now forms the sixth branch of his majesty's ordinary revenue.

7. A seventh branch might also be computed to have arisen from wine-licenses; or the rents payable to the crown by such persons as are licensed to sell wine by retail throughout Britain, except in a few privileged places. These were first settled on the crown by the statute 12 Car. II. c. 25. and, together with the hereditary excise, made up the equivalent in value for the loss sustained by the prerogative in the abolition of the military tenures, and the right of pre-emption and purveyance: but this revenue was abolished by the statute 30 Geo. II. c. 19, and an annual sum of upwards of 7000l. *per annum*, issuing out of the new stamp duties imposed on wine-licenses, was settled on the crown in its stead.

8. An eighth branch of the king's ordinary revenue is usually reckoned to consist in the profits arising from his forests. See FORESTS. These consist principally in the ameracements or fines levied for offences against the forest laws. But as few, if any, courts of this kind for levying ameracements have been held since 1632, 8 Car. I. and as, from the accounts given of the proceedings in that court by our histories and law-books, nobody would wish to see them again revived; it is needless to pursue this inquiry any farther.

9. The profits arising from the king's ordinary courts of justice make a ninth branch of his revenue. And these consist not only

REV

in fines imposed upon offenders, forfeitures of recognizances, and amercements levied upon defaulters; but also in certain fees due to the crown in a variety of legal matters, as, for setting the great seal to charters, original writs, and other forensic proceedings, and for permitting fines to be levied of lands in order to bar entails, or otherwise to insure their title. As none of these can be done without the immediate intervention of the king, by himself or his officers, the law allows him certain perquisites and profits, as a recompence for the trouble he undertakes for the public. These, in process of time, have been almost all granted out to private persons, or else appropriated to certain particular uses: so that though our law-proceedings are still loaded with their payment, very little of them is now returned into the king's exchequer; for a part of whose royal maintenance they were originally intended. All future grants of them, however, by the statute 1 Ann st. 2. c. 7. are to endure for no longer time than the prince's life who grants them.

10. A tenth branch of the king's ordinary revenue, said to be grounded on the consideration of his guarding and protecting the seas from pirates and robbers, is the right to *royal fish*, which are whale and sturgeon: and these, when either thrown ashore, or caught near the coasts, are the property of the king, on account of their superior excellence. Indeed, our ancestors seem to have entertained a very high notion of the importance of this right; it being the prerogative of the kings of Denmark and the dukes of Normandy; and from one of these it was probably derived to our princes.

11. The revenue arising from shipwrecks, which is frequently granted out to lords of manors, as a royal franchise.

12. A twelfth branch of the royal revenue, the right to mines, has its original from the king's prerogative of coinage, in order to supply him with materials; and therefore those mines which are properly royal, and to which the king is entitled when found, are only those of silver and gold.

13. *Treasure Trove*, is where any money or coin, gold, silver, plate or bullion is found hidden in the earth or other private places, the owner thereof being unknown, in which case the treasure belongs to the king. But if he that hid it be known, or afterwards found out, the owner and not the king is entitled to it.

14. *Waifs* are goods stolen and waived, or thrown away by the thief in his flight for fear of being apprehended. These are given to the king by the law, as a punishment upon the owner for not himself pursuing the felon, and taking away his goods from him; and therefore if the party robbed follows and apprehends the thief and convicts him, he shall have his goods again.

15. *Estray* imports any tame beast, as sheep, oxen, swine, horse, found within a lordship and not owned by any man; after being cried in the church and two market towns adjacent, if not claimed by the owner within a year and a day, it becomes the property of the king.

16. The next branch of the king's ordinary revenue consists in forfeitures of lands and goods for offences. The true reason and only substantial ground of any forfeiture for crimes, consist in this: that all property is derived from society, being one of those civil rights which are conferred upon individuals, in exchange for that degree of natural freedom which every man must sacrifice when he enters into social communities. If therefore, a member of any national community violates the fundamental contract of his association, by transgressing the municipal law, he forfeits his right to such privileges as he claims by that contract; and the state may very justly resume that portion of property, or any part of it, which the laws have before assigned him. Hence, in every offence of an atrocious kind, the laws of England have exacted a total confiscation of the moveables or personal estate; and, in many cases a perpetual, in others only a temporary, loss of the offender's immoveables or landed property: and have vested them both in the king, who is the person supposed to be offended, being the one visible magistrate in whom the majesty of the public resides.

17. Another branch of the king's ordinary revenue arises from escheats of lands, which happen upon the defect of heirs to succeed to the inheritance; whereupon they in general revert to and vest in the king, who is esteemed, in the eye of the law, the original proprietor of all lands in the kingdom.

18. The last branch of the king's ordinary revenue, consists in the custody of idiots, from whence we shall naturally be led to consider also the custody of lunatics. See *IDIOT* and *LUNATIC*. This may suffice for a short view of the king's ordinary revenue, or the proper patrimony of the crown; which was very large formerly, and capable of being increased to a magnitude truly formidable: for there are very few estates in the kingdom that have not at some period or other since the Norman conquest, been vested in the hands of the king, by forfeiture, escheat, or otherwise. But, fortunately for the liberty of the subject, this hereditary landed revenue, by a series of improvident management, is sunk almost to nothing; and the casual profits, arising from the other branches of the *census regalis*, are likewise almost all of them alienated from the crown. In order to supply the deficiencies of which, we are now obliged to have recourse to new methods of raising money, unknown to our early ancestors; which methods constitute,

The king's extraordinary revenue. For, the public patrimony being got into the hands of private subjects, it is but reasonable that private contributions should supply the public service.

REV

Which, though it may perhaps fall harder upon some individuals whose ancestors have had no share in the general plunder, than upon others, yet, taking the nation throughout, it amounts to nearly the same provided the gain by the extraordinary should appear to be no greater than the loss by the ordinary revenue. And perhaps, if every gentleman in the kingdom was to be stripped of such of his lands as were formerly the property of the crown, was to be again subject to the inconveniences of purveyance and pre-emption, the oppression of forest-laws, and the slavery of feudal tenures; and was to resign into the king's hands all his royal franchises of waifs, wrecks, estrays, treasure-trove, mines, deodands, forfeitures, and the like; he would find himself a greater loser than by paying his *quota* to such taxes as are necessary to the support of government. The thing therefore to be wished and aimed at in a land of liberty, is by no means the total abolition of taxes, which would draw after it very pernicious consequences, and the very supposition of which is the height of political absurdity. For as the true idea of government and magistracy will be found to consist in this, that some few men are deputed by many others to preside over public affairs, so that individuals may the better be enabled to attend their private concerns; it is necessary that those individuals should be bound to contribute a portion of their private gains, in order to support that government, and reward that magistracy, which protects them in the enjoyment of their respective properties. But the things to be aimed at are wisdom and moderation, not only in granting, but also in the method of raising, the necessary supplies: by contriving to do both in such a manner as may be most conducive to the national welfare, and at the same time most consistent with œconomy and the liberty of the subject; who, when properly taxed, contributes only, as was before observed, some part of his property in order to enjoy the rest. These extraordinary grants are usually called by the synonymous names of *aids*, *subsidies*, and *supplies*; and are granted by the commons of Great Britain, in parliament assembled. See *PARLIAMENT* and *TAX*. The clear neat produce of the several branches of the revenue, after all charges of collecting and management paid, amounts at present annually to about ten millions and a quarter sterling; besides more than two millions and a quarter raised by the land and malt-tax. How these immense sums are appropriated, is next to be considered. And this is, first and principally, to the payment of the interest of the national debt. See *NATIONAL DEBT*, and *FUNDS*. The respective produces of the several taxes were originally separate and distinct funds; being securities for the sums advanced on each several tax; and for them only. But at last it became necessary, in order to avoid confusion, as they multiplied yearly, to reduce the number of these separate funds, by uniting and blending them together; superadding the faith of parliament for the general security of the whole. So that there are now only three capital funds of any account, the *aggregate fund*, and the *general fund*, so called from such union and addition; and the *South-Sea fund*, being the produce of the taxes appropriated to pay the interest of such part of the national debt as was advanced by that company and its annuitants. Whereby the separate funds, which were thus united, are become mutual securities for each other; and the whole produce of them, thus aggregated, liable to pay such interest or annuities as were formerly charged upon each distinct fund: the faith of the legislature being moreover engaged to supply any casual deficiencies.

The customs, excises, and other taxes, which are to support these funds, depending upon contingencies, upon exports, imports and consumptions, must necessarily be of a very uncertain amount; but they have always been considerably more than was sufficient to answer the charge upon them. The surplusses, therefore, of the three great national funds, the aggregate, general, and South-Sea funds, over and above the interest and annuities charged upon them, are directed by statute 3 Geo. I. c. 7. to be carried together, and to attend the disposition of parliament; and are usually denominated the *sinking fund*, because originally destined to sink and lower the national debt. To this have been since added many other entire duties, granted in subsequent years; and the annual interest of the sums borrowed on their respective credits is charged on, and payable out of, the produce of the sinking fund. However, the neat surplusses and savings, after all deductions paid, amount annually to a very considerable sum. For as the interest on the national debt has been at several times reduced, (by the consent of the proprietors, who had their option either to lower their interest or be paid their principal), the savings from the appropriated revenues must needs be extremely large. This sinking fund is the last resort of the nation; its only domestic resource, on which must chiefly depend all the hopes we can entertain of ever discharging or moderating our incumbrances. And therefore the prudent and steady application of the large sums, now arising from this fund, is a point of the utmost importance, and well worthy the serious attention of parliament; which was thereby enabled in the year 1763, to reduce above two millions sterling of the public debt; and several additional millions in several succeeding years. But, before any part of the aggregate fund (the surplusses whereof are one of the chief ingredients that form the sinking fund) can be applied to diminish the principal of the public debt, it stands mortgaged by parliament to raise an annual sum for the maintenance of the king's household.

household and the civil list. For this purpose, in the late reigns, the produce of certain branches of the excise and customs, the post-office, the duty on wine-licences, the revenues of the remaining crown-lands, the profits arising from courts of justice, (which articles include all the hereditary revenues of the crown), and also a clear annuity of 120,000*l.* in money, were settled on the king for life, for the support of his Majesty's household, and the honour and dignity of the crown. And as the amount of these several branches was uncertain, (though in the last reign they were computed to have sometimes raised almost a million) if they did not arise annually to 500,000*l.* the parliament engaged to make up the deficiency. But his present majesty having, soon after his accession, spontaneously signified his consent that his own hereditary revenues might be so disposed of as might best conduce to the utility and satisfaction of the public, and having graciously accepted the limited sum of 500,000*l.* per annum, for the support of his civil list (charged also with three life annuities, to the princess of Wales, the duke of Cumberland, and the princess Amelia to the amount of 77,000*l.*) the said hereditary and other revenues are now carried into, and made a part of, the aggregate fund; and the aggregate fund is charged with the payment of the whole annuity to the crown of eight hundred thousand pounds per annum. The expenses themselves, being put under the same care and management as the other branches of the public patrimony, produce more, and are better collected than heretofore. The civil list, thus liquidated, together with the four millions and an half interest of the national debt, and the two millions produced from the sinking fund, make up the seven millions and a quarter per annum, neat money, which were before stated to be the annual produce of our perpetual taxes; besides the immense, though uncertain, sums arising from the annual taxes on land and malt, but which, at an average, may be calculated at more than two millions and a quarter; and, added to the preceding sum, make the clear produce of the taxes, exclusive of the charge of collecting, which are raised yearly on the people of this country, amount to near ten millions sterling.

The expenses defrayed by the civil list are those that in any shape relate to civil government; as, the expenses of the household; all salaries to officers of state, to the judges, and every one of the king's servants; the appointments to foreign ambassadors; the maintenance of the queen and royal family; the king's private expenses, or privy-purse; and other very numerous outgoings, as secret service money, pensions, and other bounties: which sometimes have so far exceeded the revenues appointed for that purpose, that application has been made to parliament to discharge the debts contracted on the civil list; as particularly in 1724, when one million was granted for that purpose by the statute 11 George I. c. 17. and in 1769, when half a million was appropriated to the like uses by the statute 9 George III. c. 34. The civil list is indeed properly the whole of the king's revenue in his own distinct capacity; the rest being rather the revenue of the public, or its creditors, though collected and distributed again in the name and by the officers of the crown: it now standing in the same place as the hereditary income did formerly; and as that has gradually diminished, the parliamentary appointments have increased. The whole revenue of queen Elizabeth did not amount to more than 600,000*l.* a year: that of king Charles I. was 800,000*l.* and the revenue voted for king Charles II. was 1,200,000*l.* though complaints were made (in the first years at least), that it did not amount to so much. But it must be observed, that under these sums were included all manner of public expenses; among which Lord Clarendon, in his speech to the parliament, computed that the charge of the navy and land-forces amounted annually to 800,000*l.* which was ten times more than before the former troubles. The same revenue, subject to the same charges, was settled on king James II. but by the increase of trade, and more frugal management, it amounted on an average to 1,500,000*l.* per annum, (besides other additional customs granted by parliament, which produced an annual revenue of 400,000*l.*) out of which his fleet and army were maintained at the yearly expense of 1,100,000*l.* After the revolution, when the parliament took into its own hands the annual support of the forces both maritime and military, a civil-list revenue was settled on the new king and queen, amounting, with the hereditary duties, to 7000,000*l.* per annum; and the same was continued to queen Anne and king George I. That of king George II. was nominally augmented to 800,000*l.* and in fact was considerably more: but that of his present majesty is expressly limited to that sum; though 100,000*l.* has been since added. And upon the whole, it is doubtless much better for the crown, and also for the people, to have the revenue settled upon the modern footing rather than the ancient. For the crown; because it is more certain, and collected with greater ease: for the people; because they are now delivered from the dreadful feudal hardships, and other odious branches of the prerogative.

REVERBERATION, in physics, the act of a body repelling or reflecting another, after its impinging thereon. In the glass-men's furnace the flame reverberates or bends back again to burn the matter on all sides. Echoes are occasioned by the reverberation of sounds from arched obstacles.

REVERBERATION, in chymistry, denotes a kind of circulation of the flame, by means of a reverberatory; or the return of the

flame from the top of the furnace back to the bottom, chiefly used in calcination.

REVERBERATORY, or **REVERBERATING Furnace**, is a chymical furnace built close all round, and covered at the top with a capital of brick or tiles, so as not to give any vent to the heat or flame, but to determine it to reverberate or turn back from the brick-work with new force, upon the matters placed at bottom. For plan of a wind furnace, when designed for a reverberatory, see the System of CHYMISTRY, Article *Chymical Apparatus*, and Plate fig. 4.

REVEREND, *reverendus*, a title of respect given to ecclesiastics. The religious abroad are called *reverend fathers*; and abbesses, prioresses, &c. are called *reverend mothers*. With us, bishops are *right reverend*; and archbishops *most reverend*. In France, their bishops, archbishops, and abbots, were all alike *reverendissimes*, *most reverend*.

REVERIE, a term purely French, frequently used of late in English, to signify a delirium, raving, or distraction. It is an ill sign in fevers when the patient falls into a reverie. Hence also reverie comes to be used for any ridiculous, extravagant imagination, action, or proposition, a chimera or vision. Thus we say, authors obtrude abundance of their reveries upon us for solid truths. But the most ordinary use of the word *reverie*, among English writers, is for a deep disorderly musing or meditation, equivalent to what we popularly call a *brown study*.

REVERSED, in heraldry, a thing turning backwards, or upside down.

REVERSION, in the law of England, has two significations: the one of which is an estate left, which continues during a particular estate in being: and the other is the returning of the land, &c. after the particular estate is ended; and it is further said, to be an interest in lands, when the possession of it fails, or where the estate which was for a time parted with, returns to the grantors, or their heirs. But, according to the usual definition of a reversion, it is the residue of an estate left in the grantor, after a particular estate granted away, ceases, continuing in the grantor of such an estate. The difference between a remainder and a reversion consists in this, that the remainder may belong to any man except the grantor; whereas the reversion returns to him who conveyed the lands, &c. For the method of finding the values of reversions or estates in reversion, with tables explanatory of the subject. See the System of ANNUITIES.

REVERSION of Series, in algebra, is a method of finding a natural number from its logarithms given; or the sine from its arch; or the ordinate of an ellipsis from an area given to be cut off from any point in the axis. See the System of ALGEBRA, FLUXIONS, and the Article *Logarithms*.

REVIVICATION, or **REDUCTION**, in chymistry, the art of restoring a mixed body to its first state, after it had been altered and disguised by dissolution, calcination, or the like. This term, in its more confined sense, is usually applied to those operations by which metals are restored to their metallic state, after they have been deprived of this state, either by the loss of their phlogiston, or by the union of some heterogeneous matters which disguise them, as fulminating gold, luna cornea, cinnabar, and other such compounds.

REVOLUTION, in politics, denotes a grand turn or change of government. There are no states in the world but have undergone frequent revolutions. The abbot de Vertot has furnished us with two or three good histories of the revolutions of Sweden, the revolutions of Rome, &c.

The **REVOLUTION** used with us by way of eminence, denotes the great turn of affairs in England in 1688, when king James II. abdicating, the prince and princess of Orange were declared king and queen of England, &c. The true ground and principle upon which that memorable event proceeded, was an entire new case in politics, which had never before happened in our history; the abdication of the reigning monarch, and the vacancy of the throne thereupon. Accordingly, in a full assembly of the lords and commons, met in convention, on occasion of this vacancy, both houses came to this resolution: "That king James the Second, having endeavoured to subvert the constitution of the kingdom, by breaking the original contract between king and people; and, by the advice of Jesuits, and other wicked persons, having violated the fundamental laws; and having withdrawn himself out of this kingdom, has abdicated the government, and that the throne is thereby vacant." The lords and commons having determined this fundamental article, that there was a vacancy of the throne, proceeded to fill up that vacancy in such manner as they judged most proper. And this was done by their declaration of 12 February, 1688, in the following manner: "That William and Mary, prince and princess of Orange, be, and be declared king and queen, to hold the crown and royal dignity during their lives, and the life of the survivor of them; and that the sole and full exercise of the regal power be only in, and executed by, the said prince of Orange, in the names of the said prince and princess, during the joint lives: after their deceases the said crown and royal dignity to be to the heirs of the body of the said princess; and for default of such issue to the Princess Anne of Denmark, and the heirs of her body; and in default of such issue to the heir of the body of the said prince

prince of Orange." This transaction, founded in equity, and strictly agreeable to the spirit of our constitution, and the rights of human nature, formed a new æra in the history of our country, in which the bounds of prerogative and liberty have been better defined, the principles of government more thoroughly examined and understood, and the rights of the subject more explicitly guarded by legal provisions, than in any other period of the English history. The most remarkable and happy revolution, that has taken place this last century, is that of Poland, which was effected with very little tumult and without any bloodshed, the equilibrium of power between king and people being adjusted to the satisfaction of all parties, and the restoration of perfect tranquillity; and happy would it have been, if the revolution in France could have been effected by similar means.

REVOLUTION, in geometry. The motion of any figure quite round a fixed line, as an axis, is called the revolution of that figure; and the figure so moving is said to revolve. Thus, a right-angled triangle, revolving round one of its legs, as an axis, generates, by that revolution, a cone.

REVOLUTION, in astronomy, denotes the period of a star, planet, comet, or other phenomenon; or its course from any point of its orbit, till it return to the same. The planets have a twofold revolution. The one about their own axis, usually called their *diurnal rotation*, which constitutes what we call their day. The other about the sun, called their *annual revolution* or *period*, constituting their year. See the System, Sect. VII.

REVULSION, *revulsio*, in medicine, the turning a flux of humours from one part of the body to another, either neighbouring or opposite part. In very dangerous wounds, where the loss of blood is great, and the stopping it speedily enough is impracticable, it is usual to open a vein in some remote part, to cause a revolution; that is, to turn the course of the blood from the former part to that where the aperture is made. Revulsions are also caused by cupping, friction, &c.

REVULSION is also used for the spontaneous turn or reflux of humours in the body. Sudden diseases are occasioned by great revulsions of humours, which fall all at once on certain parts.

RHAPSODY, *ῥαψωδία*, in antiquity, a discourse in verse, sung or rehearsed by a rhapsodist. Others will have rhapsody properly to signify a collection of verses, especially those of Homer; which having been long time dispersed in pieces and fragments, were at length, by Pisistratus's orders, digested into books, called rhapsodies.

RHENISH Wine, that produced on the hills about Rheims. This wine is much used in medicine as a solvent of iron, for which it is well calculated on account of its acidity. Dr. Percival observes, that it is the best solvent of the Peruvian bark; in which, however, he thinks its acidity has no share, because an addition of vinegar to water does not augment its solvent power.

RHETORIC, the art of speaking copiously on any subject, with all the advantages of beauty and force. For explanation of the import and uses of the principal tropes appertaining to this art, see the Treatise on ORATORY, Part III. Sect. I. Article III.

RHEUM, *Rhubarb*; a genus of the monogynia order, belonging to the enneandria class of plants. There are five species. Two sorts of rhubarb are met with in the shops. The first is imported from Turkey and Russia, in roundish pieces freed from the bark, with a hole through the middle of each; they are externally of a yellowish colour, and on cutting appear variegated with lively reddish streaks.

Rhubarb is a mild cathartic, which operates without violence or irritation, and may be given with safety even to pregnant women, and children. Besides its purgative quality, it is celebrated for an astringent one, by which it strengthens the tone of the stomach and intestines, and proves useful in diarrhoeas and disorders proceeding from a laxity of the fibres. Rhubarb in substance operates more powerfully as a cathartic than any of the preparations of it. Watry tinctures purge more than the spirituous ones; whilst the latter contain in greater perfection the aromatic, astringent, and corroborating virtues of the rhubarb. The dose, when intended as a purgative, is from a scruple to a drachm or more. The Turkey rhubarb is, among us, universally preferred to the East-India sort, though this last is for some purposes at least equal to the other; it is manifestly more astringent, but has somewhat less of an aromatic flavour. Tinctures drawn from both with rectified spirit, have nearly the same taste; on distilling off the menstruum, the extract left from the tincture of the East India rhubarb, proved considerably the strongest. Of late, rhubarb has been cultivated in this country with tolerable success, and is found not to be inferior for medical purposes to the foreign.

RHEUMATISM, in medicine, a painful disorder, affecting the intermediate spaces between the joints and muscles in different parts of the body, and occasionally the viscera, and sometimes attended with inflammation and swelling. For description, causes, and cure, see the System, Genus 21 and 22.

RHINOCEROS, in the System of MAMMALIA, a genus belonging to the order of *Belluæ*. There are two species.

1. *Unicornis*, or one-horned Rhinoceros. We are indebted to the labours of many learned and ingenious naturalists for accurate descriptions of this wonderful creature, which in size is only ex-

ceeded by the Elephant, and in strength and power inferior to no other animal. Bontius says, that in the bulk of its body it equals the Elephant, but is lower only on account of the shortness of its legs.

The length of this animal, from the extremity of the muzzle to the insertion of the tail, is usually twelve feet; and the circumference of its body nearly equal to its length: its nose is armed with a formidable weapon, peculiar to this creature, being a very hard and solid horn, with which it defends itself from every adversary. The tiger will rather attack the elephant, whose trunk it can lay hold of, than the rhinoceros, which it cannot face, without danger of having its bowels torn out. The body and limbs of the rhinoceros are covered with a skin so hard and impenetrable, that he fears neither the claws of the tiger, nor the more formidable proboscis of the elephant; it will turn the edge of a scimitar, and even resist the force of a musquet ball. The skin, which is of a blackish colour, forms itself into large folds at the neck, the shoulders, and the crupper, by which the motion of the head and limbs is facilitated; round the neck, which is very short, are two large folds, there is a fold from the shoulders, which hangs down upon the fore legs; and another from the hind-part of the back to the thighs. The body is every-where covered with small tuberosities or knots, which are small on the neck and back, but larger on the sides. The thighs, legs, and even the feet, are full of these incrustations, which have been mistaken for scales by some authors. They are, however, only simple indurations of the skin, without any uniformity in their figure, or regularity in their positions. Between the folds, the skin is penetrable and delicate, as soft to the touch as silk, and of a light flesh-colour; the skin of the belly is nearly of the same colour and consistency. The body of the rhinoceros is long and thick; its belly is large, and hangs near the ground; its legs short, round, and very strong; and its hoofs are divided into three parts, each pointing forward. The head of this animal is large; its ears long and erect; and its eyes small, sunk, and without vivacity; the upper lip is long, overhangs the lower, and is capable of great extension; it is so pliable that the rhinoceros can move it from side to side, twist it round a stick, collect its food, or seize with it any thing it would carry to its mouth. The rhinoceros, without being ferocious, carnivorous, or even extremely wild, is, however, totally untractable and rude. It is subject to paroxysms of fury, which nothing can appease. Like the hog, this animal is fond of wallowing in the mire. It is a solitary animal, loves moist and marshy grounds, and seldom quits the banks of rivers. It is found in Bengal, Siam, China, and other countries of Asia; in the isles of Java, Sumatra, Ceylon, &c. in Ethiopia, and the country as low as the Cape of Good Hope: but in general, the species is not numerous, and is much less diffused than that of the elephant.

The female produces but one at a time, and at considerable intervals. During the first month, the young rhinoceros exceeds not the size of a large dog. At the age of two years the horn is not more than an inch long; at six years old, it is nine or ten inches long; and grows to the length of three feet and an half, and sometimes four feet. The rhinoceros feeds on the grossest herbs, and prefers thistles and shrubs to soft or delicate pasturage. It is fond of the sugar cane, and eats all kinds of grain. Dr. Parsons remarks, that this animal has an acute and very attentive ear: it will listen with a deep and long continued attention to any kind of noise; and, though it be eating, lying down, or obeying any pressing demands of nature, it will raise its head, and listen till the noise ceases. From the peculiar construction of his eyes, the rhinoceros can only see what is immediately before him. When he pursues any object, he proceeds always in a direct line, overturning every obstruction. With the horn on his nose, he tears up small trees, raises stones and throws them behind him to a considerable distance. His sense of smelling is so exquisite, that the hunters are obliged to avoid being to windward of him. They follow him at a distance, and watch till he lies down to sleep: they then approach him with great precaution, and discharge their muskets all at once in the lower part of his belly. The rhinoceros is supposed to be the *Unicorn* of holy writ, and possesses all the properties ascribed to that animal, rage, untameableness, great swiftness, and immense strength. It was known to the Romans in very early times, and is handed down to us in some of the works of that celebrated people. Augustus introduced one into the shows, on his triumph over Cleopatra. Its flesh is eaten, and is much relished by the natives of India and Africa.

2. *Bicornis*, or the two-horned Rhinoceros. We have given the figure of this animal from Mr. Sparman, whose authenticity there is every reason to depend upon, and who has given a most exact anatomical description of this hitherto undescribed animal. Of two that were shot, he only mentions the size of the smaller of them, which was eleven feet and a half long, seven feet high, and twelve in circumference. It was without any folds on the skin, which was of an ash colour, excepting about the groin, where it was of a flesh colour. The surface of the skin was scabrous and knotty, of a close texture, and, when dry, extremely hard. There were no hairs on any part of the body, except the edges of the ears and the tip of the tail, which were furnished with a few dark bristly hairs, about an inch long.

The horns of this animal are placed one behind the other, in a line

R I C

R I D

line with the nose: the foremost of them measures about eighteen inches in length, and is always the larger of the two. It is remarkable, that this species of the rhinoceros makes use of the shorter horn only for the purpose of digging up roots, which compose great part of its food; it being endued with the power of turning the larger horn on one side out of the way. The shape of the horns is conical, with the tips inclining a little backwards; the texture of the lower part is rough, and seems as if it consisted of horny fibres; the upper part is smooth and plain, like those of an ox. The feet are round and do not spread much: they have three hoofs on each of them, which project but little; the middle one is the longest. In other respects it resembles the first species.

From the account of its intestines, given us by the same ingenious author, we shall just mention the following, which will enable our readers to form a more perfect idea of its enormous bulk: the stomach was four feet in length, and two in diameter; to which was annexed a tube or canal, twenty-eight feet long, and six inches diameter; the kidneys were a foot and a half in breadth; the heart was a foot and a half long, and nearly the same in breadth; the liver, when measured from right to left, was found to be three feet and a half in breadth, and two feet and a half deep, as it hangs in the animal's body when it is in a standing position; it had no gall-bladder, in which it resembles the horse. Upon opening the stomach, the contents of it were found to consist of roots and small branches of trees masticated, some of which were as big as the end of a man's finger; in the mass there appeared a great quantity of the succulent plants, as well as some that were harsh and prickly: the effluvia arising from this mass was so far from being offensive, that it diffused around a very strong and not disagreeable aromatic odour. We shall conclude our account of this animal by observing, that the cavity which contained the brains was small, being barely six inches long, and four high, and of an oval shape. Being filled with pease, it was found to contain barely one quart; a human skull, measured at the same time, did not require much less than three pints to fill it. For representation of the two species of this wonderful animal, see the Plates in the System of MAMMALIA, Order 6. Genus 36.

RHOMBOIDES, in anatomy, a muscle thus called from its figure. It is a thin, broad, and obliquely square fleshy plane, and may be divided into two portions, one superior, the other inferior, which sometimes appear separate. For its origin, insertion, and use, see the System, Part II. Sect. II. Art. XVIII.

RHOMBUS, in geometry, an oblique angular parallelogram; or a quadrilateral figure, whose sides are equal and parallel, but the angles unequal; two of the opposite ones being obtuse, and the other two acute. See the System, Part I. Sect. I.

RHUBARB, in botany, the English name of the Genus *RHEUM*. See **RHEUM**.

RHUMB, RUME, or RUM, in navigation, a vertical circle of any given place; or the intersection of a part of such a circle with the horizon. Rhumbs, therefore, coincide with points of the world, or of the horizon.

RHUMB-LINE, in navigation, is a line prolonged from any point of the compass, in a nautical chart, except the four cardinal points: or it is the line which a ship, keeping in the same collateral point, or rhumb, describes throughout its whole course. See the System, Sect. I.

RHYME, or RHIME, in poetry, the similar sound or cadence, and termination of two words which end two verses, &c. Or, rhyme is a similitude of sound between the last syllable or syllables of one verse, and the last syllable or syllables of a verse succeeding either immediately, or at the distance of two or three lines. See **POETRY**.

Since the restoration of learning in the sixteenth century, attempts have been made to banish rhyme out of the modern poetry, and to settle the English and French verses on the footing of the ancient Greek and Latin ones, by fixing the quantities of the syllables, and trusting wholly to those, and to the numbers or measure. This Milton has done, with great success, in his *Paradise Lost*, and other pieces; and after him Philips, Addison, and some others. Verses of this kind we call *blank verses*. To succeed in such kind of verses, there must be a liberty of varying the order of the words, or of changing their situation, as may best suit the occasions of the poet; of making the substantive either go before or follow after the verb, as the verse requires, &c. Now none of the modern tongues will admit of such an arbitrary situation of the words, equally with the ancients; yet none will allow this to be more than the English, nor less than the French.

RIBBAND, or RIBBON, in heraldry, is the eighth part of a bend. See the System, Sect. VI. Art. I. and Plate I.

RIBS *Costæ* in anatomy, certain long arched bones, serving to form or sustain the inner sides of the thorax or breast. For description, see the System, Part I. Sect. II. For representation, see Plate I. Fig. I. letters *a, b, c*.

RICE, *oryza*, in botany a genus of the *horandria digynia* class. There is but one species of this plant. This grain is greatly cultivated in most of the Eastern countries, where it is the chief support of the inhabitants; and great quantities of it are brought into England, and other European countries, every year, where it is in great esteem for puddings, &c. It is too tender to

be produced in these Northern countries, without the assistance of artificial heat; but from some seeds, which were sent to South Carolina, about the year 1697, there have been great quantities produced, and it is found to succeed as well there as in its native country, which is a very great improvement to the American settlements. Among the common kinds of grain, rice is accounted the oldest and most nutritious, and is supposed to be particularly serviceable in dysenteries and diarrhoeas. It is less viscous than wheat, or of less tenacity when boiled with water. The northern nations eat their fowls and other meats with rice and saffron. The Chinese make a wine of rice, which is of an amber colour, and tastes like Spanish wine, and serves them for their common drink. In some parts of Europe they also draw a very strong brandy, or spirit from rice.

RICKETS, rhachitis, in physic, a disorder affecting the bones of children, and causing a considerable protuberance, incurvation, or distortion thereof; generally attacks children betwixt the age of nine months and two years.

Causes of the RICKETS. Diseased parents often produce rickety children. Any disorder that weakens the constitution, or relaxes the habit of children, as the small pox, measles, teething, the whooping-cough, &c. disposes them to this disease: but the chief cause is bad nursing. It sometimes arises from a fault in swathing the child, rolling it too tight in some place, and too loose in others; placing it in an inconvenient, or too often in the same posture; or suffering it to be long wet. It is likewise attributed to the want of proper motion, for a healthy child should be always in motion, unless when asleep; and if it be suffered to lie or sit, instead of being tossed or dandled about, it will not thrive. It is likewise occasioned by using the child to be borne in one arm only; whence the legs and knees remain too long in the same incurvated situation. The want of free air is also very pernicious to children. When a nurse lives in a close small house, where the air is damp and confined, and is too indolent to carry her child abroad in the open air, it will hardly escape this disease.

Symptoms of the RICKETS. At the beginning of this disease, the part which it affects, grows lax, flaccid, and weak; and, if it be the legs, they become unable to support the body. All the parts subservient to voluntary motion are likewise debilitated and enfeebled; and the child becomes unusually grave, pale, sickly, slothful, and cannot sit erect. His head generally becomes too large for the trunk, and cannot be supported or managed by the muscles of the neck, which gradually wear away. Swellings, and knotty excrescences, appear in the wrists, ancles, and tips of the ribs; and the bones of the legs and thighs grow bowed or crooked. The like disorder sometimes also seizes the bones of the arms. If the symptoms continue long, the thorax becomes strait; a difficulty of respiration ensues, as also a cough, and a hectic fever: the abdomen swells, the face appears full, and the complexion florid; the pulse grows weak and languid; the appetite and digestion fail; the teeth come slowly and with difficulty, and often rot and fall out; and the symptoms increasing, at length prove mortal.

Method of Cure. The chief aim for this purpose, must be to brace the solids, and to promote digestion and the due proportion of the fluids. These ends will be best answered by wholesome nourishing diet, open dry air, and sufficient exercise. In a cold season, the child should be kept warm, and in hot weather it ought to be kept cool; the limbs should be frequently rubbed with a warm hand, and the child kept as cheerful as possible. This disease is more likely to be cured by the nurse than by the physician. However, if the children are of gross habits, gentle vomits, and repeated purges of rhubarb may sometimes be of use. Issues have been sometimes found beneficial in this disease, especially if the children abound with gross humours. An infusion of the Peruvian bark in wine or ale is likewise of use. *Buchan.*

When the disorder is taken early, it may be remedied by proper bolsters and bandages, suited to the parts affected; but when the bones are grown rigid and inflexible, other mechanical contrivances, as padding, strait boots, and several sorts of machines, or engines, made of pasteboard, whalebone, tin, &c. are made use of, to restore the distorted bones to their natural straightness. Cold bathing is also found of service in the rickets, before the distemper comes to be too much confirmed. This is best done during May and June, continuing the child in the water two or three seconds at each plunge, and rubbing it well with a dry cloth, after he comes out; but if cold bathing is found to weaken the child, it should be discontinued.

RIDGES, in agriculture, are long pieces of rising soil, between two furrows. For directions concerning the method, and the advantages and disadvantages of ploughing land up into ridges, see the System, Sect. XXIX.

RIDICULE, in ethics, is commonly used in the same sense with *irrisio*; and has for its objects the absurdities and misfortunes of mankind. The latter, however, are very improperly objects of ridicule, whose province should extend only to the carelessness and inconstancy, humour, affectation, impertinence, and, in short, all the lesser follies and imperfections of mankind. Such are generally the subjects of Horace's Satires; and Dr. More observes, that *irrisio*, which is the parent of ridicule, was the original of satire.

RIDING,

RIDING, a district visited by an officer. Yorkshire is divided into three ridings, viz. the east, west, and north ridings. In all indictments in that country, both the town and riding must be expressed.

RIDING, as connected with gardening, and susceptible of embellishments. See the Treatise, Part I. Art II. Sect. II.

RIFLE Guns, in the military art, are those whose barrels, instead of being smooth on the inside, like our common pieces, are formed with a number of spiral channels resembling female screws, except that the threads or rifles are less deflected, and approach more to a right line: the threads, with which the rifled barrel is indented, taking usually a little more than one turn in its whole length. See the System of PROJECTILES, Part II. Art. I.

RIGHT Angled, is understood of a figure, when its sides are at right angles, or stand perpendicularly one upon another. This sometimes holds in all the angles of the figure, as in squares and rectangles; sometimes only in part, as in right-angled triangles. See the System of GEOMETRY, Part I. Sect. I.

RIGHT Circle, in the Stereographical Projection of the Sphere, is a circle at right angles to the plane of projection, or that which passes through the eye. See PROJECTION.

RIGHT, in law, not only denotes property, for which a writ of right lies; but also any title or claim, either by virtue of a condition, mortgage, &c. for which no action is given by law, but an entry only.

RIGHT is also a title conferred, 1. Upon all bishops. 2. Together with *Honourable*, upon earls, viscounts, and barons. 3. By courtesy, together with *Honourable*, upon the sons of dukes, marquises, and the eldest sons of earls. 4. Together with *Honourable*, to the speaker of the house of commons: but to no commoner excepting those who are members of his majesty's most honourable privy-council; and the three lord mayors of London, York, and Dublin, and the lord provost of Edinburgh, during their office.

Hereditary RIGHT. See HEREDITARY.

RIGHTS and Liberties. See the article LIBERTY. Our rights, it was there observed in general, may be reduced to these principal articles; the right of personal security, the right of personal liberty, and the right of private property; the consideration of which was referred to this place. 1. The right of personal security consists in a person's legal and uninterrupted enjoyment of his life, his limbs, his body, his health, and his reputation. Life is the immediate gift of God, a right inherent by nature in every individual; and it begins, in contemplation of law, as soon as an infant is able to stir in the mother's womb. For if a woman is quick with child, and by a potion or otherwise killeth it in her womb; or if any one beat her, whereby the child dieth in her body, and she is delivered of a dead child: this, though not murder, was by the ancient law homicide, or manslaughter. But Sir Edward Coke does not look upon this offence in quiet so atrocious a light, but merely as a heinous misdemeanor.

2. A man's limbs are also the gift of the wise Creator, to enable man to protect himself from external injuries in a state of nature. To these, therefore, he has a natural inherent right; and they cannot be wantonly destroyed or disabled without a manifest breach of civil liberty. The natural life being, as was before observed, the immediate donation of the great Creator, cannot legally be disposed of or destroyed by any individual, neither by the person himself nor by any other of his fellow-creatures, merely upon their own authority. Yet nevertheless it may, by the divine permission, be frequently forfeited for the breach of those laws of society, which are enforced by the sanction of capital punishment.

3. Besides these limbs and members that may be necessary to a man, in order to defend himself or annoy his enemy, the rest of his person or body is also entitled, by the same natural right, to security from the corporal insults of menaces, assaults, beating and wounding; though such insults amount not to destruction of life or member.

4. The preservation of a man's health from such practices as may prejudice or annoy it.

5. The security of his reputation or good name from the arts of detraction and slander, are rights to which every man is entitled, by reason and natural justice; since without these it is impossible to have the perfect enjoyment of every other advantage or right.

II. Next to personal security, the law of England regards, asserts, and preserves the personal liberty of individuals. This personal liberty consists in the power of loco-motion, of changing situation, or removing one's person to whatsoever place one's own inclination may direct; without imprisonment or restraint, unless by the course of law. Concerning which we may make the same observations as upon the preceding article: that it is a right strictly natural; that the laws of England have never abridged it without sufficient cause; and that in this kingdom it cannot ever be abridged at the mere discretion of the magistrate, without the explicit permission of the laws. Here again the language of the charter is, that no freeman shall be taken or imprisoned, but by the lawful judgment of his equals, or by the law of the land. And many subsequent old statutes expressly direct, that no man shall be taken or imprisoned by suggestion or petition to the king or his council, unless it be by legal indictment, or the process of the common law. By the petition of right, 3 Car. I. it is enacted, that no freeman shall be imprisoned or detained without cause shown, to which he

may make answer according to law. By 16 Car. I. c. 10. if any person be restrained of his liberty by order or decree of any illegal court, or by command of the king's majesty in person, or by warrant of the council-board, or of any of the privy-council: he shall, upon demand of his council, have a writ of *habeas corpus*, to bring his body before the court of king's bench or common pleas; who shall determine whether the cause of his commitment be just, and thereupon do as to justice shall appertain. And by 31 Car. II. c. 2. commonly called the *habeas corpus act*, the methods of obtaining this writ are so plainly pointed out and enforced, that, so long as this statute remains unimpeached, no subject of England can be long detained in prison, except in those cases in which the law requires and justifies such detainer. And, lest this act should be evaded by demanding unreasonable bail, or surties for the prisoner's appearance, it was declared by 1 W. & M. st. 2. c. 2. that excessive bail ought not to be required.

Of great importance to the public is the preservation of this personal liberty: for if once it were left in the power of any, the highest magistrate to imprison arbitrarily whomever he or his officers thought proper, (as was daily practised in France before the revolution), there would soon be an end of all other rights and immunities. Some have thought, that unjust attacks, even upon life or property, at the arbitrary will of the magistrate, are less dangerous to the commonwealth, as such as are made upon the personal liberty of the subject. To bereave a man of life, or by violence to confiscate his estate, without accusation or trial, would be so gross and notorious an act of despotism, as must at once convey the alarm of tyranny throughout the whole kingdom. But confinement of the person, by secretly hurrying him to goal, where his sufferings are unknown or forgotten, is a less public, a less striking, and therefore a more dangerous engine of arbitrary government. And yet sometimes when the state is in real danger, even this may be a necessary measure. But the happiness of our constitution is, that it is not left to the executive power to determine when the danger of the state is so great, as to render this measure expedient. For the parliament only, or legislative power, whenever it sees proper, can authorize the crown, by suspending the *habeas corpus act* for a short and limited time, to imprison suspected persons without given any reason for so doing. In like manner this experiment ought only to be tried in cases of extreme emergency; and in these the nation parts with its liberty for a while, in order to preserve it for ever. A natural and regular consequence of this personal liberty, is, that every Briton may claim a right to abide in his own country so long as he pleases; and not to be driven from it unless by the sentence of the law. The king indeed, by his royal prerogative, may issue out his *ne exeat regnum*, and prohibit any of his subjects from going into foreign parts without licence. This may be necessary for the public safeguard of the commonwealth. But no power on earth, except the authority of parliament, can send any subject out of the land against his will; not even a criminal. For exile, or transportation, is a punishment unknown to the common law; and, wherever it is now inflicted, it is either by the choice of the criminal himself to escape a capital punishment, or else by the express direction of some modern act of parliament.

To this purpose the great charter declares, that no freeman shall be banished, unless by the judgment of his peers, or by the law of the land. And by the *habeas corpus act*, 31 Car. II. c. 2. (that second *magna carta*, and stable bulwark of our liberties) it is enacted that no subject of this realm, who is an inhabitant of England, Wales, or Berwick, shall be sent prisoner into Scotland, Ireland, Jersey, Guernsey, or places beyond the seas, where they cannot have the protection of the common law. The law is in this respect so benignly and liberally constructed for the benefit of the subject, that though within the realm the king may command the attendance and service of all his liegemen, yet he cannot send any man out of the realm, even upon the public service; excepting sailors and soldiers, the nature of whose employment necessarily implies an exception; he cannot even constitute a man lord deputy or lieutenant of Ireland against his will, nor make him a foreign ambassador. For this might in reality be no more than an honourable exile.

III. The third absolute right inherent in every Briton, is that of property: which consists in the free use, enjoyment, and disposal of all acquisitions, without any controul or diminution, save only by the laws of the land. The original of private property is probably founded in nature, as is more fully explained under the article PROPERTY: but certainly the modifications under which we at present find it, the method of conserving it in the present owner, and of translating it from man to man, are entirely derived from society; and are some of those civil advantages, in exchange for which every individual has resigned a part of his natural liberty. The laws of England are therefore, in point of honour and justice, extremely watchful in ascertaining and protecting this right. Upon this principle the great charter has declared that no freeman shall be dispossessed, or divested of his freehold, or of his liberties, or free customs but by the judgment of his peers, or by the law of the land. And by a variety of ancient statutes it is enacted, that no man's lands or goods shall be seized into the king's hands, against the great charter, and the law of the land; and that no man shall be disinherited, nor put out of his franchises or freehold, unless he be duly brought to answer, and be forejudged by course of law.

and if any thing be done to the contrary, it shall be redressed, and holden for none.

So great, moreover, is the regard of the law for private property, that it will not authorize the least violation of it; not even for the general good of the whole community. If a new road, for instance, were to be made through the grounds of a private person, it might perhaps be extensively beneficial to the public; but the law permits no man, or set of men, to do this without consent of the owner of the land. In vain may it be urged, that the good of the individual ought to yield to that of the community; for it would be dangerous to allow any private man, or even any public tribunal, to be judge of this common good; and to decide whether it be expedient or not. Besides, the public good is in nothing more essentially interested, than in the protection of every individual's private rights as modelled by the municipal law. In this and similar cases the legislature alone can, and indeed frequently does interpose, and compel the individual to acquiesce. But how does it interpose and compel? Not by absolutely stripping the subject of his property in an arbitrary manner; but by giving him a full indemnification and equivalent for the injury thereby sustained. The public is now considered as an individual treating with an individual for an exchange. All that the legislature does is to oblige the owner to alienate his possessions for a reasonable price; and even this is an exertion of power which the legislature indulges with caution, and which nothing but the legislature can perform. Nor is this the only instance in which the law of the land has postponed even public necessity to the sacred and inviolable rights of private property. For no subject of Britain can be constrained to pay any aids or taxes, even for the defence of the realm or the support of government, but such as are imposed by his own consent, or that of his representatives in parliament. By the statute 25 Edward I. c. 5. and 6. it is provided, that the king shall not take any aids or taxes, but by the common assent of the realm. And what that common assent is, is more fully explained by 34 Edward I. ft. 4. c. 1. which enacts, that no talliage or aid shall be taken without the assent of the archbishops, bishops, earls, barons, knights, burgesses, and other freemen of the land; and again, by 14 Edward III. ft. 2. c. 1. the prelates, earls, barons, and commons, citizens, burgesses, and merchants, shall not be charged to make any aid, if it be not by the common assent of the great men and commons in parliament. And as this fundamental law had been shamefully evaded under many succeeding princes, by compulsive loans, and benevolences extorted without a real and voluntary consent, it was made an article in the petition of right 3 Car. I. that no man shall be compelled to yield any gift, loan or benevolence, tax or such like charge, without common consent by act of parliament. And, lastly, by the statute 1 W. & M. ft. 2. c. 2. it is declared, that levying money for or to the use of the crown, by pretence of prerogative, without grant of parliament, or for longer time or in other manner than the same is or shall be granted, is illegal.

BILL OF RIGHTS, in law, is a declaration, delivered by the lords and commons to the Prince and Princess of Orange, 13 February, 1688; and afterwards enacted in Parliament, when they became king and queen. This declaration sets forth, that king James II. did, by the assistance of divers evil counsellors, endeavour to subvert the laws and liberties of this kingdom, by exercising a power of dispensing with and suspending of laws; by levying money for the use of the crown, by pretence of prerogative, without consent of parliament; by prosecuting those who petitioned the king, and discouraging petitions; by raising and keeping a standing army, in time of peace; by violating the freedom of election of members to serve in parliament; by violent prosecutions in the court of king's bench; and causing partial and corrupt jurors to be returned on trials; excessive bail to be taken, excessive fines to be imposed, and cruel punishments inflicted; all which were declared to be illegal. And the declaration concludes in these remarkable words, "And they do claim, demand, and insist upon, all and singular the premises, as their undoubted rights and liberties." And the act of parliament itself (1 W. & M. ft. 2. cap. 2.) recognizes "all and singular the rights and liberties asserted and claimed in the said declaration to be true, ancient, and indubitable rights of the people of this kingdom."

RIGIDITY, among philosophers, a brittle hardness; or that kind of hardness supposed to arise from the mutual indentation of the component particles within one another. Rigidity is opposed to ductility, malleability, &c.

RING, in astronomy. The *ring of Saturn* is a thin, broad, opaque, circular arch, encompassing the body of that planet, like the horizon of an artificial globe, without touching it, and appearing double, when seen through a good telescope. See the *System*, Sect. VIII.

RINGS of Colours, in optics, a phenomenon first observed in thin plates of various substances, by Mr. Boyle, and Dr. Hook, but afterwards more fully explained by Sir Isaac Newton. Mr. Boyle having exhibited a variety of colours in colourless liquors, by shaking them till they rose into bubbles, as well as in bubbles of soap and water, and also in turpentine, procured glass blown so thin as to exhibit similar colours; and he observes, that a feather of a proper shape and size, and also a black ribband held at a proper distance between his eye and the sun, shewed a variety of little rain-

bows, as he calls them; with very vivid colours. Boyle's Works by Shaw, vol. ii. p. 70.

RIOT, in law, the forcibly doing of an unlawful thing, of a private nature, by three or more persons assembled together for that purpose; either with or without a common cause or quarrel: as if they beat a man; or hunt and kill game in another's park, chase, warren, or liberty; or do any other unlawful act with force and violence; or even do a lawful act, as removing a nuisance, in a violent and tumultuous manner. The punishments of riots and routs, where a number of persons from three to eleven are concerned, is, by the common law, fine and imprisonment only; to which in very enormous cases, the pillory has been sometimes superadded. And by the stat. 13 Hen. IV. cap. 7. any two justices, together with the sheriff or under-sheriff of the county, may come with the posse comitatus, if need be, and suppress any such riot, assembly, or rout, and arrest the rioters, and record upon the spot the nature and circumstances of the whole transaction, which record alone shall be a sufficient conviction of the offenders; and it is held that any battery, wounding, or killing the rioters, that may happen in suppressing the riot, is justifiable. The riotous assembling of twelve persons or more, and not dispersing upon proclamation, was first made high treason by stat. 3 & 4 Edw. VI. cap. 5, but repealed by stat. 1 Mar. cap. 1. Nevertheless the offence was made a single felony by 1 Mar. stat. 2 cap. 12. and by 1 Eliz. c. 16. with whom the law expired. However, it was revived, in order to support the execution of the act of settlement, and made perpetual by 1 Geo. I. cap. 5. which enacts, that if any twelve persons are unlawfully assembled to the disturbance of the peace, and any one justice of peace, sheriff, under-sheriff, or mayor of a town, shall think proper to command them by proclamation to disperse, if they contemn his orders, and continue together for one hour afterwards, such contempt shall be felony without benefit of clergy. And farther, if the reading of the proclamation be by force opposed, or in any manner wilfully hindered, such opposers and hinderers are felons without benefit of clergy; and all persons concerned, knowing of such hindrance, and not dispersing, are felons, without benefit of clergy. And the act indemnifies the peace officers, and their assistants if they kill any of the mob in endeavouring to disperse them. Moreover, if any persons, so riotously assembled, begin, even before proclamation, to pull down any church, chapel, meeting-house, dwelling-house, or out-houses, they shall be felons, without benefit of clergy. Blackst. Comm. book. iv. chap. xi.

RISIBLE, any thing capable of exciting laughter. *Ludicrous* is a general term, signifying, as may appear from its derivation, what is playfome, sportive, or jocular. *Ludicrous* therefore seems the genus, of which *risible* is a species, limited as above to what makes us laugh. However easy it may be, concerning any particular object, to say whether it be risible or not, it seems difficult, if at all practicable, to establish any general character, by which objects of that kind may be distinguished from others. Were we to attempt general rules for ranging objects under different classes according to these qualities, we should be much puzzled. All men are not equally affected by risible objects, nor the same man at all times; for in high spirits a thing will make him laugh outright, which will scarce provoke a smile in a grave mood. Risible objects however are circumscribed within certain limits. No object is risible but what appears slight, little, or trivial; for we laugh at nothing that is of importance to our own interest, or to that of others. A real distress raises pity, and therefore cannot be risible; but a slight or imaginary distress, which moves not pity, is risible. The adventure of the fulling-mills in Don Quixote is extremely risible; so is the scene where Sancho, in a dark night, tumbling into a pit, and attaching himself to the side by hand and foot, hangs there in terrible dismay till the morning, when he discovers himself to be within a foot of the bottom. A nose remarkably long or short, is risible; but to want it altogether, so far from provoking laughter, raises horror in the spectator. With respect to works both of nature and of art, none of them are risible but what are out of rule, and have some remarkable defect or excess: a very long visage, for example, or a very short one. Hence nothing just, proper, decent, beautiful, proportioned, or grand, is risible.

Two emotions of contempt and of laughter unite intimately in the mind, and produce externally what is termed a *laugh of derision* or of *scorn*. Hence objects that cause laughter may be distinguished into two kinds; they are either *risible* or *ridiculous*. A risible object is mirthful only: a ridiculous object is both mirthful and contemptible. The first raises an emotion of laughter that is altogether pleasant; the pleasant emotion of laughter raised by the other, is blended with the painful emotion of contempt; and the mixed emotion is termed the *emotion of ridicule*. The pain a ridiculous object gives is repented and punished by a laugh of derision. A risible object, on the other hand, gives no pain; it is altogether pleasant by a certain sort of titillation, which is expressed externally by mirthful laughter; see **RIDICULE**. Risible objects are so common, and so well understood, that it is unnecessary to consume paper or time upon them. Take the few following examples.

Falstaff. "I do remember him at Clement's-inn, like a man made after supper of a cheese-paring. When he was naked, he was for all the world like a forked raddish, with a head fantastically

carved upon it with a knife." *Second part, Henry IV. act 3. sc. 5.*
The foregoing is of disproportion. The following examples are of slight imaginary misfortunes.

Falstaff. "Go fetch me a quart of sack, put a toast in't. Have I liv'd to be carried in a basket, like a barrow of butcher's offal, and to be thrown into the Thames! Well, if I be served such another trick, I'll have my brains ta'en out and butter'd, and give them to a dog for a new year's gift. The rogues slighted me into the river with as little remorse as they would have drown'd a bitch's blind puppies, fifteen i'th'litter; and you may know by my size, that I have a kind of alacrity in sinking: if the bottom were as deep as hell, I should drown. I had been drown'd, but that the shore was shelvy and shallow: a death that I abhor: for the water swells a man; and what a thing should I have been when I had been swelled; I should have been a mountain of mummy."

Merry Wives of Windsor, act 3. sc. 15.

Falstaff. "Nay, you shall hear, Master Brook, what I have suffered to bring this woman to evil for your good. Being thus cramm'd in the basket, a couple of Ford's knaves, his hinds, were call'd forth, by their mistresses, to carry me in the name of foul cloaths to Datchet-lane. They took me on their shoulders, met the jealous knave their master at the door, who asked them once or twice what they had in their basket. I quak'd for fear, lest the lunatic knave would have search'd it; but Fate, ordaining he should be a cuckold, held his hand. Well, on he went for a search, and away went I for foul cloaths. But mark the sequel, Master Brook, I suffered the pangs of three egregious deaths: first, an intolerable fright, to be detected by a jealous rotten bell-weather; next, to be compass'd like a good bilbo, in the circumference of a peck, hilt to point, heel to head; and then to be stopt in, like a strong distillation, with stinking cloaths that fretted in their own grease. Think of that, a man of my kidney; think of that, that am as subject to heat as butter; a man of continual dissolution and thaw; it was a miracle to 'scape suffocation. And in the height of this bath, when I was more than half stew'd in grease, like a Dutch dish, to be thrown into the Thames, and cool'd glowing hot, in that furge, like a horse-shoe; think of that; hissing hot; think of that Master Brook."

Merry Wives of Windsor, act 3. sc. 17.

RISING, in astronomy, the appearance of the sun, a star, or other luminary, above the horizon, which before was hid beneath it. By reason of the REFRACTION of the atmosphere, the heavenly bodies always rise before their time; i. e. they are seen above the horizon while they are really below it. To find the rising, &c. of the sun and stars by the globe, see **GLOBE**. See the Treatise on the **GLOBES** under the article, *The Use of the CELESTIAL GLOBE*.

RITE, denotes the particular manner or form of celebrating or performing the religious ceremonies, which obtain in this or that place. The eastern people, Armenians, &c. celebrate divine service according to the Greek rite. The Western world follow the Latin rite; or that of the Roman church. The English observe the rite of the church of England, prescribed in the Book of Common Prayer, &c.

RIVER, in geography, a stream or current of fresh water, flowing in a bed or channel, from a source or spring, into the sea. Some will have none to be properly rivers, except those which bear the same name from their source to their mouth. Others, none but those which empty themselves immediately into the sea; and not into any other river. Rivulets have their rise sometimes from great rains, or great quantities of thawed snow; especially in mountainous places; as in the long ridges in Africa, India, Sumatra, &c. But the generality of rivulets arise from springs. Rivers themselves all arise either from the confluence of several rivulets, or from lakes; nor is there any great river, such as the Rhine, Elbe, &c. known to flow from a single spring. The Volga, e. gr. consists of above two hundred rivulets, all flowing into it, before it reaches the Caspian; and the Danube receives as many. The Rhine and the Po receive each above a hundred others, great and small; and the river of the Amazons receives into its large bed a prodigious number, some of which are five or six hundred leagues in length, and very deep and broad. The Rhine, Rhone, Danube, Borysthenes, &c. arise originally from springs in the mountains; and the Nile, the Volga, the great river of St. Lawrence, &c. from lakes. It has been held by many, that all springs and rivers owe their origin to rains and dews; but there are some springs which cannot be accounted for on this principle. The intermitting springs, which flow violently in rainy seasons, and are dry in summer, are probably owing to rains; but there are some springs which discharge more water annually than all that falls in rains and dews in the neighbouring country. Such are the perennial spring at Willow-brig in Staffordshire, and that of the Sorgne in France, which, according to Gassendus, is navigable to its source.

But if such springs as these discharge too great a quantity of water for the supply of rains and dews; how is it possible, that such small supplies of water, as these can afford the constant currents of the larger rivers? The Volga alone, according to Ricciolus, pours forth as much water in a year's time into the Caspian sea, as would suffice to drown the surface of the whole earth. The river of St. Lawrence in America pours forth nearly as much as this. If such be the case with these rivers singly, how are all the rest to be supplied by rains: and where is left the supply of the Rio de la Plata;

which Ricciolus affirms to be larger than the Nile, the Ganges and the Euphrates, put together, its mouth being ninety miles wide, and running with that violence into the sea, that it makes it fresh for two hundred miles together. These, and the other rivers of the several parts of the globe, upon a very moderate calculation, discharge at least five hundred times as much water into the sea, as falls upon the whole surface of the earth, in rains, mists, dews, snows, &c. in a like space of time. As it is evident, therefore, that these cannot be supplied by rains, so neither is it possible that the several hot springs and the salt springs can be supplied that way; the origin of springs also in places where there falls little or no rain, and where the conservatories must needs be too small to contain a supply, are great proofs that rain and mists are not the origin of springs, at least not in all places. The isles of Mago, Rotunda, and the Strophades, and the rock whereon the Maiden Tower stands in the Thracian Bosphorus, cannot be supplied with, or retain a sufficiency of rain water to supply constant springs, yet such are always found running there.

It cannot be otherwise but that there are subterranean communications between the sea and the sources of fountains, rivers, and the larger springs, by which these are supplied; and they are certainly charybdes which swallow up the sea for these purposes; and when these happen to be stopped, the largest rivers have been dried up, and wholly ceased to run for a considerable time; this we have accounts in history has happened to the Thames, the Trent, and Medway, in England; the Elbe, the Motala, and Gulspar, in Sweden, and other rivers in other countries. If, on the other hand, these Charybdes happen to be too open, fresh-water springs depending upon them will become salt. This we have instances of in history also; and even so old a writer as Pliny has said, that this once happened in Caria near Neptune's Temple. Plot. de Orig. Font. Rivers are found subject to great alterations, at different seasons of the year, day, &c. from frequent rains, and melted snow. Thus in Peru and Chili many of the rivers are almost insensible in the night-time, and only flow by day, as being then augmented by the dissolution of the snow on the mountains Andes. Thus the Volga abounds in water in May and June, so as to cover the sandbanks, &c. which all the rest of the year lie bare, so as scarce to allow a passage to the loaded ships. Thus, also the Nile, Ganges, Indus, &c. are frequently so increased as to overflow. Some rivers bury themselves under ground in the middle of their course, and break out again in other places, like new rivers. Thus the Niger, meeting the mountains of Nubia, is hidden under them, and rises again on the western side of those mountains. Thus also the Tigris is lost in mountain Taurus, &c.

The water of most rivers carries with it particles of metals, minerals, sands, or oily and fat bodies, &c. Thus, some rivers bring sand intermixed with grains of gold; of which kind is, 1. A river in Japan. 2. Another in the island Lequeon, near Javon. 3. A rivulet in Africa, called Arroee, flowing from the mountains of the moon, wherein there are gold mines. 4. A river in Guinea, where the Negroes separate the gold-dust from the sand, and sell it to the Europeans, who traffic thither for that very purpose. 5. In some rivulets near the city of Mexico, there are grains of gold taken up, especially after rain; which is also to be understood of all the other rivers, none of which yield any thing considerable, except in rainy seasons. 6. In Peru, Sumatra, Cuba, Hispaniola, and Guinea. Lastly, there are several brooks in the countries about the Alps, especially Tirol, out of the sediment of whose waters gold is drawn, though there be no grains conspicuous therein. Add to this, that the Rhine also, in many places, affords a golden mud. As to rivers that bring grains or particles of silver, iron, copper, lead, &c. we find no mention of them in authors, though doubtless, there are great numbers of each; and many of the medicinal effects of mineral waters must be owing to particles of this kind.

We must not here omit a water in Germany, which is ordinarily supposed to change iron into copper. The fact is, that the cuprine and vitriolic particles in the water corrode the iron; and detaching parts thereof by means of the motion of the water, coppery particles succeed in their room. From this variety in the mixture of river water result various qualities, different specific gravities, different colours, &c. Some rivers, at certain seasons of the year, swell so as to overflow their banks, and drown the neighbouring lands. Of these the most eminent is the Nile, which rises so as to cover all Egypt, except the hills; and the cities which are all built on hills, appear as so many islands. To these inundations Egypt owes its fertility; the heavens there affording little or no rain. Hence as the inundation is great or small, Egypt, for that year, is fruitful or barren. The ancient Greeks, &c. were much perplexed in assigning the cause of this inundation. From the modern English and Portuguese traders into Congo, Angola, Monomotapa, &c. we learn, that the source of the Nile is in a large lake called Zaire, round which are the mountains of the moon; which being about 10° to the south of the equator, instead of being covered with snow in their winter, have rain every day; at least two hours before, and two hours after noon. So that their tops are always covered with clouds; and the rains are, at the proper seasons, almost continual. Hence torrents are constantly descending from the mountains into the lake of Zaire: whence they flow into the chan-

nel of the Nile, and other rivers arising from the same lake; and hence the inundation of the Nile.

Mr. Bruce is the first person who, in his travels to discover the source of the Nile, has described, from his own observation, the spot in which he apprehends that the Nile springs. Tracing one of the streams that run into the lake Tzana to a swamp in the 11th degree of N. lat. he there marks the head of the Nile, as our modern map-makers had actually done before he visited this dreary region. Whether his guide deserved credit, and whether he could justly infer that this rivulet was the Nile from the respect paid to it by the barbarous natives, it is not necessary particularly to inquire.

The rivers most celebrated for their length, breadth, swiftness of current, &c. are the Nile, which runs almost in a straight course two thousand five hundred and twenty geographical miles; the Niger, which runs two thousand four hundred miles; the Gan-ge, twelve hundred miles; the Ob, sixteen hundred miles; the Jemisea, in Asia, about the same length with the Ob; the river Orrellana, in America, sixty miles broad at its mouth, and five thousand miles long; the Rio de la Plata, eighty miles broad at the mouth; the Omarannon, another river of Brasil; and the great river of St. Laurence, near two thousand five hundred miles long.

ROB, in pharmacy, the inspissated juice of any substance, usually boiled up to the consistence of honey. There are robs made of quinces, floes, cherries, mulberries, elderberries, barberries, gooseberries, and other fruits, for various diseases. The juice of grapes, thus prepared, is more particularly called rob, or *sapa simplex*; this is almost of the consistence of honey. When only one third of the humidity is boiled away, it is called *defrutum*; and when only boiled to the consistence of a soft electuary, a *refin*.

ROBBERY, in law, a felonious and forcible taking away another man's goods or money, from his person, presence, or estate, by putting him in fear, &c. A mere attempt to rob was held to be felony so late as Henry the Fourth's time; and afterwards it was only a misdemeanour, and punishable with fine and imprisonment, till the stat. 7 Geo. II. cap. 21. which makes it a felony transportable for seven years. If the thief, having once taken a purse, returns it, still it is a robbery. The previous putting in fear is the criterion that distinguishes robbery from other larcenies; and yet this putting in fear does not imply any great degree of terror or fright in the party robbed; it is sufficient, that so much force, or threatening by word or gesture, be used, as might create an apprehension of danger, or oblige a man to part with his property without or against his consent. This is sometimes also called violent theft, and its punishment, be the value of the thing taken ever so small, is death. The word is said to have taken its rise hence, that anciently robbers only took away the robes or cloaths from travellers. Though lord Coke, in the third of his institutes, takes the name to have had its rise from Robin Hood, who lived under Richard I. in the borders of England and Scotland, by robbery, burning houses, rape, and spoil.

ROCK, *rupes*, a large mass or block of hard stone, firmly fixed in the ground. Rocks are generally supposed great enemies to vegetation, and the people of Scotland have been diverted from cultivating many of their best lands, from the observation that they had a rocky bottom. This is, however, but a vulgar error among them, for rocks of a proper kind and properly disposed, as very many of theirs are, fertilize and are beneficial to the land, not hurtful. In many parts of England, we see gardens, the most beautiful that can be imagined, both in regard to flowers and excellent plants, on a soil where the bottom is a hard rock, and the earth covering no more than a foot or thereabouts in depth. In some of these, all the disadvantages the Scots complain of take place, and yet the gardens are fruitful, many of them having lofty hills on the south side, the declivity, due north, and the rock perfectly bare next the walls on the north side. The north sides of these hills in this very aspect, only with the rocks covered with two or three feet of earth, make very good hop-gardens, producing a vast quantity of a very valuable commodity, at a small expense; and it is remarkable, that those gardens, which stand in this exposure, instead of being subject to particular evils, often escape those blasts, and other mischiefs, which affect the plantations of the same kind, on the south side of the hills. It might be a very valuable article of trade, if the bleak hills of Scotland, or those of some of our northern plantations in America, could be made thus fruitful in so useful a commodity, and there seems only the want of a proper trial.

Another extremely valuable plant, that might be raised on these barren rocky places, as they are generally supposed to be, is flax, in places where the descent is too steep for ploughing in the common way. It has been proved, that a hand plough with a stem of ash of about seven feet long, and a plate on each side near the end to turn the turf, a coulter to be let out shorter or longer to four or five inches depth, to cut the earth up, as deep as it lies upon the rock, and an iron wheel, may be managed with ease and conveniency by two people, and will prepare ground for producing large crops of the finest flax. The best sort of flax-seed, of Flanders, sown on this sort of ground, succeeds so well, that if brought into general use, it might give the only advantage that is at present wanting to the Scotch holland manufactory, and make it excel that of all the world beside. Agriculture, in Scotland, was too much neglected,

to the great impoverishment of the country, and the distress of a numerous poor, for whom it would find constant employment.— Since the value of land has greatly increased, agriculture has been cultivated and promoted by the first characters in this kingdom; and it is a happy circumstance to reflect, that this laudable example has been followed in the northern parts of Britain under the most respectable patronage, and has now attained to a considerable degree of perfection. It is not yet known whether many of the most valuable plants, for medicinal and mechanic uses, will not prosper as well there as where there are immense sums made by the raising of them: and the owners of lands would do well in this scheme to try this effect of liquorice, madder, woad, and the like plants, on their grounds. Wherever the ground is deep enough, it is pretty certain that madder and liquorice would flourish, and the last of these needs so little culture that if once planted, it may almost be left to itself. The rocky bottoms of lands not too bleak, may also succeed very well with saffron, which is one of the most profitable plants that can be cultivated. There are various ways of breaking rocks with wood, gunpowder, &c. We have roads, grottos, labyrinths, &c. dug through rocks. For description of the effects of rocks in Landscapes, see the Treatise on GARDENING. Part I. Sect. IV.

ROMANCE, is a discourse invented with art, to please and improve the mind, and to form or mend the manners, by instructions, disguised under the allegory of an action, or series of actions, related in prose, in a delightful and probable, yet surprising manner.

The true nature and genuine characteristics of this species of writing, with which the present generation seems more particularly delighted, are such as exhibit life in its true state, diversified only by the accidents that daily happen in the world, and influenced by those passions and qualities which are really to be found in conversing with mankind.

This kind of writing may be termed not improperly the *comedy of romance*, and is to be connected nearly by the rules of comic poetry. Its province is to bring about natural events by easy means, and to keep up curiosity without the help of wonder: it is therefore precluded from the machines and expedients of the heroic romance, and can neither employ giants to snatch away a lady from the nuptial rites, nor knights to bring her back from captivity; it can neither bewilder its personages in deserts, nor lodge them in imaginary castles.

Scaliger, upon Pontanus, remarks, that all his writings are filled with images; and that if you take from him his lilies and his roses, his fays and his dryads, he will have nothing left that can be called poetry. In like manner, almost all the fictions of the last age will vanish, if you deprive them of a hermit and a wood, a battle and a shipwreck.

Why this wild strain of imagination found reception so long, in polite and learned ages, it is not easy to conceive: but we cannot wonder, that, while readers could be procured, the authors were willing to continue it; for when a man had, by practice, gained some fluency of language, he had no farther care than to retire to his closet, to let loose his invention, and heat his mind with incredibilities; and a book was produced without fear of criticism, without the toil of study, without knowledge of nature, or acquaintance with life.

The task of our present writers is very different; it requires together with that learning which is to be gained from books, that experience which can never be attained by solitary diligence, but must arise from general converse, and accurate observation of the living world. Their performances have, as Horace expresses it, *plus oneris quantum venia minus*, little indulgence, and therefore more difficulty. They are engaged in portraits of which every one knows the original, and can therefore detect any deviation from exactness and resemblance. Other writings are safe, except from the malice of learning; but these are in danger from every common reader; as the slipper was censured by a shoemaker, who happened to stop in his way at the Venus of Apelles.

But the danger of not being approved as just copiers of human manners, is not the most important apprehension that an author of this sort ought to have before him. These books are written chiefly to the young, the ignorant and the idle, to whom they serve as lectures of conduct, and introductions into life. They are the entertainment of minds unfurnished with ideas, and therefore easily susceptible of impressions; not fixed by principles, and therefore easily following the current of fancy; not informed by experience, and consequently open to every false suggestion and partial account.

When an adventurer is levelled with the rest of the world, and acts in such scenes of the universal drama as may be the lot of any other man, young spectators fix their eyes upon him with closer attention, and hope, by observing his behaviour and success, to regulate their own practices when they shall be engaged in the like part. For this reason, these familiar histories may perhaps be made of greater use than the solemnities of professed morality, and convey the knowledge of vice and virtue with more accuracy than axioms and definitions. But, if the power of example is so great as to take possession of the memory by a kind of violence, and produce effects almost without the intervention of the will, care ought to be taken, that, when the choice is unrestrained, the best examples

ROS

examples only should be exhibited: and that which is likely to operate so strongly, should not be mischievous or uncertain in its effects.

The chief advantages which these fictions have over real life, is, that their authors are at liberty, though not to invent, yet to select objects, and to cull from the mass of mankind those individuals upon which the attention ought most to be employed; as a diamond, though it cannot be made, may be polished by art, and placed in such a situation as to display that lustre which before was buried among common stones.

Amidst the gloom of superstition, in an age of the grossest ignorance and credulity, a taste for the wonders of oriental fiction was introduced by the Arabians into Europe, many countries of which were already seasoned to a reception of its extravagancies, by means of the poetry of the Gothic scalds, who, perhaps, originally derived their ideas from the same fruitful region of invention. These fictions, coinciding with the reigning manners, and perpetually kept up and improved in the tales of troubadours and minstrels, seem to have centred, about the eleventh century, in the ideal histories of Turpin and Geoffrey of Monmouth, which record the supposititious achievements of Charlemagne and king Arthur, where they formed the ground-work of that species of fabulous narrative called romance. And from these beginnings, or causes, afterwards enlarged and enriched by kindred fancies, fetched from the Crusades, that singular and capricious mode of imagination arose, which at length composed the marvellous machineries of the more sublime Italian poets, and of their disciple Spenser.

The French, above all other nations, have applied themselves to this kind of writing; whether it be owing to the natural taste and genius of the people, or to the freedom, &c. wherewith they converse with the women. They began chiefly with romances of chivalry: hence their Amadis, in twenty-four volumes; Palmerin D'Olive, and of England; king Arthur, &c. whereof we have an agreeable critique in Don Quixote.

The latter romances are much more polite; the best of which are the Astrea of D'Urfe; the Cyrus and Clelie of Mademoiselle de Scuderi; the Castandre and Cleopatre of La Calprenede; Ariane, Francion; and the Adventures of Telemachus, by the late archbishop of Cambray, worth all the rest.

The Germans too have their romances; especially Hercules and Herculeus, the Aramena, Octavia, Arminius Othert, &c.

The Italians have their Eromena, by Biondi; the works of Loredano, Marino, &c. The Spaniards, their Diana, and Don Quixote. The English, their Arcadia, &c. and in modern times, the number has been so great, that our circulating libraries are full of them.

ROOK, in ornithology, the English name of a species of the Genus *Corvus*. See *CORVUS*.

ROOT, *radix*, in botany, that part of a plant which immediately imbibes the juices of the earth, and transmits them to the other parts, for their nutrition; see the Article *PLANT*, and the System of *BOTANY*, Sect. II. throughout, and Plate II.

ROOTS, in medicine. The principal roots used in the practice of physic, are rhubarb, rhaponticum, sarsaparilla, ipecacuanha, jalap, zedoary, galangal, cassumenar, gentian, turmeric, liquorice, madder, &c.

ROOT, in algebra, for definition, see the System, Sect. I. Article *DEFINITIONS*, No. 10. For exemplification, see Sect. II. Article VII.

ROOT, in arithmetic, for definitions, rules and examples respecting this branch of science, see the System, Chap. II. throughout.

ROOTA, *Baga*, or Swedish turnip, a root much cultivated in some parts of England. For account of its qualities, uses, &c. see the System of *AGRICULTURE*, Sect. XV.

ROSA, the *rose*, a Genus of the Polygamia order, belonging to the Icosandria class of plants. The sorts of roses are very numerous; and the botanists find it very difficult to determine with accuracy, which are species and which are varieties, as well as which are varieties of the respective species: on this account Linnaeus, and some other eminent authors, are inclined to think that there is only one real species of rose, which is the *rosa canina*, or, "dog-rose of the hedges," &c. and that all the other sorts are accidental varieties of it.

The red and white roses are used in medicine. The former distilled with water yields a small portion of butyaceous oil, whose flavour exactly resembles that of the roses themselves. This oil and the distilled water, are very useful and agreeable cordials. These roses also, besides the cordial and aromatic virtues which reside in their volatile parts, have a mild purgative one, which remains entire in the decoction left after distillation. The red rose, on the contrary, has an astringent and gratefully corroborating virtue.

Essence of *ROSES*. There is scarce a more valuable perfume in the world, than the essence of damask roses, and scarce any thing is obtained from its subject with more difficulty and in less quantity. All essences or essential oils are, while in the plant, contained in certain vesicles lodged in different parts, and of different structure: these vesicles are in the rose particularly small and tender, and are placed very superficially; the consequence of this is, that there is originally but a very little of this essence in the flower,

ROT

and this is the very subject that will be dissipated and lost when the flowers are gathered and thrown in a heap together, as they are succulent, and very quickly heat in lying together. To avoid all dissipation and waste of this choice essence, the roses should be thrown into the still as soon as gathered, and distilled with very little water, and that in a balneum Mariæ; then the fire is to be continued so long as the flowers float separate about in the water; but as soon as ever they form themselves into a cake, and stick to the bottom, the distillation should be finished, as they then yield no more essence. With all these precautions, however, it is with great difficulty we can procure any essence of roses. What we obtain by this distillation being chiefly a very odoriferous and fragrant water. In the warmer countries the same caution affords a larger quantity of oil, which may be separated and preserved under the name of the essence. In Italy, they make some quantity of it, but there it is very dear; a vast quantity of the flowers yielding only a very little essence, and that being thick and troublesome in the procuring, as it every where sticks to the vessels.

ROSARY, in the Romish church, a chaplet consisting of five or fifteen decads of beads, to direct the recitation of so many Ave Maria's; in honour of the Virgin.

ROSARY also denotes a particular mass or form of devotion addressed to the Virgin, to which the chaplet of that name is accommodated. It consists of fifteen repetitions of the Lord's prayer, and an hundred and fifty salutations of the blessed Virgin: which consist of six or seven repetitions of the Lord's prayer, and six or seven times ten salutations or Ave Maria's.

Factions of the Red and White ROSE are famous in our English histories. They had their rise in 1454, under Henry VI. between the houses of York and Lancaster, and ended in Henry VII. who united the two branches. The house of Lancaster had for its badge a red rose; that of York, a white one.

ROSES, in heraldry, is a difference denoting the seventh son of a family. See the System, Sect. V. and Plate I.

ROSTRUM literally denotes the beak or bill of a bird. For its description and uses, see the System of *ORNITHOLOGY*, Sect. I. Art. I.

ROT, a disease which, in moist years, is incident to sheep, in the same ground where, in drier years, they are free from it; which yet arises, not only from the moisture, but from a certain principle of putrefaction, both in the air and the grass. The true cause of this disorder is very imperfectly understood, if not altogether unknown. Many have satisfied themselves with attributing it to moisture in general; others have ascribed it to the quick growth of grass and herbs in wet places; a late writer considers it as an indubitable fact, that the insects which are sometimes found in the livers, &c. of sheep, and which he describes as resembling the flat fish called the plaice, are the cause of the rot; another writer conjectures that it is a disorder of the liver, occasioned by obstructed and inspissated bile; but amidst this variety of opinion, nothing more can be inferred than that this is probably a putrid disease. It is well known, that it is the greatest of all the inconveniences that attend the keeping of these useful animals. It is a very hard thing to prevent the rot, if the year prove very wet, especially in May or June. Salt marshes and lands where broom grows are the best places of preservation for them. Sheep are sometimes all cleared of the rot when not too far gone with it, only by removing them into broom-fields. Scurvy-grass, mustard, parsley, marsh-trefoil, and thyme, are also good for the prevention of it.

Some propose the giving sheep half a handful of bay-salt, every month or oftener. A farmer is said to have cured his whole flock of the rot, by giving each sheep a handful of Spanish salt, five or six mornings successively; and there is great probability that this may be of service: but the rational way of attacking all disorders in cattle, is by considering what are the causes of them. It will appear upon inquiry, that wet seasons are the general occasions of the rot in sheep, and therefore it would be advisable for the owners, when such seasons come on, to remove the animals into the driest pastures they can, and then to feed them principally with dry sweet hay, oats, bran and the like, which would prevent the occasion; and if they were already a little infected, some salt, given with their dry food, would be a happy means of curing them. The two following receipts have been much recommended by those who have tried them with success. Steep some regulus of antimony in ale, adding to it some grains of paradise, and a little sugar to sweeten it. Of this infusion, ~~water~~ three doses, each dose being somewhat less than a gill, are to be given to the infected sheep, at the interval of two days.

Or, steep a handful of rue in a pail of water all night, and in the morning put in as much salt as will make it bear an egg. Let half a pint of this liquor be given to each sheep, and repeated thrice, every other morning. A farmer, who kept four hundred sheep, tried this remedy, in a general rot, and lost none; though his neighbours lost almost all theirs. Of twenty, to which this liquor was not administered, for the sake of experiment, many were rotten.

ROTATED, in botany, the name of a sort of flowers, so called from their shape, somewhat resembling a wheel. These are of the monopetalous kind. See the System, Sect. II. and Plate I.

ROTATION,

ROTATION, in geometry, the circumvolution of a surface round an immoveable line, called the axis of rotation. By such rotation of planes, the figures of certain regular solids are formed, or generated.

ROUP, in poultry, is a filthy boil or swelling upon their rumps, known by the staring, or turning back of the feathers. The roup, if not soon remedied, will corrupt the whole body; to prevent which, the feathers are to be pulled away, the swelling laid open, and the matter pressed out; after which the part is to be washed with salt and water or brine.

ROWEL, among farriers, a kind of issue, made by drawing a piece of silk, thread, hair, or the like through the nape of the neck, or other part of a horse; answering to what in surgery is called a fistula. For the mode of operation, and the uses and abuses of the practice of Rowelling in Farriery, see the System, Part II. under the Article of *General Directions for the Management of Horses*.

ROYAL, something belonging to a king: thus we say, royal family, royal assent, royal exchange, &c.

ROYAL Assent, is that assent or approbation which the king gives to a thing done by others; as the election of a bishop by dean and chapter, or to a bill passed in both houses of parliament. The royal assent in parliament being given, the bill is indorsed with these words, *Le roy le veut*; that is, *it pleases the king*. If he refuses it, thus, *Le roy s'aviserá*; q. d. *the king will advise upon it*. See **PARLIAMENT**.

ROYAL Family. The first and most considerable branch of the king's royal family, regarded by the laws of England, is the queen. The queen of England is either queen *regent*, queen *consort*, or queen *dowager*. The queen *regent*, *regnant*, or *sovereign*, is she who holds the crown in her own right; as the first (and perhaps the second) queen Mary, queen Elizabeth, and queen Anne; and such a one has the same powers, prerogatives, rights, dignities, and duties, as if she had been a king. This is expressly declared by statute 1 Mar. I. st. 3. c. 1. But the queen *consort* is the wife of the reigning king; and she by virtue of her marriage is participant of divers prerogatives above other women.

A queen *dowager* is the widow of the king, and as such enjoys most of the privileges belonging to her as queen consort. But it is not high treason to conspire her death, or to violate her chastity; for the same reason as was before alleged, because the succession to the crown is not thereby endangered. See **QUEEN**.

The prince of Wales, or heir apparent to the crown, and also his royal consort, and the princess royal, or eldest daughter of the king, are likewise peculiarly regarded by the laws. For by statute 25 Edw. III. to compass or conspire the death of the former, or to violate the chastity of either of the latter, are as much high treason as to conspire the death of the king, or to violate the chastity of the queen. And this upon the same reason as was before given; because the prince of Wales is next in succession to the crown, and to violate his wife must taint the blood-royal with bastardy: and the eldest daughter of the king is also alone inheritable to the crown on failure of issue male, and, therefore, more respected by the laws than any of her younger sisters; inasmuch, that upon this, united with other (feodal) principles, while our military honours were in force, the king might levy an aid for marrying his eldest daughter, and her only. The heir apparent to the crown is usually made prince of Wales and earl of Chester, by special creation and investiture, but being the king's eldest son, he is by inheritance duke of Cornwall, without any new creation.

The rest of the royal family may be considered in two different lights, according to the different senses in which the term *royal family* is used. The larger sense, includes all those, who are by any possibility inheritable to the crown. Such, before the revolution, were all the descendants of William the Conqueror; who had branched into an amazing extent, by inter-marriages with the ancient nobility. Since the revolution and act of settlement, it means the Protestant issue of the princess Sophia; now comparatively few in number, but which in process of time may possibly be as largely diffused.

The younger sons and daughters of the king, and other branches of the royal family who are not in the immediate line of succession, were therefore little farther regarded by the ancient law, than to give them a certain degree of precedence before all peers and public officers, as well ecclesiastical as temporal.

ROYAL Exchange, the bursé or meeting-place of the merchants of London. It was first built in 1566, at the charge of sir Thomas Gresham; and in a solemn manner by herald, with sound of trumpet, in presence of queen Elizabeth, proclaimed the *Royal Exchange*. Till that time the merchants met in Lombard street. It was built of brick; yet then esteemed the most splendid bursé in Europe. An hundred years after its building, at the great fire, it was burnt down; but it was soon raised again in a still more magnificent manner; the expence thereof amounted to 50,000l. One half of this sum was disbursed by the chamber of London, the other by the company of mercers; who, to reimburse themselves, let to hire a hundred and ninety shops above stairs, at twenty pounds each; which, with other shops, &c. on the ground, yielded a yearly rent of above four thousand pounds; yet the ground it stands does not exceed three fourths of an acre; whence it is observed to be much the richest spot of ground in the world. It

is built quadrangular, with walks around, wherein the merchants of the respective countries associate themselves. In the middle of the area, or court, is a fine marble statue of king Charles II. in the habit of a Roman Cæsar, erected by the society of merchant-adventurers; the workmanship of Grinlin Gibbons. Around are ranged the statues of the several kings since the Norman Conquest.

ROYAL Oak, was a fair-spreading tree at Boscobel, in the parish of Donnington, in Staffordshire, the boughs whereof were all covered with ivy; in the thick of which king Charles II. sat in the day-time with Colonel Careless, and in the night lodged at Boscobel-house; so that they are mistaken who speak of it as an old hollow oak; it being then a gay flourishing tree, surrounded with many more. The poor remains hereof are now fenced in with a handsome wall, with this inscription over the gate, in golden letters: FELICITUM ARBOREM, QUAM IN ASYLUM POTENTISSIMI REGIS CAROLI II. DEUS OP. MAX. PER QUEM REGES REGNANT, HIC CRESCERE VOLUIT, &c. Phil. Trans. No. 310.

ROYAL Oak, *Robur Carolinum*, or Charles's Oak, in astronomy, one of the new southern constellations. See the System, Sect. VIII. Article *Southern Constellations*.

ROYAL Society of England, is an academy, or body, of persons, of eminent learning; instituted by king Charles II. for the promoting of natural knowledge.

This illustrious body had its original in an assembly of ingenious men, residing in London, who, being inquisitive into natural, and the new and experimental philosophy, agreed, about the year 1645, to meet weekly on a certain day, to discourse upon such subjects. These Meetings, it is said, were suggested by Mr. Theodore Haak, a native of the Palatinate in Germany. About the year 1659, the society met once or twice a week in term-time, at Gresham College, till they were dispersed by the public distractions of that year, and the place of their meeting was made a quarter for soldiers. Upon the Restoration, in 1660, their meetings were revived, and attended with a larger concourse of persons, eminent for their character and learning.

They were at length taken notice of by the king, who was pleased to grant them an ample charter, dated the twenty-second of April, 1663, whereby they were erected into a corporation, consisting of a president, council, and fellows, for promoting natural knowledge. Their manner of electing fellows is by balloting. Their council are in number twenty-one, including the president, vice-president, treasurer, and two secretaries; eleven of which are continued for the next year, and ten more added to them; all chosen on St. Andrew's day. Each member, at his admission, subscribes an engagement, that he will endeavour to promote the good of the society; from which he may be freed at any time, by signifying to the president, that he desires to withdraw.

The charges are five guineas paid to the treasurer at admission; and 13s. per quarter so long as the person continues a member; or, in lieu of the annual subscription, a composition of twenty-six guineas in one payment. Their design is "to make faithful records of all the works of nature or art, which come within their reach; so that the present, as well as after ages, may be enabled to put a mark on errors which have been strengthened by long prescription; to restore truths that have been neglected; to apply those already known to more various uses; to make the way more passable to what remains unrevealed," &c.

To this purpose they have made a great number of experiments and observations on most of the works of nature; eclipses, comets, meteors, mines, plants, earthquakes, inundations, springs, damp, subterraneous fires, tides, currents, the magnet, &c. Also numbers of short histories of nature; arts, manufactures, useful engines, contrivances, &c. The services they have been of to the public are very great. They have improved naval, civil, and military architecture; advanced the security and perfection of navigation; improved agriculture; and put not only this kingdom, but also Ireland, the plantations, &c. upon planting. They have registered experiments, histories, relations, observations, &c. and reduced them into one common stock; and have, from time to time, published some of the most immediate use, under the title of Philosophical Transactions, &c. and laid the rest up in public registers, to be nakedly transmitted to posterity, as a solid groundwork for future systems.

They have a library adapted to their institution; towards which Mr. Henry Howard, afterwards duke of Norfolk, contributed the Norfolkian library, and which is, at this time, greatly increased by a continual series of benefactions. The museum, or repository, of natural and artificial rarities, given them by Daniel Colwal, esq. and since enriched by many others, is now removed to the British Museum, and makes a part of that great repository. Their motto is, *Nullius in verba*; and their place of assembling is Somerset-place in the Strand. Sir Godfrey Copley, bart. left five guineas to be given annually to the person who shall write the best paper in the year, under the head of experimental philosophy. This reward, which is now changed to a gold medal, is the highest honour the Society can bestow. It is conferred on St. Andrew's day.

R U C

The Transactions of the Royal Society, are called Philosophical Transactions, and are a kind of journal of the principal things that come before the Royal Society of London. They contain the several discoveries and histories of nature and art, made by the members of the society, or communicated by them from their correspondents, with the several experiments, observations, &c. made by them, or transmitted to them, &c. They were first set on foot in 1665, by Mr. Oldenburg, secretary of the society, and were continued by him till the year 1677. Upon his death they were discontinued till January, 1678, when Dr. Græw resumed the publication of them, and continued it for the months of December, 1678, and January and February, 1679, after which they were intermitted till January 1683. During this last interval they were supplied in some measure by Dr. Hooke's Philosophical Collections. They were also interrupted for three years, from December 1687, to January 1691, besides other smaller interruptions, amounting to near one year and a half more, before October 1695, since which time the transactions have been regularly carried on.

They were for many years published in numbers, and the printing of them was always, from time to time, the single act of the respective secretaries, till the year 1752, when the society thought fit that a committee should be appointed to re-consider the papers read before them, and to select out of them such as they should judge most proper for publication in the future transactions. The members of the council constitute a standing committee for this purpose. They meet on the first Tuesday of every month; and no less than seven of the members of the committee (of which number the president, or in his absence, a vice-president, is always to be one) are allowed to be a quorum, capable of acting in relation to such papers. The question with regard to the publication of any paper, is always decided by the majority of votes taken by ballot.

They are published annually in two parts at the expence of the society, and each fellow is entitled to receive one copy gratis of every volume published after his admission into the society.

The *Philosophical Transactions* to the end of the year 1700, were abridged in three volumes by Mr. John Lowthorp: those from the year 1700 to 1720, were abridged in two volumes by Mr. Henry Jones: those from 1719 to 1733, were abridged in two volumes by Mr. John Eames and Mr. John Martyn; Mr. Martyn continued the abridgment of those from 1732 to 1744, in two volumes: and of those from 1743 to 1750, in two volumes.

RUBY, IN MINERALOGY, a species of gems, being a beautiful gem of a red colour with an admixture of purple. This, in its most perfect and best coloured state, is a gem of prodigious beauty and extreme value; it is often found perfectly pure and free from blemishes or foulness, but much more frequently debased greatly in its value by them, especially in the larger specimens. It is of very great hardness, equal to that of the sapphire, and second only to the diamond. It is various in size; but less subject to variations in its shape than most of the other gems. It is usually found very small, its most common size being equal to that of the head of the largest sort of pins; but it is found of four, eight, or ten carats; and sometimes, though very rarely, up to 20, 30, or 40. It is never found of an angular or crystalliform shape; but always of a pebble-like figure, often roundish, sometimes oblong, and much larger at one end than the other, and in some form resembling a pear, and is usually flatted on one side. It commonly is naturally so bright and pure on the surface, as to need no polishing; and when its figure will admit of being set without cutting, it is often worn in its rough state, and with no other than its native polish. We have the true ruby only from the East Indies; and the principal mines of it are in the kingdom of Pegu and the island of Ceylon. See Mineralogy, Class I. Ord. IV.

As rubies are frequently found in gold mines, it is very probable that they receive their colour from that metal. The ruby is formed in a stony substance, or bed, of a rose colour, called *mother of ruby*; it has not all its colour and lustre at once, but comes to it by degrees. At first it is whitish; and, as it approaches to maturity becomes red. Hence we have white rubies, others half white, half red, and others blue and red, called *sapphire rubies*. When a ruby exceeds twenty carats, it may be called a *carbuncle*; the name of an imaginary stone, whereof the ancients and moderns have given us so many descriptions. Fructiere assures us very positively, that there have been rubies in France of two hundred and forty carats. Tavernier tells us he saw one in the Indies of fifty carats, which he had a mind to have bought. He adds, that the king of France has finer and larger rubies than any in the possession of the Great Mogul.

RUBY, in heraldry, denotes the red colour wherewith the arms of noblemen are blazoned, being the same which in the arms of others, not nobles, are called *gules*. See the System, Sect. III.

RUCTATION, *belching*, a ventosity arising from indigestion, and discharging itself at the mouth, with a disagreeable noise. There are belches owing to repletion, and others to inanition, or emptiness. Quincy says, hypochondriac and hysteric people are particularly liable to this disorder. They are rather to be cured with proper stomachics than carminatives and hot liquors. Burnet recommends the illiac pills of Rhafis against ructation.

R U M

RUINS, a term particularly used for magnificent buildings fallen to decay by length of time, and whereof there only remains a confused heap of materials. Such are the ruins of the tower of Babel, of the tower of Belus, two days journey from Bagdad, in Syria, on the banks of the Euphrates; which are now no more than a heap of bricks, cemented by bitumen; and whereof we only perceive the plan to have been square. Such also are the ruins of a famous temple, or palace, near Schiras, in Persia, which the antiquaries will have to have been built by Ahasuerus, and which the Persians now call Tchelminar, or Chelminar; q. d. the forty columns; because there are so many columns remaining pretty entire, with the traces of others; a great quantity of basso relievo, and unknown characters sufficient to shew the magnificence of the antique architecture. The ruins of PALMYRA may be reckoned in the class of famous ruins. See PALMYRENE RUINS.

RULE, in arithmetic, denotes a certain operation with figures to find sums or numbers unknown, and to facilitate computations, mercantile, astronomical, &c. Each rule in arithmetic has its particular name, according to the use for which it is intended. The four first, which serve as the foundation of the whole art, are called *addition*, *subtraction*, *multiplication*, and *division*. For a full exemplification of these several rules, see the System, under their respective heads to which they belong.

RULE of Three, or of Proportion, commonly called the *golden rule*, is a rule which teaches how to find a fourth proportional number to three others given. See the System, under the article *RULE of Three*.

RULES of Court, in law, are certain orders made, from time to time, in the courts of law, which attorneys are bound to observe, in order to avoid confusion; and both the plaintiff and defendant are at their peril also bound to pay obedience to rules made in court relating to the cause depending between them. A rule of court is granted every day the courts of Westminster sit, to prisoners of the King's-bench, or Fleet prisons, to go at large about their private affairs.

RUM, a species of brandy, or vinous spirit, drawn by distillation from sugar-canes. The word rum is the name it bears among the native Americans. Rum is very hot and inflammable, and is in the same use among the natives of the sugar-countries, as brandy among the French. Rum differs from what we simply call sugar-spirit, in that it contains more of the natural flavour or essential oil of the sugar-cane; a great deal of raw juice and parts of the cane itself being often fermented in the liquor or solution of which the rum is prepared. The unctuous or oily flavour of rum is often supposed to proceed from the large quantity of fat used in boiling the sugar; which fat, indeed, of course, will usually give a stinking flavour to the spirit in our distillations of the sugar-liquor, or wash, from our refining sugar-houses; but this is nothing like the flavour of the rum, which is really the effect of the natural flavour of the cane.

The method of making rum is this: When a sufficient stock of the materials is got together, they add water to them, and ferment them in the common method, though the fermentation is always carried on very slowly at first; because at the beginning of the season for making rum in the islands, they want yeast or some other ferment, to make it work; but by degrees, after this, they procure a sufficient quantity of the ferment, which rises up as a head to the liquor in the operation, and thus they are able afterwards to ferment and make their rum with a great deal of expedition, and in large quantities.

When the wash is fully fermented, or to a due degree of acidity, the distillation is carried on in the common way, and the spirit is made up proof; though sometimes it is reduced to a much greater strength, nearly approaching to that of alcohol or spirit of wine, and is then called double distilled rum. It might be easy to rectify the spirit, and bring it to much greater purity than we usually find it to be of; for it brings over in the distillation a very large quantity of the oil; and this is often so disagreeable, that the rum must be suffered to lie by a long time to mellow before it can be used; whereas, if well rectified, it would grow mellow much sooner, and would have a much less potent flavour. The best state to keep rum in, both for exportation and other uses, is doubtless that of alcohol, or rectified spirit. In this manner it would be transparent in one half the bulk it usually is, and might be let down to the common proof strength with water when necessary. For the common use of making punch, it would likewise serve much better in the state of alcohol; as the taste would be cleaner, and the strength might always be regulated to a much greater exactness than in the ordinary way.

The only use to which it would not serve so well in this state, would be the common practice of adulteration among our distillers; for when they want to mix a large portion of cheaper spirit with the rum, their business is to have it of the proof strength, and as full of the flavouring oil as they can, that it may drown the flavour of the spirits they mix with it, and extend its own. If the business of rectifying rum was more nicely managed, it seems a very practicable scheme to throw out so much of the oil as to have it in the fine light state of a clear spirit, but lightly impregnated with it; in this case it would very nearly resemble arrack, as is proved by the mixing a very small quantity of it with the tasteless spirit, in which case the whole

R U P

whole bears a very near resemblance to arrac in flavour. Rum is usually very much adulterated in England; some are so barefaced as to do it with malt-spirit; but when it is done with molasses-spirit, the tastes of both are so nearly allied that it is not easily discovered. The best method of judging of it is by setting fire to a little of it; and when it has burnt away all the inflammable part, examining the phlegm both by the taste and smell. Shaw's Essay on Distillery.

RUMB, in navigation. See RHUMB-Line in the System, Part I. Sect. I.

RUMEN, the first stomach of animals which chew the cud, and which are hence called *ruminants*. The food is transmitted into the rumen without any other alteration in the mouth than being a little rolled and wrapped up together. The rumen, or paunch, is much the largest of all the stomachs, as being to contain both the drink, and the whole crude mass of aliment, which there lie and macerate together, to be thence remitted to the mouth, to be re-chewed and comminuted, in order to their farther digestion in the other ventricles. See ABOMASUS, and the System of Comparative Anatomy, Chap. I. Sect. I. In the rumen, or first ventricles of camels, are found divers faculi, which contain a considerable quantity of water; an admirable contrivance for the necessities of that animal, which living in dry countries, and feeding on dry hard food, would be in danger of perishing but for these reservoirs of liquor.

RUMINANT, *ruminans*, in natural history, an animal which chews over again what it has eat before: this is properly called *chewing the cud*. Ruminants are all quadrupedal, hairy, and viviparous; some with hollow and perpetual horns, others with deciduous ones. See the System of COMPARATIVE ANATOMY, Chap. I. Sect. IV.

RUNNET, or RENNET, an acid juice found in the stomachs of calves that have fed on nothing but milk, and are killed before the digestion be perfected. It also signifies the liquor made by steeping the stomach of a calf in hot water. It is this runnet that is chiefly used to curdle or turn milk for cheese. Its proper place is the Abomasus. See COMPARATIVE ANATOMY, Chap. IV.

The like matter is also said to be found in goats and hares. The longer the runnet is kept, the better it is. Though it readily coagulates milk; yet, if put into it when already coagulated, it dissolves it. If salt be put in the milk before the runnet be applied, it prevents its coagulation; but if the salt be put in afterwards, it hardens the coagulum.

RUNNING *Thrush*, or *frush*, in farriery, denotes an imposthume that sometimes gathers in a horse's frog, or a scabby and ulcerous disposition which sometimes causes it to fall off. When this discharge is natural the feet should be kept merely clean. When an imposthume appears, the safest course is to pare out the hard part of the frog, or that which appears rotten, and to wash the bottom of the foot three times a day with old chamber-ley. For a particular description of the symptoms and methods of treatment, see the System, Class II. Sect. VI.

RUPEE, a coin very current in the territories of the Great Mogul, and several other parts of the East Indies. Rupees are struck both of gold and silver, and both the one and the other have their diminutions, as half-rupees, quarter-rupees, &c.

The gold rupee is worth 15. 6d. sterling. The silver rupee is struck in the Mogul's mints, with an inscription of his name and titles, the year of his reign, and the place it was struck at. It weighs from 7 dwt. to 104 gr. to 7 dwt. 11 gr. and has from 1 to 2 parts in 100 alloy. 100,000 is one lack, 100 lacks are one crore, and 100 crores are one anib. The value of the silver rupee is various, according to its quality, and the place where it is coined.

RUPERT's Drops, *lachrymæ Batavice*, or *snappers*, a sort of glass drops with long and slender tails, which burst to pieces on the breaking off those tails in any parts, said to have been invented by prince Rupert, and therefore called after his name. They were first brought into England by prince Rupert, out of Germany, and shewn to King Charles II. who communicated them to the Royal Society, at Gresham College; and a committee, appointed on this occasion by the society.

The following account of the methods of making, breaking, &c. *Prince Rupert's Drops*, or *Snappers*, was communicated to us by Mr. T. BARNETT, *Optical, Philosophical, and Mathematical Instrument-maker*, a Subscriber to this work.

They are made with common green glass, such as common wine bottles, in the following manner, viz. a little of the glass is taken out of the melting-pot, with an iron rod, and dropped while in a fluid state in a solid piece into cold water, which immediately chills, and fixes its external parts; while its internal parts remain red hot for some time, and cool gradually in the water. While cooling, its internal parts are continually contracting till cold, which causes an infinite number of vacuums therein, by reason of its external parts being chilled, and fixed immediately as it is dropped into the water. After it is cool, if you at any time while in or out of water, break off the small end, it will instantly fly asunder, with a great noise, by reason of the air or water, (which ever medium it is broken in) rushing instantly into its pores or vacuums. If you examine one of those snappers or drops you will see in the largest part many large vacuums. If you put it into fire on something smooth,

R Y E

and heat it till it becomes a little soft, the pressure of the atmosphere will compress it together, and fill up all those vacuums, when it will be a common clear bit of glass, and will not break in the manner it would before heating. If you with a blow pipe and candle, heat it so as to make it a little soft about an inch from the small end, then afterwards break a little of it off, and it will fly asunder, as far as it was heated only; but if you afterwards break it off a little below the part that was heated, it will all fly asunder.

RUPTURE, in surgery, called also *hernia*, and popularly *burstness*, is when the rim, thin film, or caul, which holds up the intestines, is broken, or over-strained, or stretched, so that the guts fall down either into the groin, scrotum, or elsewhere. See HERNIA.

RURAL, or RUSTIC, formed of *rus*, *rusis*, *country*, something that relates to the country. For the manner in which rural scenes are best contrasted, see the Treatise on GARDENING, Part I.

RUST of Corn or Blight, in husbandry, the name given by our farmers to a disease in corn and other vegetables, in which their stalks and leaves seem burnt up, and appear of a sort of rust-colour. For a copious description of its effects, and the means of prevention, see the article BLIGHT.

RUST of a Metal, the flowers or calx thereof, procured by corroding and dissolving its superficial parts by some menstruous fluid; or the earth of the metal decomposed by the action of a proper menstruum. Water is the great instrument or agent in producing rust; the air apparently rusts bodies, but it is only in virtue of the water it contains. Hence in a dry air, metals remain a long time without contracting rust, and hence oils, and other fatty bodies, secure metals from rust; water being no menstruum to oil; &c. and therefore not able to make its way through it. See the Article IRON.

All metals are liable to rust; even gold itself, though generally held incapable thereof, grows rusty, if exposed to the fumes of sea-salt. The reason why gold is so rarely found to rust, is, that sea-salt, which is the only salt that will prey upon it, is of a very fixed nature: and therefore little of its effluvia, or exhalations are found floating in the air. Rust is usually supposed to be a corruption of the metal, but without much foundation: it is the very metal itself, only under another form; and accordingly we find, that rust of copper may again be turned into copper; the rust of copper, called *ærua*, makes what we call verdigris. Cerufs is made of lead converted into rust by vinegar. Iron, in time, turns wholly into rust, unless preserved from the air by paint or varnish.

RUT, in hunting, &c. a term used for the venery or copulation of deer. There are certain terms which obtain in respect of this and other beasts of game, known particularly to sportsmen.

The rutting time with the hart begins about the middle of September: and holds two months; the older they are, the better, and the more beloved they are by the hinds, and the earlier they go to rut. At this time they will turn head, and furiously make at any living creature. It is easy killing them at this time; their whole business being to scent and pursue the track of the females; scarce feeding at all. The young herd are forced to fly with great precipitancy when the hart comes in sight of his mate. If there be any other of bulk, they will dispute it very hotly with their horns. As the season expires, they withdraw, and dig themselves holes wherein to lie to assuage the strong fervour of their lust: when become a little sweet, they return to their pasture, and live in herds. The rutting or touring time of the roebuck begins in October, and lasts only twelve or fifteen days. When this is past, he casts his horns. After the hind is filled, she keeps no more company with the male till she be delivered. But the doe always accompanies her paramour till her time approaches, when she retires, for the safety of her young, which he would otherwise kill.

Book of RUTH, a canonical book of the Old Testament; being a kind of appendix to the book of Judges, and an introduction to those of Samuel; and having its title from the person whose story is here principally related. In this story are observable the antients rights of kindred and redemption; and the manner of buying the inheritance of the deceased, with other particulars of great note and antiquity.

RYE, in botany, a Genus of the Triandria Dyginia class. We have but one distinct species of this genus, which is cultivated in England, though it is often supposed the two varieties distinguished by the farmers under the name of winter and spring rye, are essentially different. The general use of rye is for bread, either alone or mixed with wheat. And there is another very essential use to the farmer made of rye. April is the season of the year when food is of all others the scarcest for cattle, especially for sheep and lambs; on this account some split the ridges of the wheat stubble, and sow them with rye; they harrow this in, allowing about a bushel to an acre; they feed the sheep with this in April, and in May they plow it up for fallow. When this is intended, the rye should be sown early in autumn, that it may have strength to furnish early seed. For the cultivation of Rye, see the System of AGRICULTURE, Sect. VII. for that of Rye-grass, see Sect. VIII.

S A C

S, A consonant, and the eighteenth letter of the alphabet, the sound of which is formed by driving the breath through a narrow passage between the palate and the tongue elevated near it, together with a motion of the lower jaw and teeth towards the upper; the lips being a little way open, with such a configuration of every part of the mouth and larynx, as renders the voice somewhat hissing. *S* is, therefore, accounted one of the three hissing consonants: the other two being *z* and *j*. It is also held a semi-vowel, as forming a kind of imperfect sound, without the assistance of any of the vowels.

It is the peculiar quality of *s*, that it may be sounded before all consonants except *x* and *z*, in which *s* is comprised, *x* being only *ks* and *z* a hard or gross *s*. This *s* is, therefore, termed by grammarians, *sua potestatis litera*. In the beginning of words it has invariably its natural and genuine sound; in the middle it is sometimes uttered with a strong appulse of the tongue to the palate, like *z*, as *rise*, *busy*, &c. and sometimes it keeps its natural sound, as *loose*, *designation*, &c. In the end of monosyllables, it is sometimes *s* as *this*; and sometimes *z*, as *as*, and generally in verbs where *es* stands for *eth*, as *gives*. A single *s* seldom ends any word, except the third person of verbs, as *loves*, the plural of nouns, as *trees*, the pronouns *this*, *his*, *ours*, *yours*, *us*, the adverb *thus*, and words derived from the Latin, as *rebus*: the close being either in *se*, as *house*, or *fs*, as *grass*. It sounds like *z* before *ion*, if a vowel goes before, as *intrusion*; and like *s*, if it follows a consonant, as *conversion*. It sounds like *z* before *e* mute, as *refuse*, and before *y* final, as *rosy*. Johnson.

S, in *Books of Navigation*, &c. signifies south; *S. E.* south-east; *S. W.* south-west, *S. S. E.* south-south-east, &c. See the System of NAVIGATION, Sect. I. No. 6, and the Plate, Fig. 2 and 3.

SABBATH, or the day of rest, a solemn festival of the Jews, on the seventh day of the week, or Saturday, beginning from sun-set on Friday to sun-set on Saturday. The observation of the Sabbath began with the world: for God having employed six days in its creation, appointed the seventh as a day of rest to be observed by man in commemoration of that great event. On this day the Jews were commanded to abstain from all labour, and to give rest to their cattle. They were not allowed to go out of the city farther than two hundred cubits, or a mile: a custom which was founded on the distance of the ark from the tent of the Israelites in the wilderness, after their leaving Egypt; for being permitted to go, even on the sabbath day to the tabernacle to pray, they from thence inferred, that the taking a journey of no great length, though on a different account, could not be a breach of the sabbatical rest. As the seventh day was a day of rest to the people, so was the seventh year to the land: it being unlawful in this year to plough or sow, and whatever the earth produced belonged to the poor: this was called the *sabbatical year*. The Jews, therefore, were obliged, during the six years, and more especially the last, to lay up a sufficient store for the sabbatical year. The modern as well as the ancient Jews are very superstitious in the observance of the Sabbath: they carry neither arms, nor gold, nor silver, about them, and are permitted neither to touch these, nor a candle, nor any thing belonging to the fire; on which account they light up lamps on Friday, which burn till the end of the Sabbath.

The Christians also apply the word Sabbath, by extension, to the first day of the week, popularly called Sunday, or the Lord's-day; as instituted by the apostles to take place of the Jewish Sabbath, and by us observed in remembrance not of the creation, but of the work of redemption's being completed by our Saviour's resurrection on that day. Those who dispute the divine appointment of a Christian Sabbath, yet allow the moral necessity thereof, as a wise designation of time for the recruiting of our bodies, and at the same time keeping up a sense of the great benefits we have received from God, and a spiritual temper of mind. By allowing six days to labour, the poor man has time to earn his bread, and the man of business has time to dispatch his affairs. Had more time been allotted to labour and business, and none to rest; our bodies would have been too much fatigued and wasted, and our minds too long engaged about worldly matters, so as to have forgotten divine things. Avaricious people, without such an injunction, would scarce have spared their own bodies, much less their servants, slaves, cattle, &c.

SABLE, in heraldry, the black colour in the arms of gentlemen. The name is borrowed from the little animal called sable, which is of a black colour. It is expressed in engraving by perpendicular and horizontal hatches drawn across each other. See the System, Sect. III. and Plate II.

SABLE, the English name of a species of the genus *Mustela*, in the system of Mammalia. For description, see *MUSTELA*. For representation, see the Plate 2. Order III. Genus 15.

SACCHARUM Saturni, in Pharmacy. For the method of preparing it, see *EXTRACT of LEAD*, under the article *LEAD*.

SACRAMENT, *sacramentum*, in the general, denotes a sign of a holy or sacred thing. In this sense the word includes both the sacrament of the law of nature, as sound morality, the manner of offering the bread and wine practised by Melchisedek, &c. and those of the law of Moses, as the circumcision, the paschal lamb, purifications, order of priesthood, &c. Sacrament, with regard to the Christian church, is defined, an outward and visible sign of an inward and spiritual grace annexed to the use thereof. Roman

S A G

catholics own seven sacraments; viz. baptism, confirmation, the eucharist, penance, extreme unction, ordination, and marriage. See *POPE*. The protestants admit of only two; viz. baptism and the eucharist, or Lord's supper.

SACRIFICE, a solemn act of religious worship, which consisted in dedicating or offering up something animate or inanimate on an altar, by the hands of the priest, either as an expression of their gratitude to the Deity for some signal mercy, or to acknowledge their dependance on him, or to conciliate his favour. The origin of sacrifices is by some ascribed to the Phœnicians; but Porphyry ascribes it to the Egyptians, who first offered the first-fruits of their grounds to the gods, burning them upon an altar of turf; thus in the most ancient sacrifices there were neither living creatures, nor any thing costly or magnificent, and no myrrh or frankincense. At length they began to burn perfumes; and afterwards men, leaving their ancient diet of herbs and roots, and beginning to use living creatures for food, began also to change their sacrifices. The scriptures, however, furnish us with a different account; for Noah, it is said, sacrificed animals at his coming out of the ark; and even Abel himself sacrificed the best and fattest of his flock; but Grotius thinks it more probable that he contented himself with making a mere oblation of his lambs, &c. without slaying them. For a copious account of the ceremonies of human sacrifices, as practised by the inhabitants of Otaheite, one of the new discovered islands in the South Seas, see the article *EATOAS*.

SADLER's-Wells, a well known place for entertainment in the neighbourhood of London. It derives its name from Mr. Sadler, who erected a music shop near the spot, which was much frequented, before the Reformation, on account of the famous well, to the waters of which many extraordinary cures were ascribed, and which was, therefore, deemed sacred, and called holy well. The priests belonging to the priory of Clerkenwell used to attend there, and hence the people were led to believe, that the virtues of the water proceeded from the efficacy of their prayers. Upon the Reformation the well was stopped up, on account of the superstitious use that was made of it; till in 1683, Mr. Sadler found it covered with a carved arch stone. These wells are now called New Tunbridge Wells, and their waters are deemed very salutary in various disorders. After the decease of Mr. Sadler, one Francis Forcer, a musician, became occupier of the wells and music-house. His son succeeded him, and first exhibited in this place the diversions of rope-dancing, tumbling, &c.

SADDUCES, or **SADDUCEES**, *Sadducei*, a sect among the ancient Jews, consisting of persons of the greatest quality and opulence, esteemed as deists or free-thinkers, rather than real Jews: though they assisted at all the ceremonies of the worship in the Temple.

SAFFRON, *crocus*, in botany, a Genus of the Triandria Monogynia class. The best saffron of Europe is that of England, and may be distinguished from the sorts brought from abroad by its blades being broader: that brought from Spain is good for nothing; because of the oil the Spaniards mix with it to make it keep. It should be chosen fresh, not above a year old, in close cakes, neither dry nor yet very moist, tough and firm in tearing, of a high fiery colour, staining the hands on rubbing it, and of the same colour within as on the outside. Saffron is used both in food and medicine, to cheer, fortify and resolve, it is the greatest cordial in medicine, so as when taken too freely, to occasion immoderate mirth: and a sure promoter of a diaphoresis; and is supposed to be particularly serviceable in disorders of the breast, in female obstructions, and hysteric depressions. It tinges the urine of a high colour; the dose is commonly from two or three grains to ten or twelve; Geoffroy says, it may be safely extended to a scruple and more. Saffron gives out the whole of its virtue and colour to rectified spirit, proof spirit, wine, vinegar, and water. The official preparations are the *syrup* and *tincture* of SAFFRON.

Syrup of SAFFRON. This medicine is thus made: take fine saffron an ounce, cut it small, and put it to infuse in a pint of mountain wine; let it stand three days without heat, then strain off the wine; to which, after filtration, add twenty-five ounces of double-refined sugar, melt the sugar over a gentle heat, and then set it by for use.

Tincture of SAFFRON, a preparation made as follows: take saffron an ounce, cut it small, and pour on it in a matras a pint of proof spirit; let them stand together three days without heat, often shaking the vessel, then filter off the tincture for use. Its dose is from thirty drops to a drachm or more. It is good in all cases where the saffron in substance is. If the same quantity of wine be used instead of spirit, it is called *vinum crocaceum*, *saffron-wine*.

SAGE, *salvia*, in botany, a Genus of the Diandria Monogynia class, Miller enumerates twelve species, including several varieties; and Linnaeus reckons thirty-nine species. The common broad-leaved sage; or as we usually call it, from the colour of the leaves, red sage, is a sudorific and diuretic, it promotes the menfes, and is good in palfies, vertiges, tremors, and catarrhs; and mixed with honey, it is said to be one of the best known cures for the apthæ and erosions of the mouths of children. This alone is used in the shops. It makes an excellent gargarism for sore throats, when mixed with honey, and sharpened with vinegar or any acid. Its decoction is very grateful and cooling, with the addition of a little lemon-juice.

lemon-juice. It is both detergent and absorbent, and as such, finds place in diet-drinks, and medicated ales; intended for sweeteners and cleansers of the blood. The Dutch dry and prepare this fage like other teas, and carry it to the Indies as a very precious thing. They there find a good market for it; the Chinese preferring it to the best of their Indian teas; and for every pound of fage give in exchange four pounds of their tea, which they sell again very dear in Europe. Of both kinds the flowers are weaker and more grateful than the leaves; and the cup of the flower stronger, and obviously more refinous than any other part. The leaves of fage give out their virtue both to water and rectified spirit, most perfectly to the latter. To the former they impart a brownish, to the latter a dark green tincture. The broad-leaved fawed fage, called by the gardeners balsamic fage, is preferred to all the others for making tea. The school of Salerno recommends fage as a remedy in all diseases: hence the verse,

Cur moriatur homo, cui salvia crescit in horto?

"Why should a man die, while he has fage in his garden?"

Sage, when viewed with a microscope, often appears covered all over with little spiders, which are seen moving about. It yields, by distillation, a very agreeable, aromatic essential oil, of some use in the shops. For the cultivation of fage, see the Treatise on GARDENING, article *Kitchen Garden*; months March and April.

SAGITTA, in Astronomy, the arrow or dart, a constellation of the northern hemisphere near the Eagle. See the System, Sect. VIII.

SAGITTARIUS, in astronomy, the archer, one of the signs of the zodiac; the ninth in order. See the System, Sect. IX.

SAIL, in navigation. For the names, descriptions and uses of the several sails of a ship, see the Treatise on NAVAL Affairs, Sect. IV. For representation of a ship with three masts in full sail, see the Plate annexed. For a representation of the principal sails, see the same Plate.

SAILING, in a general sense denotes the movement by which a vessel is wafted along the surface of the water, by the action of the wind upon her sails.

SAILING, in a particular sense, is used for the art or act, of navigating; or of determining all the cases of a ship's motion, by means of sea-charts. And as these charts are constructed either on the supposition that the earth is a large extended flat surface, whence we obtain those that are called plain charts, or on the supposition that the earth is a sphere, whence we derive globular charts; sailing may be distinguished into two general kinds, viz. *plane*, or *plain*, and *globular sailing*. For full and accurate descriptions, plain rules and copious directions, relative to the theory and practice of navigation in general, with descriptions and the modes of adjusting the several instruments appertaining to the art, see the System throughout; for representation of the instruments, see the Plate annexed to the System of NAVIGATION.

SAINT, in the Romish Church, a holy person deceased, and since his decease canonized by the pope, after several informations and ceremonies. See the articles CANONIZATION, &c. One of the points wherein the Roman Catholics and Protestants differ is, that the former address, invoke, and supplicate Saints, &c. to intercede for them; whereas the latter hold it sufficient to propose their good examples for our imitation. The number of saints, allowed as such in the Romish church is prodigious.

SAINT-FOIN, in botany, a plant of great utility in agriculture. For its cultivation, &c. see the System of AGRICULTURE, Sect. XI.

SALIC, or SALIQUE, *law, lex salica*, an ancient and fundamental law of France while under kingly government, in virtue whereof males only were to inherit. This law had not particular regard to the crown of France: it only imported, in the general, that in Salic land no part of the inheritance should fall to any female, but the whole to the male sex. *De terra Salica nulla portio hereditatis mulieri veniat; sed ad virilem sexum tota terra hereditas perveniat.* So that it is a popular error to suppose, that the salic law was established purely on account of the succession of the crown; since it extended to private persons as much as those of the royal family.

SALIENT, or SALIANT, in heraldry, is applied to a lion, or other beast, when its four legs are raised in a leaping posture. See the System, Sect. VI. Art. III.

SALINE, a name given to a preparation of sea-salt, procured from the froth of the sea, hardened by the sun in hot countries. It is called by some authors *pilatro de Levant*, and is used in glass making; and in the making the fine purple colour from cochineal, by boiling it in a small quantity with the bran and saenugreek, of which the magistery is made for that purpose. Saline is also the name given by authors to springs of salt-water, called by us salt-wells, salt-springs, and brine-pits. Most parts of the world are found to have these; but those of Franche Compté, in France, seem to be the most remarkable.

SALINE Principle, a term used by the chymical writers, to express a constituent part of several mixed bodies, on which their existence in that form depends; and which, though always existent in them, and always separable by art, is yet not perceivable in many of them in the complex.

SALINE Earths. The chymists under this, as a general head, reckon all those saline and earthy substances, which are calcined or burn in the fire; as all the kinds of lime, pot-ashes, foot, and the

like; these being so many mixtures of salt and earth; and all salts appearing to them, indeed, on a rigorous examination, to be only earths of different natures, which, when reduced to a certain degree of subtilty or fineness of parts, so as permanently to dissolve in water, are then emphatically demonstrated salts. Shaw's Lectures p. 67. See the System of Chymistry. Part II.

SALIVA, is that fluid by which the mouth and tongue are continually moistened in their natural state; and is supplied by glands which form it, that are called *salivary glands*. This humour is thin and pellucid, incapable of being concreted by the fire, almost without taste or smell. By chewing, it is expressed from the glands, which separate it from the blood, and is intimately mixed with our food, the digestion of which it greatly promotes. In hungry persons it is acrid, and copiously discharged; and in those who have fasted long it is highly acrid, penetrating, and resolvent. A too copious evacuation of it produces thirst, loss of appetite, bad digestion, and an atrophy.

SALIVAL, or SALIVARY Ducts, in anatomy, certain little lymphatic canals; whereby the saliva falls into the mouth. For a particular description of this branch of Anatomy, see the System, Part IV. Sect. XIII. Article *Digestion*.

SALIVATION, *salivatio*, in medicine, a promoting of the flux of saliva, by means of medicines; chiefly by mercury. The chief use of salivation is in diseases belonging to the glands, and the membrana adiposa, and principally in the cure of the venereal disease; though it is sometimes also used in epidemic cases. The body is prepared for salivation by a copious and continued use of attenuating, diluting, softening decoction: as of scabious, pellutary, china, saraparilla, salafra, and sanders. Salivation is either partial or universal. By the first, only the humours of some part of the body are to be discharged, as in catarrhs, tooth-ach, &c. By the second, the whole mass of blood is to be purged.

SALT, *sal*, in chymistry, a simple substance which enters the composition of all bodies, and is held one of the five principles, or elements thereof; and may always be extracted by fire. Salt is an ingredient in all animal, vegetable, and mineral bodies, excepting perhaps some metals and stones. In vegetables and animal bodies, that have undergone a fermentation, the salt rises first in the alembic, then the phlegm: if the mixt have not undergone a fermentation, the salt rises after the phlegm. Salts are distinguished with regard to the manner of extracting them, &c. into *volatile*, *fixed*, and *essential*. For a description of the different kinds of salts with their respective characters, qualities and properties, see the System, Part I. Chap. V. throughout. For the use of salt as a manure, see the System of AGRICULTURE, Sect. II.

SALTS *microscopically examined*. Mr. Leewenhoeck has opened a very extensive field for microscopic observations, in the evaporation of certain fluids, in which salts of various plants, and other substances of the like kind had been dissolved. The most agreeable way of examining these salts, is by the solar microscope; but the most accurate and fittest for making deductions from, is that by the common double microscope. The way is to dissolve a small quantity of salt of any kind, in water, and add to this about one fourth part of spirit of wine; this renders the whole a much less fit menstruum for keeping the salt in solution, and consequently it much more readily concretes from among it. A large drop of this liquor is to be laid on the surface of a thin and clear piece of glass, such as may conveniently be laid upon the stand for receiving objects in this microscope: then this glass is to be held till gently heated over a clear fire, and when it begins to evaporate, the glass is to be placed under the microscope, and about a third magnifier used to examine it. The salts will soon be seen beginning to shoot, and will form themselves under the eye into very beautiful figures; some resembling branches of trees, others ruins and fortifications, and the like: but what are most to be depended upon, as essential to the salt, are certain little single shoots resembling crystals; these are determinate in their figure, the others more vague and uncertain. These will always be produced the same from the same salt, the others scarce twice alike in all respects, from even the different drops of the same solution. Phil. Trans. N^o 172, p. 1075. See *MICROSCOPIC Objects*.

SALTIER, in heraldry, an honourable ordinary, in form of St. Andrew's cross. See the System, Sect. VI. Art. I. Plate IV.

SALTPETRE. See NITRE, and the System of Chymistry, Part I. Chap. V. Sect. III. Art. I.

SALUTATION, the act or ceremony of saluting, greeting, or paying respect or reverence to any one. For the *Sword Salute* in the Army, see the Treatise on *Military Affairs*, at the close; for the figures of representation, see Plate IV. The principal regulations with regard to salutes in the Royal Navy may be seen in Falconer's Naval Dictionary.

SAMARITANS, an ancient sect among the Jews, still subsisting in some parts of the Levant, under the same name. Its origin was in the time of Rehoboam; under whose reign a division was made of the people of Israel into two distinct kingdoms. One of these kingdoms called Judah, consisted of such as adhered to Rehoboam, and the house of David; the other retained the ancient name of Israelites, under the command of Jeroboam; the capital of the state of these latter was Samaria; and hence it was that they

S A P

they were denominated Samaritans. The Samaritans rejected all the sacred writings except the five books of Moses.

SAMUEL, an eminent prophet, under the Mosaic dispensation. *Books of SAMUEL*, two canonical books of the Old Testament, as being usually ascribed to the prophet Samuel. The books of Samuel, and the books of Kings, are a continued history of the reigns of the kings of Israel and Judah; for which reason the books of Samuel are likewise styled the first and second books of Kings. Since the first 24 chapters contain all that relates to the history of Samuel, and the latter part of the first book and all the second include the relation of events that happened after the death of that prophet; it has been supposed that Samuel was author only of the first 24 chapters, and that the prophets Gad and Nathan finished the work. The first book of Samuel comprehends the transactions under the government of Eli and Samuel, and under Saul the first king; and also the acts of David while he lived under Saul; and is supposed to contain the space of 101 years. The second book contains the history of about 40 years, and is wholly spent in relating the transactions of David's reign.

SANCTIFICATION, the act of sanctifying, or rendering a thing holy. The reformed divines define sanctification to be an act of God's grace, by which a person's desires and affections are alienated from the world; and by which he is made to die to sin, and to live to righteousness; or in other words, to feel an abhorrence of all vice, and a love of religion and virtue.

SANCTION, *sanctio*, the authority given to a judicial act; or that, whereby it becomes legal and authentic.

SANCTUARY, among the Jews, was the holiest and most retired part of the temple of Jerusalem; wherein was preserved the ark of the covenant; and into which nobody was allowed to enter but the high-priest, and that only once a year, to intercede for the people. The sanctuary, called also *sanctum sanctorum*, or *holy of holies*, is supposed to be a type or figure of heaven and of Jesus Christ the true high-priest, who is ascended thither to make intercession for us.

SANDS, *arena*, a genus of fossils, the characters of which are, that they are found in minute concretions, forming together a kind of powder, the genuine particles of which are all of a tendency to one determinate shape, and appear regular, though more or less complete concretions; not to be dissolved or diffused by water, or formed into a coherent mass by means of it, but retaining their figure in it; transparent, vitrifiable by extreme heat, and not dissoluble in, nor effervescing with acids. In agriculture, it seems to be the office of sand to make unctuous earths fertile, and fit to support vegetables, &c. For earth alone, we find, is liable to coalesce, and gather into a hard coherent mass, as appears in clay; and being thus embodied, as it were glued together, is no way disposed to nourish vegetables. But if such earth be mixed with sand, its pores are thereby kept open, and the earth itself loose, so as thus to give room for the juices to ascend, and for plants to be nourished thereby. A vegetable planted only in sand, or in a fat glebe, or in earth, receives little growth or increase; but a mixture of both renders the mass fertile. In effect, earth is in some measure made organical by means of sand; pores and spaces, something analogous to vessels, being thereby maintained, by which the juices may be conveyed, prepared, digested, circulated, and at length discharged. Common sand is, therefore, a very good addition, by way of manure, to all sorts of clay-lands; it warms them, and makes them more open and loose. For the properties of sand, as a manure, see the *System of AGRICULTURE*, Sect. II.

SANGUIFICATION, in the animal economy, the action whereby the chyle is converted into blood. See the article *BLOOD*. Sanguification succeeds *CHYLIFICATION*, and is followed by *NUTRITION*: see those Articles.

SANHEDRIM, or *Sanhedrin*, among the Jews, the great council of the nation, consisting of 70 senators, taken partly from among the priests and levites, and partly out of the inferior judges, who formed what was called the *lesser sanhedrim*. The room they met in was a rotunda, half of which was built without the temple, and half within. The nasi, or president of the sanhedrim, sat upon a throne, with his deputy on his right-hand, his sub-deputy on his left, and the other senators ranged in order on each side. The authority of this council was very extensive; for they decided such causes as were brought before them by way of appeal from the inferior courts; and the king, the high-priest, and prophets, were under the jurisdiction of this tribunal. They had the right of judging in capital cases, and sentence of death might not be pronounced in any other place; for which reason the Jews were forced to quit this hall, when the power of life and death was taken out of their hands, 40 years before the destruction of the temple, and three years before the death of Christ. There were several inferior sanhedrims in Palestine, each of which consisted of 23 persons; all these depended on the great sanhedrim of Jerusalem.

SAP, a juice furnished by the earth, and changed into the substance of plants. See *CIRCULATION* and *PLANT*.

SAPPHIRE, a pellucid gem, which in its finest state, is extremely beautiful and valuable, and second only to the diamond in lustre, hardness, and price. Its proper colour is a pure blue; in the finest specimens it is of the deepest azure, and in others varies into paleness in shades of all degrees between that and a pure cry-

S A T

stal brightness and water, without the least tinge of colour, but with a lustre much superior to the crystal. They are distinguished into four sorts, viz. the blue sapphire, the white sapphire, the water sapphire, and the milk sapphire. See *MINERALOGY*.

SARCASM, in rhetoric, a keen bitter expression which has the true point of satire, by which the orator scoffs and insults his enemy; such as that of the Jews to our Saviour; "He saved others, himself he cannot save."

SARCOCELE, in surgery, a spurious rupture, or hernia, wherein the testicle is considerably tumefied or indurated like a scirrhus, or much enlarged by a fleshy excrescence, which is frequently attended with acute pains, so as to degenerate at last into a cancerous disposition. See *HERNIA*.

SARDONYX, in mineralogy, a genus of semi-pellucid gems, of the onyx structure, zoned or tubulated, and composed of the matter of the onyx variegated with that of the red or yellow Cornelian. See *CORNELIAN* and *ONYX*.

SARSAPARILLA, in botany. See *SMILAX*.

SARTORIUS, in anatomy, a muscle of the thigh. For the origin, insertion, and use, see the *System*, Part II. For representation, see Plate II. Fig. 1. Table of Muscles, Art. 25.

SASAFRAS. See *LAURUS*.

SATELLITE, in astronomy, the same with a secondary planet or moon. See the *System*, Sect. VIII.

SATIRE, in literature, a discourse, or poem, exposing the vices and follies of mankind. Satire may be distinguished into two kinds; the jocose, or that which makes sport with vice and folly, and sets them up to ridicule; and the serious, or that which deals in asperity, and is severe and acrimonious. Horace is a perfect master of the first, and Juvenal much admired for the last. The one is facetious, and smiles: the other is angry and storms. The foibles of mankind are the object of one; but crimes of a deeper dye have engaged the other. They both agree however in being pungent and biting; and from a due consideration of the writings of these authors, who are our masters in this art, we may define satire to be, a free and often jocose, witty, and sharp poem, wherein the follies and vices of men are lashed and ridiculed in order to their reformation. Its subject is whatever deserves our contempt or abhorrence, (including every thing that is ridiculous and absurd, or scandalous and repugnant to the golden precepts of religion and virtue.) Its manner is *invektive*; and its end, *shame*. So that satire may be looked upon as the physician of a disordered mind, which it endeavours to cure by bitter and unfavourable, or by pleasant and salutary applications.

In writing satire, care should be taken that it be true and general; that is, levelled at abuses in which numbers are concerned; for the personal kind of satire, or lampoon, which exposes particular characters, and affects the reputation of those at whom it is pointed, is scarce to be distinguished from scandal and defamation. The style proper for satire is sometimes grave and animated, inveighing against vice with warmth and earnestness; but that which is pleasant, sportive, and with becoming raillery, bansters men out of their bad dispositions, has generally the best effect, as it seems only to play with their follies, though it omits no opportunity of making them feel the lash. The verses should be smooth and flowing, and the language manly, just, and decent.

Of well-chosen words some take not care enough,
And think they should be as the subject rough:
But satire must be more exactly made,

And sharpest thoughts in smoothest words convey'd.

Duke of Buck's ESSAY.

As to those satires of the serious kind, for which Juvenal is so much distinguished, the characteristic properties of which are, morality, dignity, and severity; a better example cannot be mentioned than a poem entitled, *London*, written in imitation of the third satire by Juvenal, by the late Dr. Samuel Johnson, who has kept up to the spirit and force of the original. Nor must we omit to mention Dr. Young's *Love of Fame the Universal Passion*, in seven satires; which, though characteristic, abound with morality and good sense. The characters are well selected, the ridicule is high, and the satire well pointed and to the purpose. Personal satire approaches too near defamation, to deserve any countenance or encouragement. Dryden's *Mack Flecknoe* is for this reason exceptionable, but as a composition it is inimitable. We have said thus much on the present subject, because there is reason to apprehend, that the benefits arising from well conducted satire have not been sufficiently considered. A satire may often do more service to the cause of religion and virtue, than a sermon; since it gives pleasure, at the same time that it creates fear or indignation, and conveys its sentiments in a manner the most likely to captivate the mind.

Of all the ways that wisest men could find
To mend the age and mortify mankind,
Satire well writ has most successful prov'd,
And cures, because the remedy is lov'd.

Duke of Buck's ESSAY.

But to produce the desired effect, it must be jocose, free, and impartial, though severe. The satirist should always preserve good-humour: and, however keen he cuts, should cut with kindness. When he loses temper, his weapons will be inverted, and the ridicule he threw at others, will retort with contempt upon himself: for

for the reader will perceive that he is angry and hurt, and consider his satire as the effect of malice, not of judgment; and that it is intended rather to wound persons than to reform manners.

Rage you must hide, and prejudice lay down:

A satyr's smile is sharper than his frown.

Burlesque poetry, which is chiefly used by way of drollery and ridicule, falls properly to be spoken of under the head of satire. An excellent example of this kind is a poem in blank verse entitled *The splendid Shilling*, written by Mr. John Philips, which, in the opinion of one of the best judges of the age, is the finest burlesque in the English language. In this poem the author has handled a low subject in the lofty style and numbers of Milton; in which way of writing Mr. Philips has been imitated by several, but none have come up to the humour and happy turn of the original. When we read it, we are betrayed into a pleasure that we could not expect: though at the same time, the sublimity of the style, and gravity of the phrase, seem to chastise that laughter which they provoke.

There is another sort of verse and style, which is most frequently made use of in treating any subject in a ludicrous manner, viz. that which is generally called *Hudibrastic*, from Butler's admirable poem entitled *Hudibras*. Almost every one knows, that this poem is a satire upon the authors of our civil dissensions in the reign of Charles I. wherein the poet has, with abundance of wit and humour, exposed and ridiculed the hypocrisy or blind zeal of those unhappy times. In short, it is a kind of burlesque epic poem, which, for the oddity of the rhymes, and the quaintness of the similes, the novelty of the thoughts, and that fine raillery which runs through the whole performance, is not to be paralleled. The chief satyrists among the ancients are, Horace, Juvenal, and Persius; those among the moderns are, Regnier, and Boileau, in French; and Dryden, Oldham, Rochester, Buckingham, Pope, Young, &c. among the English.

SATURN, in astronomy, one of the planets of our solar system, revolving at the distance of more than 900 millions of miles from the sun. See the System, Sect. VIII.

SATYRIASIS, in medicine, is a violent desire of venery, attended with a tension and rigidity of the pudendum, occasioned by a morbid disposition of the body. It takes its name, as some will have it, from the relation it bears to satyrs, who, according to ancient fable, are a kind of demons, extremely addicted to wine and venery: or, as others say, from the herb Satyrion, which has an extraordinary power of exciting venereal desires. Antecedent causes of this disorder are medicines taken as provocatives to venery: which are acrimonious, incentive, or prejudicial to the nerves. Or the disease may be occasioned by an intemperate and unseasonable indulgence in venery. It is an affection common to both sexes. See PRIAPISM. For the methods of treatment, See the System, Genus 68 and 69.

SAVIOUR, an appellation peculiarly given to Jesus Christ, as being the Messiah and Saviour of the world. See JESUS CHRIST.

Order of St. Saviour, in Romish church. By the constitutions of this order, it is principally appointed for women, who are to pay a particular honour and service to the Virgin. The monks are only to afford them the spiritual assistances they may need, to administer them the sacraments, &c. The number of nuns is fixed to sixty in each monastery, and that of monks to thirteen, according to the number of apostles, whereof St. Paul makes the thirteenth. Four of them are to be deacons, to represent the four doctors of the church, and eight converts; the whole number making seventy-two, the number of the disciples of our Saviour.

SCALA, in anatomy, the cochlea, or inner cavity of the ear, is divided by a septum into two canals, called *scales*, whereof the one, looking towards the tympanum, is called the *scala tympani*; the other, having a communication with the vestibulum, is called the *scala vestibuli*. See the System, Part VII. Sect. IV.

SCALE, a mathematical instrument, consisting of one or more lines drawn on wood, metal, or other matter, divided into equal or unequal parts, of great use in laying down distances in proportion, or in measuring distances already laid down. There are scales of several kinds, accommodated to the several uses, the principal are, the *plain scale*, the *diagonal scale*, *Gunter's scale*, and the *plotting scale*.

SCALE, in music, sometimes denominated a gamut, a diagram, a series, an order, a diapason. It consists of the regular gradations of sound, by which a composer or performer, whether in rising or descending, may pass from any given tone to another. See the System, Definition I. For representation of the scales of the respective instruments, see Plate II.

SCALES of fishes make a set of very curious objects for the microscope; they are formed with a surprising beauty and regularity, and in the different kinds exhibit almost an endless variety in their figure and contexture. These scales are not supposed to be shed every year, nor during the whole life of the fish, but to have an annual addition of a new scale growing over and extending every way beyond the edges of the former, in proportion to the fish's growth, somewhat in the manner that the wood of trees increases annually, by the addition of a new circle next the bark. And as the age of a tree may be known by the number of ringlets its trunk is made up of, so in fishes, the number of plates composing their scales

denotes to us their age. Mr. Leewenhoeck took some scales from an exceeding large carp, forty-two inches and a half long, Rhineland measure, which were as broad as a dollar, these he macerated in water, to make them cut the easier, and then cutting obliquely through one of them, beginning with the first formed, or very little shell in the center, he by his microscope plainly distinguished forty lamellæ, or scales, glewed, as it were, to one another, whence he concluded the fish to be forty years old.

SCALENUS, in anatomy, the name of a muscle. For its origin, insertion and use, see the System, Table of Muscles, Art. 18.

SCALLOP, the English name of the species *Pecten*, belonging to the Genus *Ostrea*. See *OSTREA*, and the System of CONCHOLOGY, Order II. Genus 14.

In the highlands of Scotland the great scallop shell is made use of for the skimming of milk. In old times it had a more honourable place; being admitted into the halls of heroes, and was the cup of their festivity when the tribe assembled in the hall of their chieftain.

SCANNING, formed of *scandere*, to climb, in poetry, the measuring of a verse, to see what number of feet and syllables it contains, and whether or no the quantities, that is, the long and short syllables be duly observed. The term is chiefly used with regard to Greek and Latin verses; the quantities not being well settled and observed in the verses of the modern languages. Hexameters are scanned one way, iambics another, sapphics another.

SCAPULA, in anatomy, *omoplate*, or *shoulder-blade*; a large broad bone, representing a scalenous triangle, situated on each side of the upper and back part of the thorax, from about the first rib down to the seventh. See the System, Part I. Sect. IV. Art. 1. and Plate I. Fig. 1. Letter a.

SCARABÆUS, the beetle, in entomology. For the generic and specific characters, and the classification, see the System, Order I. Genus 1.

SCARBOROUGH Water. The water of this medicinal spring has been the subject of great contests and disputes among physical people, all allowing it considerable virtues, but some attributing them to one ingredient, others to another. Dr. Witty alledges that its material principles are allum, nitre, and vitriol of iron; but though this author declares that these principles are all to be separated out of it, Dr. Tonstall, on the other hand, affirms, that it has no vitriol of iron in it, but a stone powder and a clay, leaving sand at the bottom of the vessel; and therefore that it is apt to breed the stone, and is bad in the gout, jaundice, and all other diseases, where indurations of the parts, or stony concretions in the body, are the cause; and this author seems to speak very experimentally, when he alledges that he never had any symptoms of the stone till he drank the Scarborough water, but acquired that disease during the course of it.

Allum-stone dissolved in water is always found to yield a purple tincture with galls, and therefore the colouring an infusion of this or other vegetable substances by the Scarborough water, which is by all allowed to contain this stone, is no proof of any vitriol of iron being contained in it, other than such a small quantity of it as is always found in this allum-stone. All waters which have dissolved iron, will yield vitriol as a salt from that metal, on evaporation. The cliffs about Scarborough yield abundance of salt in shoots and effervescences, plainly owing to the waters of the springs; yet all these are nitro-aluminous, none of them at all vitriolic. If the Scarborough water is set by some days, after it is taken fresh from the spring, it precipitates a sediment; which being examined, is found not to be of a feruginous nature, but a mere glebe of allum. Upon the whole, the virtues of allum and vitriol are so far different, that it must be easy to see which of the two salts the water partakes most of, by its virtues; but as to the stony matter, which one of these disputants calls an insipid clay, and the other a sandy stone, it is no other than spar, which is contained in all water; and which has been in general so far from being accused of breeding the stone in the bladder, that the general consent of mankind has seemed to esteem it a cure for that disorder. The spar, in the form of the lapis Judaicus and ostracites, and the very waters which are so impregnated with it as to encrust every thing with it that is put into them, are given for the cure of this disease. Phil. Trans. N° 85.

The waters of Scarborough are chalybeate and purging. Of these there are two wells, both impregnated with the same principles, in different proportions; though the purging well is the most celebrated, and the water of this is usually called the Scarborough water. When these waters are poured out of one glass into another, they throw up a number of air-bubbles; and if they are shook for some time in a phial close stopped, and the phial be suddenly opened before the commotion ceases, they displace an elastic vapour, with an audible noise, which shews that they abound in fixed air. At the fountain they have a brisk, pungent, chalybeate taste, but the purging water tastes bitterish, which is not usually the case with the chalybeate one. They lose their chalybeate virtues by exposure, and by keeping; but the purging water the soonest. They both putrify by keeping; but in time recover their sweetness. Four or five half pints of the purging water drank within an hour, give two or three easy motions, and raise the spirits. The like quantity of the chalybeate purges less, but exhilarates more, and passes off chiefly

chiefly by urine. These waters have been found beneficial in hectic fevers, weakness of the stomach, and indigestion; in relaxations of the system; in nervous, hysteric, and hypochondriacal disorders, in the green sickness, scurvy, rheumatism, and asthmatic complaints; in gleets, the fluor albus, and other preternatural evacuations, and in habitual costiveness. Elliot on Mineral waters, p. 187. See the Article WATER.

SCARLET, in dyeing, one of the six kinds of good reds. See the Treatise, Sect. II.

SCARLET Fever. For description, prognosis, and cure, see the System of MEDICINE, Genus 29.

SCENE, in its primary sense, denoted a theatre, or the place where dramatic pieces and other public shows were exhibited; for it does not appear that the ancient poets were at all acquainted with the modern way of changing the scenes in the different parts of the play, in order to raise the idea of the persons represented by the actors being in different places. The original scene for acting of plays was as simple as the representations themselves; it consisted only of a plain spot of ground proper for the occasion, which was in some degree shaded by the neighbouring trees, whose branches were made to meet together, and their vacancies supplied with boards, sticks, and the like; and to complete the shelter, these were sometimes covered with skins, and sometimes with only the branches of other trees newly cut down, and full of leaves. Afterwards more artificial scenes, or scenical representations were introduced, and paintings used instead of the objects themselves.

SCENOGRAPHY, (from the Greek, *σκηνη* scene, and *γραφω* description,) in perspective, a representation of a body on a perspective plane; or a description thereof in all its dimensions, such as it appeared to the eye. See the System, Sect. VII.

SCPTICISM, the doctrine and opinions of the sceptics; called also *Pyrrhonism*, from the name of its author. The term sceptic, in its original Greek, *σκηπτικός*, properly signifies *considerative*, and *inquisitive*; or a man who is ever weighing the reasons on one side and the other, without ever deciding between them. The ancient scepticism consisted in doubting of every thing, in affirming nothing, and in keeping the judgment in suspense on every subject. Sextus Empiricus makes scepticism to consist in a faculty of opposing all appearances, of making all, even contrary things, equally probable, and of proceeding first to an *εποχη*, or suspense of mind, and then to entire undisturbedness or tranquillity.

Plato refutes the great principle of the sceptics thus: when you say that all things are incomprehensible, do you comprehend or conceive that they are thus incomprehensible, or do you not? if you do, then something is comprehensible; if you do not, there is no reason we should believe you, since you do not comprehend your own assertion.

SCPTICS, a sect of ancient philosophers, founded by Pyrrho, whose distinguishing tenet was, That all things are uncertain and incomprehensible; that contraries are equally true; and that the mind is never to assent to any thing, but to keep up an absolute hesitancy or indifference. See SCPTICISM. The term sceptic, in its original Greek, *σκηπτικός*, properly signifies *considerative* and *inquisitive*; or, a man who is ever weighing reasons on one side and the other, without ever deciding between them: it is formed from the verb *σκηπταμαι*, I consider, look about, deliberate.

SCHIRRUS, in medicine and surgery, a hard indolent tumor formed gradually in the soft, glandulous part of the body; sometimes internal, and sometimes external. When a *schirrhous* tumor is accompanied with all, or most of these appearances, the disease is then called a CANCER. See CANCER.

SCHISM, (from the Greek, *σχισμα*, cleft, fissure,) in the general signifies *division* or *separation*; but is chiefly used in speaking of separations happening through diversity of opinions, among people of the same religion and faith. Thus we say the schism of the ten tribes of Judah and Benjamin, the schism of the Persians from the Turks and other Mahometans, &c. Among ecclesiastical authors, the great schism of the West, is that which happened in the times of Clement VII. and Urban VI. which divided the church for 40 or 50 years, and was at length ended by the election of Martin V. at the council of Constance. The Romanists number 34 schisms in their church. They bestow the name English schism on the reformation of religion in this kingdom. Those of the church of England again apply the term schism to the separation of the non-conformists, viz. the presbyterians, independents, and anabaptists, for a further reformation.

The word schism is used, in Scripture, in an indifferent sense; and, therefore, the lawfulness or unlawfulness of it is entirely to be determined by circumstances. In our own language, indeed, common use has affixed to the term an idea of guilt or reproach: but in this sense there can be no such thing as schism, except in cases where there is an obligation to unity and communion; so that in order to define the nature of it justly, we must find some centre of union, which is common to all Christians. This must be either uniformity of sentiment in matters of speculative belief, or in external modes of worship and discipline, which, in the nature of things, is impossible; or, if it be unreasonable to expect either of these, the only centre of unity that remains is charity and mutual forbearance, notwithstanding lesser differences, where there is an assent to all the necessary principles of Christian faith, and the pro-

fession of Christianity is proved to be sincere by a regular and virtuous life. However numerous the differences that subsist among Christians, as long as mutual charity is preserved, there cannot be the guilt of schism. Alienations of affections, and a turbulent communicating spirit, are the essence of schism, and not mere difference of opinion; not the use of different ceremonies, or of no ceremonies at all; or joining ourselves to any particular religious communion: for according to St. Paul, who in several passages, blames the Corinthians for divisions, or schisms among themselves, in the same community, this crime may be committed where there is no separation from a particular church, and consequently they that differ uncharitably, when they belong all to one or to distinct worshipping assemblies (and they alone) are *schismatic*.

SCHOLASTIC, *σχολαστικός*, something belonging to the schools, or that is taught in schools. See SCHOOL. Scholastic, *Scholasticus*, was a long time a title of honour, at first given only to such as distinguished themselves by their eloquence in declaiming, &c.

SCHOOL, *schola*, a public place wherein the languages, humanities, or other arts and sciences, are taught. Thus we say grammar-school, a writing-school, a school of natural philosophy, &c. School is also used for a whole faculty or sect, as Plato's school, the school of Epicurus, &c.

In painting, it is used as a term to distinguish the different manner of places and persons. Thus we say the Roman school, the Venetian school, the Flemish school, &c. Raphael's school, Titian's school, Da Vinci's school, &c. meaning their disciples, pupils, &c.

SCIATICA, in medicine, the gout, or rather rheumatism in the hip and thigh. For description, causes, prognosis, and methods of treatment, see the System, genus 21 and 22.

SCIENCE in philosophy, denotes any doctrine deduced from self-evident principles. Sciences may be properly divided as follows: 1. The knowledge of things, their constitutions, properties, and operations: this, in a little more enlarged sense of the word, may be called *φυσική*, or natural philosophy; the end of which is speculative truth. See PHYSICS. 2. The skill of rightly applying these powers, *πραγματική*. The most considerable under this head is ethics, which is the seeking out those rules and measures of human actions that lead to happiness, and the means to practise them, (see MORAL PHILOSOPHY) and the next is mechanics, or the application of the powers of natural agents to the uses of life. (see MECHANICS.) 3. The doctrine of signs, *σημαστική*; the most usual of which being words, it is aptly enough termed logic. See LOGIC. This, says Mr. Locke, seems to be the most general, as well as natural, divisions of the objects of our understanding. For a man can employ his thoughts about nothing but the contemplation of things themselves for the discovery of truth: or about things in his own power, which are his actions, for the attainment of his own ends; or the signs the mind makes use of both in the one and the other, and the right ordering of them for its clearer information. All which three, viz. things as they are in themselves knowable, actions as they depend on us in order to happiness, and the right use of signs in order to knowledge, being *into* *caro* different, they seem to be the three great provinces of the intellectual world, wholly separated and distinct one from another.

SCIENCE is also used for a former system of any branch of knowledge, comprehending the doctrine, reason, and theory, of the thing, without any immediate application thereof to any uses or offices of life. In this sense the word is used in opposition to art. See the Articles ART and DICTIONARY.

Academy of SCIENCE. See ACADEMY.

SCIENTIFIC, or SCIENTIFICAL, something relating to the pure, sublimer sciences; or that abounds in science or knowledge. A work, a method, &c. is said to be scientific, when it is founded on the pure reason of things, or conducted wholly on the principles thereof. In which sense the word stands opposed to narrative, arbitrary, opinionative, positive, tentative, &c.

SCIURIS, the Squirrel, in the System of Mammalia, a Genus belonging to the order of Glires. It has two fore-teeth in each jaw, the superior ones shaped like wedges, and the inferior ones compressed. There are 11 species; of which the most remarkable are, The vulgaris, or common-squirrel, with ears terminated with long tufts of hair; larger, lively, black eyes; head, body, legs and tail, of a bright reddish brown; breast and belly white; hair on each side the tail lies flat. In Sweden and Lapland it changes in winter into grey. In Russia it is sometimes found black. In many parts of England there is a beautiful variety, with milk-white tails. It is a neat, lively, active animal; lives always in woods; in the spring, the female is seen pursued from tree to tree by the males, feigning an escape from their embraces. The striatus or ground squirrel, with plain ears; ridge of the back marked with a black streak; each side with a pale yellow stripe, bounded above and below with a line of black; head, body, and tail, of a reddish brown: the tail the darkest: breast and belly white; nose and feet pale red; eyes full. Inhabits the north of Asia, but found in the greatest abundance in the forests of North America. They never run up trees except they are pursued and find no other means of escaping; they burrow, and form their habitations under ground, with two entrances, that they may get access to the one in case the other is stopped up. Their retreats are formed with great skill, in form of a long

a long gallery, with branches on each side, each of which terminates in an enlarged chamber, as a magazine to store their winter provision in; in one they lodge their acorns, in another the maize, in a third the hickory nuts, and in the last their favourite food, the chinquapin chestnut. They very seldom stir out during the winter, at least as long as their provisions last. The volans or flying squirrel, with round naked ears, full black eyes, and a lateral membrane from the fore to the hind legs. It leaps from bough to bough, sometimes at the distance of ten yards: this action has improperly been called flying, for the animal cannot go in any other direction than forward; and even then cannot keep an even line, but sinks considerably before it can reach the place it aims at. For representation of these several species, see Plate VII. Order IV. Genus 25.

SCLEROTICA, in anatomy, one of the common membranes of the eye, situate between the adnata and the uvea; it is very firm and opaque behind, but transparent before. Though, in strictness, it is only the hind part that is called *sclerotica*, the fore-part being properly called the *cornea*. The sclerotica is a segment of a larger spheroid than the cornea. See the System, Part VII. Sect. IV.

SCOLOPAX, in ornithology, a genus belonging to the order *Gralla*. The back is cylindrical, obtuse, and longer than the head; the nostrils are linear; the face is covered, and the feet have four toes. There are 18 species; of which the two following are the principal. The arquata, or curlew, frequents our sea-coasts and marshes in the winter time, in large flocks, walking on the open sands, feeding on shells, frogs, crabs, and other marine insects. In summer they retire to the mountainous and unfrequented parts of the country, where they pair and breed. For classification, see the System; for representation, see Plate VI. Genus 67. The rusticola, or woodcock, during the summer, inhabits the Alps of Norway, Sweden, Polish Prussia, the marsh of Brandenburg, and the northern parts of Europe; they all retire from those countries the beginning of winter, as soon as the frosts commence; which force them into milder climates, where the ground is open, and adapted to their manner of feeding. They live on worms and insects, which they search for with their long bills, in soft ground and moist woods. Woodcocks generally arrive here in flocks, taking advantage of the night or a mist; they soon separate; but before they return to their native haunts, pair. They feed and fly by night; beginning their flight in the evening, and return the same way or through the same glades to their day retreat. They leave England the latter end of February, or beginning of March; not but they have been known to continue here accidentally.

SCOLOPENDRA, in entomology, a genus belonging to the order *Aptera*. For classification, see the System, Order VII.

SCOMBER, in ichthyology, is a distinct genus of the Thoracic order. The scomber, or common mackerel, is a fish of passage that visits our shores in vast shoals in the months of May and June. It is less useful than other species of gregarious fish, being very tender and unfit for carriage; not but that it may be preserved by pickling and salting, a method, we believe, practised only in Cornwall, where it proves a great relief to the poor during winter. For the generic and specific characters, and the classification, see the System, Order IV.

SCORPIO, in entomology, a genus of insects belonging to the order *Aptera*. For description and classification, see the System, Order VII. Genus 85.

Of all the class of noxious insects the scorpion is the most terrible, whose shape is hideous, whose size among the insects is enormous, and whose sting is generally fatal. Happy for Britain, the scorpion is entirely a stranger among us! In several parts of the continent of Europe it is but too well known, though it seldom grows above four inches long; but in warm tropical climates, it is seen a foot in length, and in every respect as large as a lobster, which it somewhat resembles in shape. There have been enumerated nine different kinds of this dangerous insect, including species and varieties, chiefly distinguished by their colour. The belly is divided into seven little rings; from the lowest of which is continued a tail, composed of six joints, which are bristly, and formed like little globes, the last being armed with a crooked sting. This is that fatal instrument which renders this insect so formidable; it is long, pointed, hard, and hollow; it is pierced near the base by two small holes, through which, when the animal stings, it ejects a drop of poison, which is white, caustic, and fatal. Some experiments were tried upon a dog, and even with aggravated cruelty; yet the dog seemed no way affected by the wounds; but, howling a little when he received them, continued alert and well after them; and soon after was set at liberty, without showing the smallest symptoms of pain; so far was this poor creature from being terrified at the experiment, that he left his own master's house, to come to that of the philosopher, where he had received more plentiful entertainment. Experiments were tried by fresh scorpions upon seven dogs, and upon three hens; but not the smallest deadly symptom was seen to ensue. From hence it appears, that many circumstances, which are utterly unknown, must contribute to give efficacy to the scorpion. The success of this experiment may serve to show, that many of those boasted antidotes which are given for the cure of the scorpion's sting, owe their success rather to accident than their own efficacy. Such is the terrible and unrelenting nature of this insect, which neither the bonds of society nor of nature.

ture can reclaim; it is even asserted, that when driven to an extremity, the scorpion will often destroy itself. The experiment was ineffectually tried by Maupertius; "But," says Mr. Goldsmith, "I am so well assured of it by my eye-witness, who have seen it both in Italy and America, that I have no doubt remaining of its veracity. A scorpion, newly caught, is placed in the midst of a circle of burning charcoal, and thus an egress prevented on every side: the scorpion, as I am assured, runs for about a minute round the circle, in hopes of escaping; but finding that impossible, it flings itself on the back of the head: and in this manner the undaunted suicide instantly expires."

SCORPIO, in astronomy, the eighth sign of the zodiac, denoted by the character π . See the System, Sect. IX.

SCOTIA, one of the regular mouldings in architecture, used to separate and distinguish other mouldings. See the System, Plate VI. Fig. 3.

SCOURINGS, among farriers, such gentle purges as preserve horses from noxious humours: see the System, Class IX. Sect. XXVII.

SCREW, in mechanics, one of the six mechanical powers: chiefly used in pressing or squeezing bodies close, though sometimes also in raising weights. It is not a simple machine, because it is never used without the assistance of other powers, and then it becomes a compound engine of great force in effecting the purposes for which it is constructed. By the combination of these powers all great weights are raised to a considerable height. For a particular description of its construction and uses, see the System Sect. III. No. 6. For representation, see Plate III. Fig. 14, 15, 16.

Archimedes's SCREW, or the *Spiral Pump*, is a machine for the raising of water, first invented by Archimedes. For its structure and use, see the System of HYDRAULICS, Article IX. For representation and the mode of operation, see the Plate, Fig. 23, 24, and 25.

SCROFULA, in medicine, scirrhus tumours, arising usually about the neck, and sometimes on other glandulous parts. For description, causes, prognosis, &c. see the System, Genus 58.

SCROLL, in heraldry, is the ornament placed under the escutcheon, containing a motto, or short sentence, alluding sometimes to the bearings, or the bearer's name; sometimes expressing somewhat divine or heroic; sometimes enigmatical. See the System, Sect. VII. Article IX.

SCROTUM, in anatomy, the common capsula or membrane, wherein the testicles are contained; thus called from its resembling a pouch or purse of leather, called by the ancients *scortea*. See the System, Part III. Sect. XV. Art. I.

SCULPTURE, *Sculptura*, the art of cutting or carving, wood, stone, or other matter, and forming various figures and representations therein; as also of fashioning wax, earth, plaster, &c. to serve as models, or moulds, for casting of metalline figures. Sculpture, in its latitude, includes both the art of working en creux, properly called ENGRAVING; and of working in rilievo, which is what we more strictly call sculpture. The antiquity of this art is past doubt; as the sacred writings, the most ancient and authentic monuments we have of the earliest ages, mention it in several places; witness Laban's idols, stolen away by Rachael, and the golden calf which the Israelites set up in the desert, &c. But it is very difficult to fix the original of the art, and the first artists, from profane authors; what we read thereof being greatly intermixed with fables, after the manner and taste of those ages. The first works in sculpture were clay, not only in making statues, but in forming models; and to this day a sculptor never undertakes any thing considerable, without forming a model either in clay or wax. In making figures of these materials, they begin and finish their work with their hands, using only three or four pieces of wood, which are roundish at one end, and at the other flat, with a sort of claws and teeth, which are to smooth and scratch the work. For waxen models, for every pound of wax add half a pound of colophony; some add turpentine, and melt it together with oil of olives, more or less of the latter being used as they would have the matter harder or softer; some also add a little vermilion, to give it a colour; this is wrought and moulded with the fingers, like clay.

Although the arts had lain dead for many centuries, they no sooner felt the genial warmth of protection in the generosity of Lorenzo de Medicis, Leo X. Cosmo, grand duke of Tuscany, &c. than they started into being, like a man awoke from sleep, and appeared in their maturity, as it were, instantaneously. The truth of this remark will appear in an enumeration of some of the chief productions of several eminent modern artists. Lorenzo Ghiberti produced the fine gates of St. John the Baptist at Florence; Donatelli executed the groupe of Judith and Holofernes in the great square of that city, and a bas-relief in the church of St. Croce; Michael Angelo formed the statue of Moses in St. Peter's de Vinculis, at Rome, a Bacchus in the gallery of Florence, and some figures on the monuments of the sepulchral chapel in that place; John of Bologna produced the rape of the Sabines in the great square at Florence, the large fountain in the great square at Bologna, and the fine horse at the Pont Neuf, at Paris; Rofconi and Algardi formed many statues and monuments of Popes, &c. in St. Peter's, and the latter executed a large bas-relief in the same church, representing Leo I. going out to meet king Attila,

whereby he saved the city of Rome from destruction, about the year 450; to Bernini we are indebted for the chair of St. Peter, supported by the four fathers of the church; the monuments of the Popes Urban VIII. and Alexander VII. and the large fountain in the Piazza Navona; and to Francis Quesnoy, surnamed the Flemish, for a beautiful statue of Christ, another of Susanna, and a fine one of St. Andrew, in St. Peter's; the reputation of this artist for boys is unparalleled both among the ancients and moderns. In France, the principal artists in sculpture have been Jean Goujoin cotemporary with Michael Angelo, who formed the fountain in the Rue of St. Denis, at Paris, some fine caryatides in the Louvre, and the sculptures at the gate of St. Anthony; Puget, celebrated on account of the sculptures at the gate of the town-house at Marseilles, the statue of St. Sebastian at Genoa, and that of Milo at Versailles; and Girardon, for the monument of cardinal Richelieu, at the Sorbonne; the equestrian statue of Louis XIV. at Paris, and the rape of Proserpine, at Versailles. For these last sculptors we are indebted to the munificence of Louis XIV.

We are not without some excellent specimens of sculpture in England. The statues of Frenzy and Melancholy on the piers before Bethlem-hospital, deserve to be ranked amongst the first performances in this art: they were executed, in the reign of Charles II. by Cibber, the father of the poet-laureat of that name. There is also a most elegant statue of King Edward VI. in bronze, which stands in one of the courts of St. Thomas's hospital, in Southwark, by Skeeemaker, and one of Sir Isaac Newton, at Cambridge, by Roubiliac. Westminster-abbey is the most famous repository of sculpture in England; but the figures that are here preserved lose much of their effect, by being crowded together, without any orderly arrangement; the monument of the duke of Argyle, and of Mrs. Nightingale, both by Roubiliac, and Dr. Chamberlain's, by Skeeemaker; seem to stand highest in the public opinion. It is probable that sculpture is more ancient than painting; and if we examine the style of ancient painting, there is reason to conclude, that sculpture stood first in the public esteem: as the ancient painters have evidently imitated the statuary, even to their disadvantage; since their works have not that freedom of style, more especially with respect to their composition and drapery, which the pencil might easily acquire to a greater degree than that of the chisel; but as this is universally the case, it cannot be attributed to any thing else besides the higher estimation of the works on which they formed themselves. Which is the most difficult art? has been a question often agitated. Painting has the greatest number of requisites, but at the same time her expedients are the most numerous; and, therefore, we may venture to affirm, that, whenever sculpture pleases equally with painting, the sculptor is certainly the greatest artist. Sculpture has indeed had the honour of giving law to all the schools of design, both ancient and modern, with respect to purity of form. The reason, perhaps, is, that being divested of those meretricious ornaments, by which painting is enabled to seduce its admirers, it is happily forced to seek for its effect in the higher excellencies of the art; hence elevation in the idea, as well as purity and grandeur in the forms, is found in greater perfection in sculpture than in painting. Besides, whatever may be the original principles which direct our feelings in the approbation of intrinsic beauty, they are, without doubt, very much under the influence of association. Custom and habit will necessarily give a false bias to our judgment: it is, therefore, natural, and in some measure reasonable, that those arts which are transitory, should adapt themselves to the changes of fashion, &c. But sculpture, by its durability, and consequent application to works of perpetuity, is obliged to acquire and maintain the essential principles of beauty and grandeur, that its effect on the mind may be preserved through the various changes of mental taste. It is conceived, that it will scarcely admit of a question, whether the ancients or moderns have most excelled in this art? the palm having been so universally adjudged to the former. To determine in what proportion they are superior is too difficult an attempt. Wherever there is a real superiority in any art or science, it will in time be discovered: but the world, ever fond of excess, never stops at the point of true judgment, but dresses out its favourite object with the ornaments of fancy, so that even every blemish becomes a beauty. This it has done by ancient sculpture to such a degree as not to form its judgment of that by any rules, but to form an opinion of rules by the example. As long as this is the case, modern art can never have a fair comparison with the ancient. This partiality to the ancients is so strong as to prevent almost all discrimination; and is the sole reason, why many antiques, that now stand as patterns of beauty in the judgment of most connoisseurs, are not discovered to be copies. This is not more important than it is easy to be perceived by a judicious eye; for wherever there is a grandeur or elegance to an eminent degree in the idea and general composition of a statue, and when the execution of the parts (called by artists the treating of the parts) betrays a want of sense and feeling, there is the greatest reason to conclude that the statue is a copy, though we were ever so certain of its antiquity. And surely if evidence of a picture being a copy proportionably diminishes its value, the same rule of judgment may be no less properly applied to a statue. Modern and ancient art can never, therefore, be fairly compared, till both are made to submit to the determination of reason and nature.

It may be observed, that the ancients have chiefly confined themselves to the sublime and beautiful; and whenever a pathetic subject has come before them, they have sacrificed expression to beauty. The famous groupe of Niobe is one instance of this kind; and, therefore, however great our partiality to the ancients may be, none can hesitate to affirm that whenever the moderns shall unite great expression with great beauty, they will wrest the palm out of their hands.

SCURVY, in medicine, a disorder of the putrid kind. For description, causes, prevention, and cure, see the System, Genus 60.

SCURVY-GRASS, in botany, the officinalis, or common official scurvy-grass; grows upon rocks on the sea-coast, and on the Highland mountains, abundantly. It has an acrid, bitter, and acid taste, and is highly recommended for the scurvy. There are instances of a whole ship's crew having been cured of that distemper by it; and as it abounds with acid salts, there can be no doubt but that it is a great resister of putrefaction. The best way of taking it is raw in a salad. It is also diuretic, and useful in dropsies. The Highlanders esteem it as a good stomachic.

SEA, is frequently used for that vast tract of water encompassing the whole earth, more properly called ocean. What proportion the superficies of the sea bears to that of the land, is not precisely known, though it is said to be somewhat more than two-thirds. As the waters of the earth must necessarily rise to the surface thereof, as being specifically lighter than the earth, it was necessary there should be large cavities therein for receptacles to contain them; otherwise they would have overspread all the superficies of the earth, and so have rendered it uninhabitable for terrestrial animals; for the centre of the earth being the common centre of gravity, and the nature of fluids being such that they equally yield to equal powers, and the power of attraction being every where equal at equal distances from the centre, it follows, that the superficial parts of the water will every where conform themselves to an equidistant situation from the centre, and consequently will form the surface of a sphere so far as they extend. With regard to the depth or profundity of the sea, Varenus affirms, that it is in some places unfathomable, and in others very various, being in certain places 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.

SEA, is more properly used for a particular part or division of the ocean; denominated from the countries it washes, or from other circumstances. Thus we say, the Irish Sea, the Mediterranean Sea, the Baltic Sea, the Red Sea, &c. Till the time of the emperor Justinian, the sea was common and open to all men; whence it is that the Roman laws grant an action against a person who shall prevent another in the free navigation or fishing therein. The emperor Leo, in his 36th novel, first allowed such as were in possession of the land the sole privilege of fishing before their respective territories, exclusive of all others; he even gave a particular commission to certain persons to divide the Thracian Bosphorus among them. From that time, the sovereign princes have been endeavouring to appropriate the sea, and to withdraw it from public use. The republic of Venice pretends to be so far mistress in her gulf, that there is a formal marriage every year between the seignory and the Adriatic. In these last ages, the British have particularly claimed the empire of the sea in the Channel; and even that of all the seas encompassing the three kingdoms of England, Scotland, and Ireland; and that as far as the shores of the neighbouring states. In consequence of which pretension it is, that children born on these seas are declared natural Britons, as much as if born on British ground. The justice of this pretension is strenuously argued between Grotius and Selden, in the *Mare Liberum*, and *Mare Clausum*.

SEA

SEA

General Motion of the SEA. Dr. Daffie of Paris, in a work published about eighty years ago, has been at great pains to prove that the sea has a general motion, independent of wind and tides, and of more consequence in navigation than is usually supposed. He affirms that this motion is from east to west, inclining toward the north, when the sun has passed the equinoctial, northward, and that during the time the sun is in the northern signs; but the contrary way, after the sun has passed the said equinoctial, southward; adding, that when this general motion is changed, the diurnal flux is changed also; whence it happens, that in several places the tides come in during one part of the year, and go out during the other, as on the coasts of Norway, in the Indies, at Goa, Cochinchina, &c. where, while the sun is in the summer signs, the sea runs on the shore; when in the winter signs, from it. On the most southern coasts of Tonquin and China, for the six summer months, the diurnal course runs from the north with the ocean; but the sun having repassed the line towards the south, the course declines also southward.

Encroachments by the SEA on the dry Land. It has been matter of dispute whether the land or the water are gaining upon each other in this terraqueous globe? and it is a dispute which seems not to be capable of an easy solution: in many places, it is certain that the sea has gained very considerably, and very recently too. In Britain, several considerable encroachments have been remarked. In the reign of Augustus, the Isle of Wight made part of the island of Britain, so that at low water the Britons crossed over towards it, with cart-loads of tin; but now the connection is cut off, and the Isle of Wight is constantly separated from Britain by a channel half a mile wide. And in other places the same encroachments are perceptible. In general, on the eastern coast, the sea has gained ground; while on the southern and western, it has gained in some places and lost in others. It has gained considerably on the coast of Yorkshire, Norfolk, Suffolk, Essex, and the eastern shore of Kent; as also that of Suffex, Hampshire, Dorsetshire, and Cornwall. Within this last half century, also, the sea has made large encroachments upon the isle of Scilly, and from May 1766 to May 1767, was observed to encroach considerably. It has also encroached upon the coasts of north Devonshire, Pembrokehire, and Cardigan-shire. But, on the other hand, in the southern parts of Kent, in Lincolnshire, and Lancashire, the land has gained upon the sea. In Kent, it has retreated from the beach of Sandwich, sunk the small estuary of Solinus into an insignificant current, and converted a fine harbour, called by the Romans *Rhutape*, where their fleet were regularly laid up, into a valley watered by a river. In Lincolnshire it has added a considerable quantity of ground to the coast, and left many thousand acres betwixt the old bank of its waters, and the present margin of its shore. And in Lancashire, the sands which originally formed the beach of the sea, and were covered every tide with its waters, are now regularly inhabited. They still retain the name given them by the Britons, *viz. Meales*, or *loose quaggy lands*; though, loose and quaggy as they once were, they are now cultivated, and a parochial church and village erected upon them. From considering these facts, we may doubt whether the sea, in fact, has gained on the land, or the land on the sea? as what is gained by either on one side, may perhaps be lost on the other. Buffon imagines that the sea is perpetually gaining upon the land, and will at last cover the tops of the highest mountains, leaving its present bed quite dry; but his notions concerning the gradual motion of the waters from one place to another have been so fully refuted, that it is needless to mention any thing concerning them in this place. Others there are who argue strenuously for the continual increase of dry land, and decrease of the sea. Their principal argument is drawn from a supposition of the vegetation of stone, and a petrifying quality inherent in sea-water.

A gentleman, who was at Boulogne in the summer 1780, has favoured us with a remarkable instance of this petrifying quality in sea-water. He observed that the British channel, which washes the bottom of a hill near that place (commonly called *Cæsar's Fort*, from a Roman encampment still visible on it, said to have been constructed by Julius Cæsar, when he invaded Britain) had worn in through a great part of the hill, which consists mostly of mixed sand, with about three or four feet of a strong bluish clay soil above. As the sandy part is washed away, the clay falls down in large masses, and, as the inhabitants there affirm, is petrified by the salt water. In fact, one sees, about 40 or 50 yards within the present high-water mark, a large stratum of rocks, much resembling the black rocks at Leith; and between these and the hill many huge masses of rock, though there appears nothing rocky on the bare side of the hill next the channel. And the inhabitants of Boulogne are every day seen blowing up these rocky masses with gunpowder, burning the stones in lime, and using them also as stones for their buildings. This gentleman, walking one day on the sands, saw a large lump of clay fallen from the hill, and so lying to be washed by the tide. He impressed a mark on it with his stick, which, being soft, it then easily received. But passing the same way about three weeks afterwards, he could not force his stick into the same lump.

From some limestone quarries, also, in the neighbourhood of Kirkcaldy in Fife; it is inferred that stones vegetate, and that the waters of the sea have retreated ever since the deluge. These two

causes, say the abettors of this doctrine, in a long series of ages, alter the face of our globe entirely, or rather have reduced the earth into its present form, by creating rocks at the bottom of the sea, and then leaving them in dry land, where they turn into inland mountains. This seems to be the method which nature observes: for all along our coasts there are limestone rocks, and some of them within low-water mark, which have the very same inclination, and the same mixture of petrified sea-bodies, as in the quarry we have described; but since we see rocks of this kind arising out of the sea, we must of necessity ascribe the same origin to such as are more remote from the shore, and left up in the country. All rocks, therefore, where such extraneous bodies are found, seem to be formed from the common sediment of the sea, as sands of several kinds, with the bones of fishes, stalks of sea-weed, and empty shells, which are all rolled into beds by the agitation of the waters. These different bodies, thus blended together, are, by the violence of the flux and reflux, banked up towards the shore: which is the cause of the inclination or dipping of the rock. No sooner is one stratum laid, than, by a continual accession of the same matter, a second is superinduced; and so on successively, till the mass has reached a certain height in water. These loose materials, as soon as the vegetation commences, are fastened by a very strong cement, and begin to assume the consistency of stone. For the petrific matter fills up all the interstices, pervades the pores of the most solid bodies, and lodges every where the particles that enter into its own composition; which seems to be a fixed salt, or very powerful astrigent, together with a mixture of mineral juices or metallic ores, which run in small veins, like wire, in several places of the rock. The shells, being of a close and compact texture, and therefore refusing admission to the grosser parts, seem to have received only the finer parts of the mixture, which has converted them into a transparent substance, somewhat resembling crystal. The sea-weeds, of a more porous and spongy nature, have imbibed the whole lapidific matter; which has changed them into a fine white marble, capable of a very high polish. The like may be said of all the other bodies, as they are more rare or dense in their texture, and fitted to receive more or less of the petrific matter. The only difficulty in this hypothesis, and what we must endeavour to surmount, is, that we must conceive the sea to be so high as to cover all the hills where such sea-bodies are to be found. So, in the present case, we must suppose it to have been above 200 feet higher than it is at present. Now, though neither history nor tradition could assist us in the enquiry, yet still the fact may be ascertained from indelible monuments, and more to be depended on than any human testimony whatever. For since our inland hills have the very same inclination, and the same mixture of shells, &c. as the rocks have which stand within low-water mark; what can we think, but that the former once stood where the latter stands now? why may we not conclude for certain that, according to their distances, they have all successively arisen from the sea, as the only proper matrix for such productions, and the only place, too, where the materials that enter into their composition can be found? In short, by means of these petrified sea-bodies, we trace the waters which drowned the old world, like an enemy who leaves his spoils behind him in his retreat, from the tops of our highest inland hills down to the shore; and there see them all confined within the limits of our present sea, which seems still to be making the proper dispositions for leaving us. Historians, when all our helps fail, produce medals and gold coins, as an authentic evidence of certain facts; in like manner, we may look upon sea rocks, turned into inland hills, to be an undeniable proof that our earth hath arisen, inch by inch, from the sea.

The age of man bears so small a proportion to the age of the world, that the insensible changes made on the face of nature pass unobserved. We see so few alterations in our own times, that we conclude, too hastily, that there are none at all; or, when the land makes any encroachments in one place, the sea, we imagine, takes her revenge by inundations in another, and that in this manner their limits are pretty well secured. But this is undoubtedly a very lame account of the matter. For inundations seldom happen, and are but partial; whereas the recesses of the waters is universal, and, like the other great laws of nature, act incessantly at all times. An earthquake in one place, the washing of loose sands and earths in another, may lay some particular spot under water; but these will by no means balance the encroachments of the land, remarkable more or less all over the globe. We will give but two or three instances, out of many which, with equal facility, might be produced.

The island Pharos, according to Homer, who perhaps spoke from experience, stood a day's sailing with a fair wind from the continent. That island, however, was joined to the land, in very ancient times, by a causeway of 900 paces, and makes now a part of the city of Alexandria. The city of Tyre, before the time of Alexander the Great, and for some ages after, was surrounded with a very deep sea, of four fathoms over; and yet we know for certain, it has been joined to the continent upwards of 1000 years. Æneas landed at Lavinium, if we can believe Virgil; but Lavinium stands now above 12 miles from the sea, and as rich vineyards and corn-fields as age in Italy must for ever go by the name of the *Lavinian shores*. Ostia, too, has undergone the same fate,

late, and become an inland town. Nothing but the express authority of historians, and its own stately ruins, could convince us that it was the celebrated Ostia, built at the mouth of the Tiber. The same observations may be extended to all the maritime towns famous in ancient history: their old harbours are now all choked up, buried under ground, or deserted by the sea, and left far up in the country. Nor is there much weight in an objection that may be started in this place, namely, that there are several seaport towns, famous in the ancient world, which have the same character in our own times. So, London, under the emperor Nero, was, as it still is, a rendezvous of merchants, and a place of great foreign trade. But are we sure that these towns, though they have the same names, occupy all the same spots of ground with the old ones? Is it not more probable, that the inhabitants, not out of choice, but absolute necessity, and for the convenience of shipping, draw gradually down towards the sea, as the rivers choke up towards their sources? This we know has happened to some, and we have great reason to believe the same of all.

We may produce several very strong circumstances, which, taken all together, will amount to the force of a direct proof that the land has gained very considerably on our coasts. Whoever views the Carle of Falkirk from Stirling castle in Scotland, will think it extremely probable, that all that champaign country, as the ancients believe of the Lower Egypt, has been gained from the sea, by the vast quantity of sand and mud brought down the river. To confirm this conjecture, whenever the ground is digged, in several places thereabouts, they meet with vast collections of shells and other spoils of the sea. A ship's anchor was found, some time since, in the same country, buried under ground, at two miles' distance from the Forth. These two circumstances put it out of all doubt, nor need we any further proof of the matter. We have nothing but the name to inform us, that ever Burnt-island was surrounded with the sea; but whoever views the situation of that place, will be convinced, that, not many centuries ago, it has been joined to Fife by a narrow and flat neck of land to the north. The inhabitants of Kirkcaldy, even those of a middle age, remember to have seen the tides flow a great deal higher than they do at present. The truth of it is, our shores are insensibly rising, not only from the huge sand-banks, but from a vigorous vegetation of stone, which prevails, among all our coasts, at the bottom of the sea. For nature is as hard at work now as ever; and it is not improbable, but that these rocks, where there is such a mixture of sea-bodies, which but just show their heads above water, will occasion as much speculation to future ages as their elder brothers in the inland places of the country do to us.

The encroachments of the land in the frith of Tay are more remarkable, and seem to be of a more recent date. The whole Carle of Gowrie has been, we may say, but a late acquisition from the sea; as the flat face of the country, and names of the towns, sufficiently evince. Most of their towns begin or end with *infe*, that is, *island*; as Meg-infe, Infe-tower, &c. probably, the very names they went by when they were sand-banks, or islands surrounded by the sea. Some old written instruments mention Errol as a place standing to the south of Tay, though it stands a long mile to the north of the river at present. The inhabitants of the country have a tradition, that the course of Tay, in former ages, was by the foot of the hills to the north of Errol, and to this day they shew the very holes in rocks to which the ships cables were fastened. But if the Tay ran so far to the north, as there is great reason to believe, all the lower grounds to the south of Errol would be drowned, and that frith would be twice, if not thrice, as broad as it is in our time. The inhabitants of Perth remember to have heard their fathers say, that, in the high hill of Kinnoul, they have seen the remains of staples and rings, with other conveniences for shipping; as in a harbour. At a village two miles above Perth, and far from the Tay, some workmen draining a peat-marsh, found the ring, stock, and shaft of an anchor, with a great log of wood standing erect in the earth, to which it was conjectured the ships' cables were fixed. The children of the workmen were lately alive, to attest this fact.

These circumstances make it probable, that the land is continually usurping upon the sea, and may also reconcile us to what follows: for if the limestone quarry in the neighbourhood of Kirkcaldy was a sea-rock, as it undoubtedly was, our frith must have covered twice the extent of ground that it does at present. All the lower part of Fife, for some miles up the country, except some islands here and there, and which are now hills or high lands, would be laid under water. The Lothians must have shared the same fate with Fife: for the very spot on which Edinburgh stands, would be covered with water; the Castle-rock, Calton-hill, and Salisbury Craig, would be sea-rocks; Arthur's seat would be diminished almost to its head; and, with respect to the coast then, might appear what Infe Keith does to us. Northumberland and the Merse must have been in the same situation with the counties bordering on the Forth. The lower parts of these two counties would be deluged with a great sea, whose shores would be five or six miles westward from Berwick. The Tweed must have been so great a frith, that the largest ship in the present navy of England might have gone up the river, as far as Kelso, if not farther. We call places by their names which then had none. In this manner we might make the tour of Great Britain, and, by imagining the sea

to be 200 or 300 feet higher than it is at present, demonstrate that our island is larger, by a third at least, than it was at that time. Such has been the state of our island; in a very remote period of time, no doubt; though perhaps not in the ages immediately succeeding the deluge. On the contrary, it may be presumed, that many ages must have passed from the deluge to the period we are speaking of, as from thence to our own times. For we have all the reason in the world to believe, that, ever since the old world was drowned, the waters have fallen equally in equal times, and not faster at one time than at another, as is commonly imagined. The bare rocks on our highest hills shew sufficiently both the place where they have vegetated, and that for many ages they have borne the violence of that dreadful element; for it is impossible to conceive that they could have come out of nature's hands in the miserable and ruinous condition in which they appear. Their ragged tops, tattered surfaces, and rifted sides, are the wounds they have received from an obstinate foe; who, though vanquished at last, has made many furious attacks, and disputed every inch of ground, before he has retreated. These are some of the strongest arguments which have been advanced for the continual increase of the dry-land, and decrease of the sea. How far they appear conclusive, we leave to the judgment of the reader.

Luminousness of the SEA, is a phenomenon that has been taken notice of by many nautical and philosophical writers. Mr. Boyle, after reciting several circumstances attending this appearance, ascribes it to some cosmical law, or custom of the terrestrial globe, or at least of the planetary vortex. The Abbé Nollet was of opinion, that the light of the sea proceeded from electricity, and others have had recourse to the same hypothesis. Mr. Bayon, in his *Mémoires pour servir à l'Histoire de Cayenne*, &c. Paris, 1778, informs us, that, having made a great number of experiments, in different seasons, in order to find out the true cause of this phenomenon, he always found, that the luminous points in the surface of the sea were produced merely by friction. However, there have been two hypotheses, which have most generally been received, for the solution of this phenomenon; one of which ascribes it to the shining of luminous insects or animalcules, and the other to the light proceeding from the putrefaction of animal substances. The Abbé Nollet, who at first considered the luminousness of the sea as an electrical phenomenon, having had an opportunity of ascertaining the circumstances of it, when he was at Venice, in 1749, relinquished his former opinion, and concluded that it was occasioned either by the luminous aspect, or by some liquor or effluvia of an insect which he particularly describes; but does not altogether exclude other causes, and especially the spawn or fry of fish.

Mr. Forster in his account of a voyage round the world with captain Cook, in the years 1772, 1773, 1774, and 1775, describing this phenomenon as a kind of blaze of the sea, and having attentively examined some of the illumined water, expresses his conviction, that the appearance was occasioned by innumerable minute animals, of a round shape, moving through the water, in all directions. One of these luminous sparks which stuck to his finger while he was stirring the water with his hand, was examined by the common magnifier of Mr. Ramsden's improved microscope, and was found to be globular, transparent like a gelatinous substance, and somewhat brownish; by means of the greatest magnifier, the orifice of a little tube was discovered, which entered the body of the animal; within which were four or five intellial bags connected with the tube. He imagines that these animalcules may be the young fry of some species of medusa, or blubber, and considers them as possessed of the power of shining, or of withholding their light, at pleasure.

M. le Roi, after giving much attention to this phenomenon, concludes that it is not occasioned by any shining insects, especially as, after carefully examining with a microscope some of the luminous points, he found them to have no appearance of any animal; and he also found, that the mixture of a little spirit of wine with water just drawn from the sea, would give the appearance of a great number of little sparks, which would continue visible longer than those in the ocean: the same effect was produced by all the acids, and various other liquors. M. le Roi is far from asserting that there are no luminous insects in the sea; for he allows that the Abbé Nollet and M. Vianelli had found them; but he is satisfied that the sea is chiefly luminous on some other account, though he does not so much as offer a conjecture with respect to the true cause. Other writers, equally dissatisfied with the hypothesis of luminous insects, for explaining the phenomenon which is the subject of this article, have ascribed it to some substance of the phosphorous kind, arising from putrefaction. The correspondent of Dr. Franklin, observes, that several gentlemen have been of opinion, that the separated particles of putrid, animal, and other bodies, floating on the surface of the sea, might cause this appearance, for putrid fish, &c. will cause it; and the sea animals which have died, and other bodies putrified therein since the creation might afford a sufficient quantity of these particles to cover a considerable portion of the surface of the sea; which particles being differently dispersed, might account for the different degrees of light in this appearance: but he adds, this account seems liable to an obvious objection, viz. that as putrid fish, &c. make a luminous appearance without being moved or disturbed, it might be expected that

that the supposed putrid particles on the surface of the sea should always appear luminous, when there is not a greater light, and, consequently, that the whole surface of the sea covered with those particles, should always, in dark nights, appear luminous, without being disturbed, which, he says, is contrary to fact. Franklin's Experiments and Observations, p. 274, &c. This difficulty is, in a great measure, removed by the experiments of Mr. Canton, recited in the Philosophical Transactions, vol. lix. p. 446, &c. which have the advantage of being easily made, and leave no room for doubt that the luminousness of the sea is principally owing to putrefaction. Having put a fresh whiting into a gallon of sea-water, neither the whiting, nor the water, when agitated, gave any light; Fahrenheit's thermometer, placed in the cellar where the pan was placed, standing at 54°; the following evening, that part of the fish which was even with the surface of the water was luminous, but the water itself was dark, however, on drawing through it the end of a stick, the water appeared luminous behind the stick all the way, but gave light only where it was disturbed; when all the water was stirred, the whole became luminous, and appeared like milk, yielding a considerable degree of light to the sides of the pan, which it continued to do for some time after it was at rest. The water was most luminous when the fish had been in it about twenty-eight hours, but would give no light by being stirred after it had been in three days. He then put a gallon of fresh-water into one pan, and an equal quantity of sea-water into another, and into each pan he put a fresh herring, of about three ounces; the next night the whole surface of the sea-water was luminous without being stirred, but much more so when put in motion, and the upper part of the herring, which was considerably below the surface of the water, was also very bright; while, at the same time, the fresh-water, and the fish that was in it, were quite dark. There were several very bright luminous spots on different parts of the surface of the sea-water, and the whole, when viewed by the light of a candle, seemed covered with a greasy scum. The third night, the light of the sea-water, while at rest, was very little, if at all, less than before; but when stirred, its light was so great as to discover the time by a watch, and the fish in it appeared as a dark substance. After this its light was evidently decreasing, but was not quite gone before the seventh night: the fresh-water and the fish in it were perfectly dark during the whole time.

SEA-Bear. } See PHOCA.

SEA-Calf.

SEA-Cow. See TRICHECUS.

SEA-Crow, MIRE-Crow, or Pewit. See LARUS.

SEA-Horse.

SEA-Lion. } See PHOCA.

SEA-Water, that briny bitterish fluid which constitutes the sea. The saltness of this water is very rationally judged to arise from great multitudes both of mines and mountains of salt, dispersed here and there in the depths of the sea. Dr. Halley supposes that it is probable that the greatest part of the sea-salt, and of all salt lakes, as the Caspian Sea, the Dead Sea, the Lake of Mexico, and the Titicaca, in Peru, is derived from the water of the rivers they receive; and since this sort of lakes has no exit or discharge but by the exhalation of vapours, and also since these vapours are entirely fresh, or devoid of such particles, it is certain that the saltness of the sea, and such lakes, must from time to time increase, and therefore the saltness at this time is greater than at any time heretofore. He further adds, that if, by experiments made in different ages, we could find the different quantity of salt which the same quantity of water (taken up in the same place, and in all other the same circumstances) would afford, it would be easy from thence, by rules of proportion, to find the age of the world very nearly, or the time wherein it has been acquiring its present saltness.

With regard to the use of this salt property of sea-water, it is observed, that the saltness of the sea preserves its waters pure and sweet, which otherwise would corrupt and stink like a filthy lake, and consequently that none of the myriads of creatures which now live therein could then have a being. From thence also the sea-water becomes much heavier, and therefore ships of greater size and quantity may be used thereon. Salt-water also doth not freeze so soon as fresh water, whence the seas are more free for navigation. We have a dissertation, by Dr. Russel, concerning the medical uses of sea-water in diseases of the glands, &c. wherein the author premises some observations upon the nature of sea-water, considered as impregnated with particles of all the bodies it passes over, such as submarine plants, fish, salts, minerals, &c. and saturated with their several effluvia, to enrich it, and keep it from putrefaction; whence this fluid is supposed to contract a soapiness; and the whole collection, being pervaded by the sulphureous steams passing through it, to constitute what we call sea-water, the confessedly distinguished characteristics of which are saltness, bitterness, nitrosity, and unctuousity: whence the author concludes, that it may be justly expected to contribute signally to the improvement of physic. The cases in which our author informs us we are to expect advantages from the sea-water, are, 1. In all recent obstructions of the glands of the intestines and mesentery. 2. All recent obstructions of the pulmonary glands, and those of the viscera, which frequently produce consumptions. 3. All recent glandular swellings of the neck, or other parts. 4. Recent tumours of the

No. 138.

joints, if they are not suppurated, or become schirrhous or cancerous, and have not carious bones for their cause. 5. Recent defluations upon the glands of the eyelids. 6. All defordations of the skin, from an erysipelas to a lepra. 7. Diseases of the glands of the nose, with their usual companion, a thickness of the lip. 8. Obstructions of the kidneys, where there is no inflammation, and the stone not large. 9. In recent obstructions of the liver, this method will be proper, where it prevents constipations of the belly, and afflicts other medicines directed in iëteric cases. The same remedy is said to be of signal service in the bronchocele; and is likewise recommended for the prevention of those bilious colics that so frequently affect our mariners.

Freshening SEA-Water. The method of making sea-water fresh, an advantage long wanted for the benefit of navigation, is now found to be easily performed by the simple process of distillation in a common still. This method was published by Dr. Lind, some time ago, and cannot by any means be improved, as the process is already reduced to its utmost simplicity. A pretended improvement was afterwards proposed by Dr. Irvine; for which he had the dexterity not only to get the merit of Dr. Lind's discovery, but a premium of 5000l. The improvement, if such it may be called, consists only in having a very large tube instead of the worm of the common still, and a person to wet the tube constantly with a mop, instead of using a worm-tub.

SEAL, *Sigillum*, a punchon, or piece of metal, or other matter, usually either round or oval, whereon are engraved the arms, device, &c. of some prince, state, community, magistrate, or private person, often with a legend or inscription; the impression whereof in wax serves to make acts, instruments, &c. authentic. The king's great seal, is that whereby all patents, commissions, warrants, &c. coming from the king are sealed; this consists of two impressions, one being the seal itself, with the effigies of the king stamped upon it; the other has an impression of the king's arms in the figure of a target, for matters of smaller moment, as certificates &c. that are usually pleaded *sub pede sigilli*. The keeping hereof is in the hands of the lord-chancellor, who is hence also denominated *lord-keeper*. This office of lord CHANCELLOR, or lord KEEPER, whose authority, by 5 Eliz. c. 18, is declared to be exactly the same, is with us at this day created by the mere delivery of the king's great seal into his custody, without a writ or patent. The king's PRIVY-Seal is a seal usually first set to grants that are to pass the great seal. The use of seals is very ancient, an instance of which occurs in Daniel, chap. vi. 17; but seals are still older than this; for Jezebel, in 1 Kings, chap. xxi. seals the orders she sent for Naboth's death with the king's ring. See also Jerem. xxxii. 10, &c.

In England, the first sealed charter we find extant, is that of Edward the Confessor, upon his founding of Westminster Abbey; yet, we read of seals in the MS. history of king Offa. Before the time of William the Conqueror, the English did not seal with wax, but only made a golden cross on the parchment, and sometimes an impression on a piece of lead, which hung to the grant with a silken string, and was deemed an abundant authorizing of the grant itself, without either signing or witnessing. This practice of affixing the sign of the cross proceeded from their inability to write; which is honestly avowed by Caedwalla, a Saxon king, at the end of one of his charters: *propria manu pro ignorantia literarum signum sanctæ crucis expressi et subscripsi*. The same circumstance is related concerning the emperor Justin in the East, and Theodoric, king of the Goths in Italy.

SEASON. For an explanation of the causes of the different seasons of the year, see the System of ASTRONOMY, Sect. IV. Plate III. fig. 3.

SECANT, in geometry, is a line that cuts another, or divides it into two parts. See the System, Part I. Sect. I.

SECOND, in geometry, chronology, &c. the 60th part of a prime or minute, whether of a degree or of an hour. Second, in music, one of the musical intervals; being only the difference between any sound and the next nearest sound, whether above or below it. See the System, Sect. II. and III.

SECRETION, in the animal economy, the separation of some fluid, mixed with the blood, by means of the glands. In the bodies of animals we observe a great number of juices of different natures, viz. the blood, lymph, saliva, stomach-liquor, intestinal juices, pancreatic juice, bile, urine, &c. and the blood is the general source of all. See the articles BLOOD, LYMPH, SALIVA, &c. See the System of ANATOMY, Part IV. Sect. VII.

SECT, a collective term, comprehending all such as follow the doctrines and opinions of some famous divine, philosopher, &c. The sects of philosophers among the ancients, particularly in Greece, were numerous, as the Pyrrhonians, Platonists, Stoics, Peripatetics, Academics, &c. See them under their proper articles. At present, the sects of philosophy are chiefly reducible to three, viz. the Cartesian, Peripatetic, and Newtonian. In theology, the sects are much more numerous, the principal now existing are the Lutherans, Calvinists, Anabaptists, Arians, Socinians, and Arminians; see them under their respective names, in the order of the alphabet.

SECTION, in geometry, denotes a side or surface appearing of a body or figure cut by another; or the place where lines, planes, &c. cut each other.

SECTOR, in geometry, is a part of a circle, comprehended

4 E

between

between two radii and the arch; or it is a mixed triangle formed by two radii and the arch of a circle. See the System, Sect. III.

SECTOR, is also a mathematical instrument of great use in finding the proportion between quantities of the same kind, as between lines and lines, surfaces and surfaces, &c. for which reason the French call it the *compass of proportion*. The great advantage of the sector above common scales, &c. is that it is adapted to all radii, and all scales. For by it the line of chords, sines, tangents, &c. is adapted to any radius betwixt the length and breadth of the sector, when opened. The sector is founded on the fourth proposition of the sixth book of Euclid, where it is demonstrated that similar triangles have their homologous sides proportional.

SECULAR, something which is temporal; in which sense the word stands opposed to ecclesiastical: thus we say, secular power, secular jurisdiction, &c. Secular is more peculiarly used for a person who lives at liberty in the world, not shut up in a monastery, nor bound by vows, or subjected to the particular rules of any religious community: in which sense it stands opposed to regular. The Romish clergy are divided into secular and regular.

SECUNDINES, in anatomy, the several coats or membranes wherein the fœtus is wrapped up in the mother's womb; as the chorion and amnios, with the placenta, &c. For directions respecting this article, as it relates to Midwifery, see the System, Part VIII. Sect. III.

SEDITION, among civilians, is used for an irregular commotion of the people, or an assembly of a number of citizens without law, tending to disturb the peace and order of society. This offence is of different kinds; some seditions more immediately threatening the supreme power, and the subversion of the present constitution of state; others tending only towards the redress of private grievances.

The same distinction holds in the law of England and Scotland. Some kinds of sedition in England amount to high-treason, and come within the statute 25 Edward III. as levying war against the king: and several seditions are mentioned in the Scotch acts of parliament as treasonable.

The law of Scotland makes riotous and tumultuous assemblies a species of sedition. But the law there, as well as in England, is now chiefly regulated by the riot act, under 1 Geo. I. only it is to be observed, that the proper officers in Scotland, to make the proclamation thereby enacted, are sheriffs, stewards, and bailies of regalities, or their deputies, magistrates of royal boroughs, and all other officers of the peace in any county, stewarty, city, or town; and in that part of the island, the punishment of the offence is death and confiscation of moveables. See RIOT.

SEDUCTION, the act of seducing, corrupting, or drawing aside. *Seduction of women-children*. By 4 and 5 of Ph. and Mary, c. 8, if any person, above the age of fourteen, unlawfully shall convey or take away any woman-child unmarried (which is held to extend to bastards as well as to legitimate children) within the age of 16 years, from the possession and against the will of her father, &c. he shall be imprisoned two years, or fined at the discretion of the justices. See the statute, and Blackst. Comment. vol. iv. p. 108, 109.

SEED, in physiology, a substance prepared by nature for the reproduction and conservation of the species, both in animals and plants. See GENERATION, PLANTS, SEMEN, and the System of BOTANY, Sect. II. For an account of the different kinds of seed used in husbandry, with the methods of sowing them, see the System of AGRICULTURE, Sect. XXVII.

SEEDS, in gardening, and agriculture; it is observed, that the seeds of plants, though exceedingly good, will degenerate from the mother plant, if they be sown on the same ground whence they were gathered; so that there is a great necessity for a yearly change of seeds of forest trees, as acorns, masts, &c. If the place be too cold to sow them when gathered in August, they may be kept barrelled or potted up in moist sand or earth, layer upon layer, during the winter, at the end of which time they are found sprouted, and if gently sown, will be as forward as if sown in autumn, besides their missing the vermin.

It is surprising how many sorts of seed will keep good for several years, and retain their growing faculty; whereas many others will not grow when they are more than one year old. This is supposed to be owing in a great measure to their abounding more or less with oil, as also to the nature of the oil, whether it be of a cold or hot quality, and the texture of their outer covering, *e. gr.* the seeds of cucumbers, melons, and gourds, will continue good eight or ten years; those of radish, turnip, rape, &c. for three or four years; but those of parsley, carrot, parsnep, and most other umbelliferous plants, lose their growing faculty often in one year, and seldom remain good longer than two years. All sorts of seeds are best preserved in their pods or husks, especially if they are not separated from their placenta, at which they are fastened by an umbilical cord, through which they receive their nourishment in their embryo state.

SEEING, the art of perceiving objects by the organ of sight; or it is the sense we have of external objects by means of the eye. See the System of ANATOMY, Part VII. Sect. V. and the System of OPTICS, Part I. Sect. III.

SEGMENT of a circle, in geometry, is that part of the circle

contained between a chord and an arch of the same circle. See the System, Part I. Sect. III.

SEGREANT, is the herald's word for a griffin when drawn in a leaping posture, and displaying his wings as if ready to fly.

SELTZER-Water, the name of a mineral-water of Germany, which arises near Neider Seltzer, or Lower Seltzer, about ten miles from Franckfort on the Mayne, and which is now used in England and many other countries. This water issues forth at the spring with great rapidity, is remarkably clear and bright, and on pouring it from one bottle to another, discharges abundance of air-bubbles. That which is imported to London is brought over in stone bottles, closely corked and cemented, containing about three English pints each, by which means this water, as long as the common air is excluded, will retain many of its excellent qualities for several months; but this caution is so necessary, that if too large an empty space be left even in the neck of the bottle, it soon loses in a great degree that brisk, smart, pungent taste, which principally characterises its excellence, and is more liable to be injured by keeping than any other mineral water.

The operation of this water, as Hoffman observes, is chiefly by urine, for it has no purgative virtues. It corrects acidities, renders the blood and juices more fluid, and promotes a brisk and free circulation; and, therefore, it is good in obstructions of the glands, and against gross and viscid humours. It is of great use in the gravel and stone, and other disorders of the kidneys and bladder. It is also excellent in gouty and rheumatic complaints, especially when mixed with milk, or improved by the addition of Rhenish wine and a little sugar. It is drunk with great success in febrile, cutaneous, and putrid disorders. It relieves the heartburn, and is an excellent stomachic. On account of its diuretic quality, it is serviceable in dropical complaints; and, mixed with asses' milk, it is much recommended in consumptive cases, and in disorders of the lungs: with or without milk, it is in great esteem in nervous disorders; and also in hypochondriacal and hysterical complaints, and in obstructions of the menses, accompanying the use of it with proper exercise. It is also administered with success in purging and fluxes arising from acidity in the bowels; and if drunk by nurses, it renders their milk more wholesome and nourishing, and prevents it from turning sour on the stomachs of children. See on the subject of this article, Hoffman. Oper. vol. v. p. 144. London Med. Observ. vol. 4, p. 7, &c. Elliot's Account of the Principal Mineral Waters, p. 194, &c.

SEMEN, in botany, the seed; the essence of the fruit of every vegetable; defined by Linnæus to be a deciduous part of the plant, containing the rudiments of a vegetable, and fertilized by the copulation or sprinkling of the male-dust. The parts of a seed, properly so called, enumerated by Linnæus, may be seen in the System, Sect. III.

SEMEN *Masculinum*, in the animal economy, is a white liquid matter or humour, the thickest of any in the body, separated from the blood in the testicles, and reserved in proper vessels to be the means of generation. By chymical analysis it is found to consist almost entirely of oil and volatile salts, blended together by the mediation of a little phlegm.

SEMIBREVE, in music, a note or measure of time, comprehending the space of two minims, or four crochets, or half a breve. For representation, see the System, Plate I.

SEMICIRCLE, in geometry, a figure comprehended between the diameter of a circle, and half the circumference. Two semicircles can only cut each other in one point. See the System, Sect. III.

SEMICOLON, in grammar, one of the points or stops used to distinguish the several members of a sentence from each other. The mark or character of the semicolon is (;). It has its name, as having a somewhat less effect than a colon, or as demanding a shorter pause. See the System, Part II. Chap. IV. Article PUNCTUATION.

SEMI-DIAMETER, a right-line drawn from the centre of a circle or sphere, to its circumference; the same with what we otherwise call a radius. See the System of GEOMETRY, Part I. Sect. I.

SEMINARY, in its primary sense, the ground where any thing is to be sown, to be afterwards transplanted. Seminary, in a figurative sense, is frequently applied to places of education, whence scholars are transplanted into life. In Catholic countries it is particularly used for a kind of college or school, where youth are instructed in the ceremonies, &c. of the sacred ministry. Of these are great numbers; it being ordained by the council of Trent, that there be a seminary to each cathedral, under the direction of the bishop.

SEMITONE, in music, one of the degrees, or concinnous intervals of concord. See the System, under the article DEFINITIONS, No. 2. For representation, see Plate I.

SENATE, in general, is an assembly or council of senators; that is, of the principal inhabitants of a state, who have a share in the government.

The senate of ancient Rome is, of all others, the most celebrated. It exercised no contentious jurisdiction; but appointed judges, either from among the senators or knights, to determine processes; it also appointed governors of provinces, and disposed of the revenues of the

the commonwealth, &c. Yet did not the whole sovereign power reside in the senate, since it could not elect magistrates, make laws, or decide of war and peace; in all which cases the senate was obliged to consult the people. According to Dr. Middleton, the constant and regular supply of the senate was from the annual magistrates; who, by virtue of their several offices acquired a right to sit and vote in that assembly: the usual gradation of these offices being that of quæstor, tribune of the people, ædile, prætor, and consul. But though these offices gave both an immediate right, and actual entrance into the senate; yet the senatorial character was not esteemed complete, till the new senators had been enrolled by the censors, at the next general lustrum, or review of all the orders of the people. The senate always met of course on the 1st of January, for the inauguration of the new consuls; and in all months, universally, there were three days, viz. the kalends, nones, and ides, on which it regularly met: but it always met on extraordinary occasions, when called together by consul, tribune, or dictator. For an account of the British Senate, see PARLIAMENT.

SENATOR, in general, denotes a member of some senate.

Among us, senator is a member of parliament.

SENNA, the leaf of the Cassia senna of Linnæus, a very common and useful purgative. It is produced from a shrub about a foot high, growing naturally in Egypt and several parts of the Levant. The insect is that from Alexandria, called by the Turks *palte*, which pays a considerable tribute to the grand signior. Senna is a very useful cathartic, operating mildly, and yet effectually; and, if judiciously dosed and managed, rarely occasioning the ill consequences which too frequently follow the exhibition of the stronger purges. The only inconveniences complained of in this drug are its being apt to gripe, and its nauseous flavour. The griping quality depends upon a resinous substance, which, like the other bodies of this class, is naturally disposed to adhere to the coats of the intestines; the more this resin is divided by such matters as take off its tenacity, the less adhesive, and consequently the less irritating and griping it will prove; and the less it is divided, the more griping: hence senna given by itself, or infusions made in a very small quantity of fluid, gripe severely, and purge less than when diluted by a large portion of suitable menstruum, or divided by mixing the infusion with oily emulsions. The ill-flavour of this drug is said to be abated by the greater water-figwort; but we cannot conceive that this plant, whose smell is manifestly fetid, and its taste nauseous and bitter, can at all improve those of senna: others recommend bohea-tea, though neither has this any considerable effect. The smell of senna resides in its more volatile parts, and may be discharged by lightly boiling infusions of it made in water; the liquor thus freed from the peculiar flavour of the senna, may be easily rendered grateful to the taste, by the addition of any proper aromatic tincture or distilled water. The colleges both of London and Edinburgh, have given several very elegant infusions of this drug. The dose of senna in substance is from a scruple to a drachm; in infusion from one to three or four drachms. It has been customary to reject the pedicles of the leaves of senna, as of little or no use; Geoffery, however, observes, that they are not much inferior in efficacy to the leaves themselves. The pods, or seed-vessels, met with among the senna brought to us, are by the college of Brussels preferred to the leaves; they are less apt to gripe, but proportionally less purgative.

SENSATION, the act of perceiving external objects, by means of the organs of sense. For a copious description, see the System of ANATOMY, Part VII. throughout. For representation of the several Organs, see Plate XI.

To conceive the manner wherein sensation is affected; observe, that all the organs consist of little filaments, or nerves, which have their origin in the middle of the brain, are diffused thence throughout all the members which have any sense, and terminate in the exterior parts of the body, that when we are in health, and awake, one end of these nerves cannot be agitated or shaken, without shaking the other; because they are always a little stretched; as is the case of an extended chord, one part of which cannot be stirred without a like motion of all the rest. Observe, farther, that these nerves may be agitated two ways; either at the end out of the brain, or at that in the brain. If they be agitated from without, by the action of objects, and their agitation be not communicated as far as the brain, as frequently happens in sleep, when the nerves are in a state of relaxation; the soul does not then receive any new sensation. But if the nerves happen to be agitated on the brain, by the flux of the animal spirits, or any other cause; the soul perceives something, though the parts of those nerves that are out of the brain, diffused through the several parts of the body, remain at perfect rest; as likewise is frequently the case in sleep. Lastly, observe, that experience tell us, we may sometimes feel pain, as if in parts of the body that have been entirely cut off; by reason the fibres in the brain, corresponding to them, being agitated in the same manner as if they were really hurt, the soul feels a real pain in those imaginary parts. All these things seem to shew, that the soul resides immediately in that part of the brain wherein the nerves of all the organs of sense terminate; we mean, that it is there it perceives all the changes that happen with regard to the objects that cause them, or that have been used to cause them; and that it only perceives what passes out of this part, by the mediation

of the fibres terminating in it. These things premised, it will not be difficult to explain how sensation is performed, the manner whereof may be conceived from what follows: when the point of a needle, for instance, is thrust against the hand, that point stirs and separates the fibres of the flesh; which fibres are extended from that place to the brain, and, when we are awake, in are such a degree of tension, as that they cannot be stirred without shaking also the fibres of the brain. If then the motion of the fibres of the hand be gentle, that of the fibres of the brain will be so too; and if the first be violent enough to break any thing in the hand, the last will be stronger and more violent in proportion. This is what befalls the body, when objects strike upon it. We are now to consider how the mind is affected.

The mind, we have observed, resides principally, if we may be allowed to say so, in that part of the brain, where all the fibres of the nerves terminate. It attends here, as its sensory, or office, to look to the preservation of all the parts of the body, and, of consequence, it must be here advertised of all the changes that happen, and must be able to distinguish between those agreeable to the constitution of the body, and those hurtful; the motion which occasions pain, being violent, it is capable of breaking some of the fibres of the body; wherefore it is necessary the soul be advertised hereof by some disagreeable sensation, that it may provide against it.

SENSE, a faculty of the soul, whereby it perceives external objects, by means of some action or impression made on certain parts of the body, called *organs of sense*, and propagated by them to the sensory. Some use the word *sense* in a greater latitude: and define it a faculty whereby the soul perceives ideas or images of objects, either conveyed to it from without, by the impression of objects themselves, or excited within by some effort of the soul on the sensory itself. Under this notion, sense becomes distinguishable into two kinds, external and internal: corresponding to the two several manners wherein the images of the objects perceived are occasioned, and presented to the mind, viz. either immediately from without, or from within; that is, either by what we commonly call the *five external senses*, hearing, seeing, &c. or by the internal ones, imagination, memory, and attention, to which some also add hunger and thirst. But as these internal senses are not ordinarily considered in the notion of senses, nor implied under the word *sense*, but are thus only denominated by analogy; we shall waive them, to be farther considered under their respective articles, IMAGINATION, MEMORY, &c.

External SENSES, or simply, the *SENSES*, in their general signification, are the means whereby the soul apprehends, or takes cognizance of, external objects; the means, we mean, both on the part of the mind, and on that of the body. Hence those several organs of sense, called eye, ear, nose, palate, and the universal one cutis; each of which is so disposed as to give some representation and report to the mind, of the state of external things, the nearness convenience, hurtfulness, and other habitudes; and each of them a different one, according to the degree and immediateness, &c. of the danger, or convenience. And hence the several exercises of those organs, hearing, seeing, smelling, tasting, and feeling.

External SENSES, are powers of perceiving ideas, upon the presence of external objects. On such occasions, we find the mind is merely passive, and has not power directly to prevent the perception, or idea, or to vary it at its reception; as long as the body is continued in a state fit to be acted upon by the external object. All the several senses seem to have their distinct organs, except feeling, which is, in some degree, diffused over the whole body. Enquiry into the Origin of our Ideas of Beauty and Virtue. p. 2, 8vo. 1726.

Internal SENSES, are powers or determinations of the mind to be pleased with certain forms and ideas, which occur to our observation, in objects perceived by the external senses. Of these there are two different species, distinguished by the different objects of pleasure, viz. pleasurable or beautiful forms of natural things, and pleasurable or beautiful actions, or characters of rational agents; whence the internal senses become divisible into natural and moral; though what some call the *internal natural sense*, our author calls simply, and by way of eminence, the *internal sense*. In reflecting on our external senses, we plainly see, that our perceptions of pleasure and pain do not depend directly on our will. Objects do not please us according as we incline they should; the presence of some objects necessarily pleases us, and the presence of others as necessarily displeases us; nor can we, by our will, any otherwise procure pleasure, or avoid pain, but by procuring the former kind of objects, and avoiding the latter. By the very frame of our nature, the one is made the occasion of delight, and the other of dissatisfaction. In effect, our sensitive perceptions are pleasant, and painful, immediately, and without any knowledge of the cause of this pleasure and pain, or of the manner how they excite it, or are occasions of it, or without our seeing to what farther advantage or detriment the use of such objects might tend. Nor would the most accurate knowledge of these things vary either the pleasure or the pain of the perception; however, it might give a rational pleasure distinct from the sensible; or might raise a distinct joy, from prospect of farther advantage in the object, or another aversion, from apprehension of evil. There is scarce any object which our minds are employed about, but is constituted the necessary occasion of some pleasure or pain.

pain. Thus, we shall find ourselves pleased with a regular form, a piece of architecture, or painting, a composition of notes, a theorem, an action, an affection, a character; and we are conscious that this pleasure naturally arises from the contemplation of the idea then present to the mind, with all its circumstances, though some of those ideas have nothing of what we call sensible perception in them; and in those which have, the pleasure arises from some uniformity, order, arrangement, or imitation; and not from the simple ideas of colour, or sound, or mode of extension, separately considered. It seems hence to follow, that when instruction, education, or prejudice of any kind, raise any desire or aversion towards an object: this desire, or aversion, is founded on an opinion of some perfection, or deficiency, in those qualities, for perception whereof we have the proper senses. Thus, if beauty be desired by one who has not the sense of sight; the desire must be raised by some apprehended regularity of figure, sweetness of voice, smoothness, softness, and some other quality perceivable by the other senses, without relation to the ideas of colour.

For the general manner wherein our senses act, or more properly the manner wherein we become sensible, that is, perceive external objects, see SENSATION. For the particular senses, or, more properly, the particular manner wherein we become sensible, by particular organs of sense, see HEARING, SEEING, SMELLING, &c. For the several organs of sense, ministering to the several manners of sensation, see EYE, EAR, NOSE, &c. in the *Systém of ANATOMY*, Part VII. and Plate XI.

In the *Philosophical Transactions*. No. 312, we have an account of Dan. Frazer, who continued deaf and dumb from his birth to the seventeenth year of his age; when, upon recovering from a fever, he perceived an uneasy motion in his brain, after which he began to hear, and, by degrees, to speak.

Moral SENSE, is a determination of the mind to be pleased with the contemplation of those affections, actions, or characters, of rational agents, which we call *good* or *virtuous*. This moral sense of beauty in actions and affections, may appear strange at first view: some of our moralists themselves are offended at it in lord Shaftesbury, as being accustomed to deduce every approbation, or aversion, from rational views of interest. Our gentlemen of good taste can tell us of a great many senses, tastes, and relishes, for beauty, harmony, imitation in painting and poetry; and may we not find, too, in mankind a relish for a beauty in characters, in manners? The truth is, human nature does not seem to have been left quite indifferent in the affair of virtue, to form to itself observations concerning the advantage or disadvantage of actions, and accordingly to regulate its conduct. The weakness of our reason, and the avocations arising from the infirmities and necessities of our nature, are so great, that very few of mankind could have framed those long deductions of reason, which may shew some actions to be, in the whole, advantageous, and their contraries pernicious. The Author of nature has much better furnished us for a virtuous conduct, than our moralists seem to imagine; by almost as quick and powerful instructions, as we have for the preservation of our bodies: he has made virtue a lovely form, to excite our pursuit of it; and has given us strong affections, to be the springs of each virtuous action.

Public SENSE is defined by the same author to be our determination to be pleased with the happiness of others, and to be uneasy at their misery. This, he says, is found in some degree in all men, and was sometimes called *κοινωνικὸς νόστος*, or *sensus communis*, by some of the ancients.

Common SENSE, is a term that has been variously used both by ancient and modern writers. With some it has been synonymous with *public sense*; with others it has denoted prudence; in certain instances it has been confounded with some of the powers of taste; and accordingly, those who commit egregious blunders with regard to decorum, saying and doing what is offensive to their company, and inconsistent with their own character, have been charged with a defect in common sense. Some men are distinguished by an uncommon acuteness in discovering the characters of others; and this talent has been sometimes called common sense: similar to which is that use of the term, which makes it to signify that experience and knowledge of life which is acquired by living in society.

But the term common sense hath in modern times been used to signify that power of the mind which perceives truth, or commands belief, not by progressive argumentation, but by an instantaneous, instinctive, and irresistible impulse; derived neither from education nor from habit, but from nature, acting independently of our will, whenever its objects is presented, according to an established law, and therefore called sense; and acting in a similar manner upon all, or at least upon a great majority of mankind, and therefore called common sense. The first among the moderns who took notice of this principle, as one of the springs of our knowledge, was Buffier, a French philosopher of the present century, in a book entitled *Traité des Premières Vérités*; and this doctrine hath lately, in our own country, been illustrated and maintained by Dr. Reid, Beattie, Oswald, and Campbell. It is impossible to teach common sense to one who wants it; though this, like other instincts, may languish for want of exercise; and that a distinction, similar to that which is here maintained, is acknowledged by the vulgar, who speak of natural wit, as something different from

the deductions of reason, and the refinements of science. All sound reasoning, it is said, must ultimately rest on the principles of common sense; that is on principles intuitively certain, or intuitively probable: and, consequently, common sense is the ultimate judge of truth, to which reason must continually act in subordination. Thus the advocates for this faculty, as an original and distinct power of the human mind, assign to it a very extensive empire, and an authority that is supreme and absolute. And they have proceeded so far, as to substitute in the room of Mr. Locke's ABSTRACTION, this faculty, as the characteristic of rationality. To this they refer the evidence of mathematical truth, of external and internal sense, of memory, of reasoning from the effect to the cause, of probable or experimental reasoning, of analogical reasoning, of faith in testimony, and indeed of all primary truths. To common sense, therefore, all truth must be conformable: this, they say, is its fixed and invariable standard. And whatever contradicts common sense, or is inconsistent with that standard, though supported by arguments, that are deemed unanswerable, and by names that are celebrated by all the critics, academics, and potentates on earth, is not truth, but falsehood. In a word, the dictates of common sense are, in respect to human knowledge, in general, what the axioms of geometry are in respect to mathematics: on the supposition that these axioms are false or dubious, all mathematical reasoning falls to the ground; and on the supposition that the dictates of common sense are erroneous or deceitful, all truth, virtue, and science, are vain. And hence it appears, that, according to this system, common sense is not only the test of truth, but the standard of moral obligation.

Dr. Priestley, in his attack upon this system, has charged the abettors of it with an unnecessary innovation in the received use of a term; as no person ever denied that there are self-evident truths, and that these must be assumed as the foundation of all reasoning. But they also recommend particular positions as axioms, not as being founded on the perception of the agreement or disagreement of any ideas, which is the great doctrine of Mr. Locke, and which makes truth to depend upon the necessary nature of things, to be absolute, unchangeable, and everlasting; but merely some unaccountable instinctive persuasions, depending upon the arbitrary constitution of our nature, which makes all truth to be a thing that is relative to ourselves only, and consequently to be infinitely vague and precarious. This system, he says, admits of no appeal to reason, properly considered, which any person might be at liberty to examine and discuss: but, on the contrary, every man is taught to think himself authorized to pronounce decisively upon every question, according to his present feeling and persuasion; under the notion of its being something original, instinctive, ultimate, and uncontrovertible; though, if strictly analysed, it might appear to be a mere prejudice, the offspring of mistake. Some of the maxims which they have adopted as self-evident truths, and which they have multiplied without necessity, are so far from being self-evident, that, in the judgment of many candid enquirers after truth, they are not true, but capable of a satisfactory refutation. At the same time, since no man can pretend to any natural right to fix the principles of faith for another, they teach unbelievers, and by their example authorize them, to reject the principles of religion by the same summary and superficial process, as what appear to them to be, at first sight, too absurd and ridiculous to be admitted as true and divine.

Dr. Priestley apprehends, that the inconveniencies abovementioned, may attend even the calling of that faculty by which we discern truth by the name of sense. By this term philosophers in general have denominated those faculties, in consequence of which we are liable to feelings relative to ourselves only, and from which they have not pretended to draw any conclusions concerning the nature of things: whereas truth is a thing not relative, but absolute and real, independent of any relation to this or that particular being, or this or that order of beings. Besides, if the determinations of this new principle of common sense be so instantaneous, irresistible, and infallible, as Dr. Reid, Dr. Beattie, and Dr. Oswald represent, how can we account for all the error there is in the world? Not to add, that this system, in its practical influence, tends to prevent the exercise of free and unrestricted enquiry, with regard either to truth or duty; and to promote, in many cases, the extravagancies of credulity, enthusiasm, and mysticism. Dr. Priestley also observes, that Dr. Price, in his *Review of the Principal Questions and Difficulties in Morals*, 8vo. though unnoticed by the writers above cited, by maintaining that the understanding is the source of many of our most important simple ideas (see IDEA) has secured all the flattering advantages of the new doctrine of common sense, without the capital inconveniencies attending it. Like this system, his scheme cuts off, if it be admitted, all objections to primary moral truths, resisting them on a simple appeal to the faculty of intuition; and refusing to reason upon a subject, which is maintained to be as evident as the truth of the geometrical axiom, that if equal things be taken from equal things, the remainder will be equal. If the ideas of moral right and wrong, &c. be perceived by a sense, it depends upon our arbitrary constitution, that we conceive of them as we do, or whether we perceive them at all; and we have no method whatever of investigating, whether they have any foundation in the absolute nature of things: whereas, by making moral ideas the

object of the understanding, as such, the principles of morality become part of the system of necessary, eternal, and unalterable truth, perceived by the divine Being, as by ourselves, but altogether independent of his will, as well as of all other beings and things whatsoever; as much so as the truth of the axiom before-mentioned, or of the proposition that two and two make four. It is added, that these writers seem to have borrowed their language, as well as their ideas, from Dr. Price, who also uses the term common sense, though applied in a different manner. Reid's Enquiry into the Human Mind, on the Principles of Common Sense, 8vo. ed. 2, 1765. Beattie's Essay on the Nature and Immutability of Truth, 8vo. ed. 2, 1771. Oswald's Appeal to Common Sense in Behalf of Religion, 8vo. ed. 2, 1768. Campbell's Philosophy of Rhetoric, 8vo. 1776, vol. 1, p. 109, &c. Priestley's Examination of Reid, Beattie, and Oswald, &c. 8vo. 1774. For a further account of this system, see ABSTRACTION and IDEA.

SENSITIVE PLANT. The sensitive and humble plants are arranged by Linnæus under the same genus with the acacias. These are well known to possess a kind of muscular motion, by which the leaves and stalks are contracted, and fall down upon being slightly touched, or shaken with some degree of violence. The sensibility of these plants is lodged in the young branches, in the common foot-stalk of the winged leaves, and in the nerve or middle rib to which the lobes or lesser leaves are attached. These different motions, which seem to be totally independent of each other, may be aptly enough compared, by analogy, with the irritability of certain parts in animals. The sensitive plant has two kinds of motion: the one natural, occasioned by the action of warm nourishing vapours; the other artificial, in consequence of being touched or shaken. With whatever body the sensitive plant is touched or irritated, it is remarkable that the sensibility resides particularly in the articulation or joining either of the branches of the common foot-stalk, or of the particular foot-stalk, of each wing. The time which a branch requires to recover itself after being touched, varies according to the vigour of the plant, the hour of the day, the season of the year, or the heat and other circumstances of the atmosphere. The order in which the parts recover themselves varies in like manner: sometimes it is the common foot-stalk; sometimes the rib to which the lobes are attached; and sometimes the lobes themselves are expanded, before the other parts have made any attempt to be reinflected in their former position. If, without shaking the other smaller leaves, we cut off the half of a lobe belonging to the last pair, at the extremity or summit of a wing, the leaf cut, and its antagonist, that is to say, the first pair, begin to approach each other; then the second; and so on successively, till all the lesser leaves, or lobes of that wing, have collapsed in like manner.

Different from all kinds of sensitive plants hitherto known, is the *dionea muscipula*, or Venus's mouse-trap, a plant lately discovered in the swamps of North America. The negroes in Senegal call a large species of sensitive plant which grows in that country, *guerac-kiao*, that is, "good-morrow;" because, say they, when you touch it, or draw near to speak to it, the plant immediately inclines its leaves, to wish you, as it were, good-morning, and to shew you that it is sensible of the politeness done it. In the same country is produced a small sensitive plant, that is rampant, not spinous, and which Mr. Adanson affirms to be infinitely more delicate and sensible than all the other species. The cause of this and the other motions of plants is merely external. The motions themselves, therefore, are not spontaneous as in perfect animals, which have that cause dependent on their choice and will. How many imperfect animals, however, are there, such as those in animal and vegetable insulations, the polypes and animalcules in feed, whose certain motions, like those of the plants in question, are perhaps to be attributed to heat, light, and other external causes? and again, how many, as the gall-insects, the oyster, and other shell-fish, have not a motion so perceptible nor rapid as that of Venus's mouse-trap and the sensitive plant?

SENSORY, SENSORIUM Commune, the seat of the common sense, or that part or place where the sensible soul is supposed more immediately to reside. The sensory is supposed to be that part of the brain wherein the nerves, from all the organs of sense, terminate; which is generally allowed to be about the beginning of the medulla oblongata: Descartes will have it in the cenarion or pineal gland. Sir Isaac Newton describes the sensory of animals as the place to which the sensible species of things are carried through the nerves and brain, that they may be there perceived by their immediate presence to the soul. The organs of sense are not intended for enabling the soul to perceive the species of things in its sensory; but only for conveying them thither. The same great author considers the universe as the sensory of the godhead.

SENTENCE, in law, *Doom*; a judgment-passed in court by the judge, upon some process either civil or criminal. See JUDGMENT.

SENTENCE, in grammar, denotes a period, or a set of words comprehending some perfect sense or sentiment of the mind. Every sentence comprehends at least two words. The business of pointing is, to distinguish the several parts and members of sentences, so as to render the sense thereof the clearest, aptest, and fullest possible. See PUNCTUATION, in the System, Chap. IV.

SENTIMENT, is a term appropriated to such thoughts as are prompted by passion. It differs from a perception: for a percep-

tion signifies the act by which we become conscious of external objects. It differs from consciousness of an internal action, such as thinking, suspending thought, inclining, resolving, willing, &c. And it differs from the conception of a relation among objects; a conception of that kind being termed opinion.

SENTIMENT, in poetry. To talk in the language of music, each passion hath a certain tone, to which every sentiment proceeding from it ought to be turned with the greatest accuracy: which is no easy work, especially where such harmony ought to be supported during the course of a long theatrical representation. In order to reach such delicacy of execution, it is necessary that a writer assume the precise character and passion of the personage represented; which requires an uncommon genius. But it is the only difficulty; for the writer, who, annihilating himself, can thus become another person, need be in no pain about the sentiments that belong to the assumed character: these will flow without the least study, or even preconception; and will frequently be as delightfully new to himself as to his reader. But if a lively picture even of a single emotion, require an effort of genius, how much more the effort to compose a passionate dialogue, with as many different tones of passion as there are speakers? With what ductility of feeling must that writer be endued, who approaches perfection in such a work; when it is necessary to assume different and even opposite characters and passions, in the quickest succession? Yet this work, difficult as it is, yields to that of composing a dialogue in genteel comedy, exhibiting characters without passion. The reason is, that the different tones of character are more delicate, and less in fight than those of passion: and, accordingly, many writers who have no genius for drawing characters, represent, tolerably well, an ordinary passion, in its simple movements. But of all works of this kind, what is truly the most difficult, is a characteristical dialogue upon any philosophical subject: to interweave characters with reasoning, by suiting to the character of each speaker a peculiarity not only of thought but of expression, requires the perfection of genius, taste, and judgment. The truth is, such execution is too delicate for an ordinary genius; and for that reason the bulk of writers, instead of expressing a passion as one who feels it, content themselves with describing it in a lifeless inanimate manner.

To awake passion by an internal effort merely, without any external cause, requires great sensibility; and yet that operation is necessary, not less to the writer than to the actor: because none but those who actually feel a passion can represent it to the life. The writer's part is the more complicated: he must add composition to passion; and, must, in the quickest succession, adopt every different character.

Unhappy is the player of genius who acts a part in what may be termed a *descriptive tragedy*; after assuming the very passion that is to be represented, how is he cramped in action, when he must utter, not the sentiments of the passion he feels, but a cold description, in the language of a bystander? It is that imperfection undoubtedly, in the bulk of our plays, which confines our stage almost entirely to Shakspeare, notwithstanding his many irregularities. In our modern English tragedies, we sometimes find sentiments tolerably well adapted to a plain passion: but we must not in any of them expect a sentiment expressive of character; and upon that very account, our late performances of the dramatic kind are, for the most part, intolerably insipid. But it may be proper to illustrate this subject by examples. The instances are chiefly borrowed from Shakspeare, who for genius in dramatic composition stands uppermost in the rolls of fame. The following sentiments, dictated by a violent and perturbed passion, are:

Lear.—Fili! ingratitude!

Is it not as if this mouth should tear this hand
For lifting food to't?—But I'll punish home;
No, I will weep no more.—In such a night,
To shut me out!—Pour on, I will endure.
In such a night as this! O Regan, Gonerill,
Your old kind father, whose frank heart gave all—
O! that way madness lies; let me shun that!

Kent. Good, my lord, enter here.

Lear. Pr'ythee, go in thyself, seek thine own ease,
This tempest will not give me leave to ponder
On things would hurt me more:—but I'll go in;
In, boy, go first. You houseless poverty—
Nay, get thee in; I'll pray, and then I'll sleep—
Poor naked wretches, wheresoe'er you are,
That bide the pelting of this pitiless storm!
How shall our houseless heads, and unfed sides,
Your loop'd and window'd raggedness, defend you
From seasons such as these?—O have ta'en
Too little care of this! Take physic, pomp;
Expose thyself to feel what wretches feel,
That thou may'st shake the superfluous to them,
And shew the heavens more just. *King Lear, act 3, sc. 5.*

The next is an example of the same kind, expressing sentiments arising from remorse and despair:

Othello. Lo! I have a weapon:

A better never did itself sustain
Upon a soldier's thigh. I've seen the day,
That with this little arm, and this good sword,

SEN

I've made my way through more impediments
Than twenty times your stop. But, oh vain boast!
Who can control his fate? 'tis not so now.
Be not afraid, though you do see me weapon'd,
Here is my journey's end, here is my butt,
The very sea-mark of my utmost sail.
Do you go back dismay'd? 'tis a lost fear.
Man but a rush against Othello's breast,
And he retires. Where should Othello go?
Now—how dost thou look now! Oh ill-farr'd wench!
Pale as thy smock! when we shall meet at 'compt,
This look of thine will hurl my soul from heav'n,
And fiends will snatch at it. Cold, cold, my girl;
Ev'n like thy chastity. O cursed slave!
Whip me, ye devils,
From the possession of this heav'nly sight:
Blow me about in winds, roast me in sulphur,
Wash me in sleep-down gulfs of livid fire—
Oh, Desdemona! Desdemona! dead! oh! oh!

Othello, act 5, sc. 9.

The sentiments here displayed flow so natural from the passions represented, that we cannot conceive any imitation more perfect. Passions seldom continue uniform any considerable time: they generally fluctuate, swelling and subsiding by turns, often in a quick succession; and the sentiments cannot be just unless they correspond to such fluctuation. Accordingly, a climax never shows better than in expressing a swelling passion: the following passages may suffice for an illustration:

Oroonoko.—Can you raise the dead?

Pursue and overtake the wings of time?
And bring about again the hours, the days,
The years, that made me happy? *Oroonoko, act 2, sc. 2.*

I would not be the villain that thou think'st
For the whole space that's in the tyrant's grasp,
And the rich earth to boot. *Macbeth, act 4, sc. 4.*

In the tragedy of Jane Shore, Alicia, in the full purpose of destroying her rival, has the following reflection:

Oh jealousy! thou bane of pleasing friendship,
Thou worst invader of our tender bosoms;
How does thy rancour poison all our softness,
And turn our gentle nature into bitterness!
See where she comes! Once my heart's dearest blessing,
Now my chang'd eyes are blasted with her beauty,
Loathe that known face, and sicken to behold her. *Act 3, sc. 1.*

A person sometimes is agitated at once by different passions; and the mind in that case, vibrating like a pendulum, vents itself in sentiments that partake of the same vibration. This we give as another observation.

Queen. Would I had never trod this English earth,
Or felt the flatteries that grow upon it!
Ye've angels' faces, but heav'n knows your hearts.
What shall become of me now? wretched lady!
I am the most unhappy woman living.
Alas! poor wenches, where are now your fortunes?

[To her women.]

Shipwreck'd upon a kingdom where no piety,
No friend, no hope, no kindred, weep for me!
Almost no grave allowed me. *Henry VIII. act 3, sc. 1.*

Othello. Oh devil, devil!
If that the earth could teem with woman's tears,
Each drop she falls would prove a crocodile.
Out of my sight!

Oth. Aye; you did wish that I would make her turn:
Sir, she can turn and turn, and yet go on;
And turn again. And she can weep, Sir, weep;
And she's obedient: as you say, very obedient.

Emilia. Oh! my good lord I would speak a word with you.

Othello. Yes; 'tis Emilia—By and by.—She's dead.
'Tis like she's come to speak of Cassio's death;
The noise was high—Ha! no more moving?
Still as the grave. Shall she come in? were't good?
I think she stirs again—No—what's the best?
If she come in, she'll, sure, speak to my wife:
My wife! my wife! What wife? I have no wife:
Oh insupportable! oh heavy hour! *Othello, act 5, sc. 7.*

Hence a capital rule in representation of immoderate passions, is, that they ought to be hid or dissembled as much as possible. And this holds in an especial manner with respect to criminal passions: one never counsels the commission of a crime in plain terms; guilt must not appear in its native colours, even in thought; the proposal must be made by hints, and by representing the action in some favourable light. Of the propriety of sentiment upon such an occasion, Shakspeare, in the Tempest, has given us a beautiful example, in a speech by the usurping duke of Milan, advising Sebastian to murder his brother, the king of Naples:

Antonio.—What might,
Worthy Sebastian,—O, what might—no more—
And yet, methinks, I see it in thy face

SEN

What thou should be: the occasion speaks thee, and
My strong imagination sees a crown
Dropping upon thy head.
There cannot be a finer picture of this kind, than that of king
John soliciting Hubert to murder the young prince Arthur: *Act 2, sc. 1.*

K. John. Come hither, Hubert. O my gentle Hubert,
We owe thee much; within this wall of flesh,
There is a soul counts thee her creditor,
And with advantage means to pay thy lover
And, my good friend; thy voluntary oath
Lives in this bosom, dearly cherished.
Give me thy hand, I had a thing to say—
But I will fit it with some better time.
By heav'n, Hubert, I'm almost ashamed
To say what good respect I have of thee.

Hubert. I am much bounden to your majesty.

K. John. Good friend, thou hast no cause to say so yet—
But thou shalt have—and, creep time ne'er so slow,
Yet it shall come for me to do thee good.

I had a thing to say—but, let it go;
The sun is in the heav'n, and the proud day,
Attended with the pleasures of the world,
Is all too wanton and too full of gawds.

To give me audience. If the midnight-bell
Did with its iron tongue and brazen mouth
Sound one into the drowsy race of night;

If this same were a church-yard where we stand,
And thou possessed of a thousand wrongs;
Or if that surly spirit, melancholy,
Had bak'd thy blood, and made it heavy-thick,

Which else runs trickling up and down the veins,
Making that idiot laughter keep men's eyes,
And strain their cheeks to idle merriment,
(A passion hateful to my purposes);

Or if thou could'st see me without eyes,
Hear me without thine ears, and make reply
Without a tongue, using conceit alone,
Without eyes, ears, and harmful sound of words;

Then, in despite of broad-ey'd watchful day,
I would into thy bosom pour my thoughts.
But ah, I will not.—Yet I love thee well;
And, by my troth, I think thou lov'st me well.

Hubert. So well, that what you bid me undertake,
Though that my death were adjunct to my act,
By heav'n, I'd do't.

K. John. Do not I know thou would'st?
Good, Hubert, Hubert, Hubert, throw thine eye
On yon young boy. I'll tell thee what, my friend;

He is a very serpent in my way,
And wheresoever this foot of mine doth tread,
He lies before me. Dost thou understand me?
Thou art his keeper. *King John, act 3, sc. 5.*

There are faulty sentiments of various kinds, of which we shall cite a few instances.
Othello.—O my soul's joy!
If after every tempest come such calms,
May the winds blow till they have waken'd death:
And let the labouring bark climb hills and seas
Olympus high, and duck again as low
As hell's from heaven? *Othello, act 2, sc. 6.*

This sentiment may be suggested by violent inflamed passion; but is not suited to the satisfaction, however great, that one feels upon escaping danger.

The sentiments of the *Mourning Bride* are for the most part no less delicate than just copies of nature: in the following exception the picture is beautiful, but too artful to be suggested by severe grief.

Had they or hearts or eyes, that did this deed?
Could eyes endure to guide such cruel hands?
Are not my eyes guilty alike with their's,
That thus can gaze, and yet not turn to stone?

—I do not weep! The springs of tears are dry'd,
And of a sudden I am calm, as if
All things were well; and yet my husband's murder'd!

Yes, yes, I know to moan: I'll sluice this heart,
The source of woe, and let the torrent in. *Act 5, sc. 11.*

Pope's elegy to the memory of an unfortunate lady, expresses delicately the most tender concern and sorrow that one can feel for the deplorable fate of a person of worth. Such a poem, deeply serious and pathetic, rejects with disdain all fiction. Upon that account, the following passage deserves no quarter; for it is not the language of the heart, but of the imagination, indulging its flights at ease, and by that means is eminently discordant with the subject. It would be a still more severe censure if it should be ascribed to imitation, copying indifferently what has been said by others:

What tho' no weeping loves thy ashes grace,
Nor polish'd marble emulate thy face?
What though no sacred earth allow'd thee room,
Nor hallow'd dirge be mutter'd o'er thy tomb?

Yet shall thy grave with rising flow'rs be dress'd,
And the green turf lie lightly on thy breast:

There

SEP

SER

There shall the morn her earliest tears bestow,
There the first roses of the year shall blow;
While angels with their silver wings o'er shade
The ground, now sacred by thy relics made,
The Lady Macbeth, projecting the death of the king, has the following soliloquy.

The raven himself's not hoarse
That croaks the fatal entrance of Duncan
Under my battlements. Come, all you spirits
That tend on mortal thoughts, unsex me here,
And fill me from the crown to the toe, top-full
Of direst cruelty; make thick my blood,
Stop up th' access and passage to remorse,
That no compunctious visitings of nature
Shake my fell purpose. *Macbeth, act. 1, sc. 7.*

This speech is not natural. A treacherous murder was never perpetrated even by the most hardened miscreant without compunction.

Ozym. Yet I behold her—yet—and now no more.
Turn your lights inward, eyes, and view my thought;
So shall you still behold her—'Twill not be.
O impotence of sight! mechanic sense,
Which to exterior objects ow'st thy faculty,
Not seeing of election, but necessity.
Thus do our eyes, as do all common mirrors,
Successively reflect succeeding images,
Not what they would, but must; a star or toad;
Just as the hand of chance administers!

Mourning Bride, act 2, sc. 8.

No man in his senses, ever thought of applying his eyes to discover what passes in his mind; far less of blaming his eyes for not seeing a thought or idea.

Ventidius. But you ere love misled your wandering eyes,
Were sure the chief and best of human race,
Fram'd in the very pride and boast of nature,
So perfect, that the gods who formed you wonder'd
At their own skill, and cried, A lucky hit
Has mended our design. *Dryden, All for Love, act 1.*

Not to talk of the impiety of this sentiment, it is ludicrous instead of being lofty.

SEPTEMBER, the ninth month of the year, reckoned from January, and the seventh from March, whence its name, viz. from *septimus, seventh*.

SEPTENNIAL, any thing lasting seven years.

SEPTENNIAL Elections. Blackstone, in his Commentaries, Vol. I. p. 189, says (after observing that the utmost extent of time allowed the same parliament to sit by the stat. 6 W. and M. c. 2, was three years) "But, by the statute 1 Geo. I. st. 2, c. 38, (in order *professedly* to prevent the great and continued expences of frequent elections, and the violent heats and animosities consequent thereupon, and for the peace and security of the government, just then recovering from the late rebellion) this term was prolonged to seven years; and what alone is an instance of the vast authority of parliament, the very same house that was chosen for three years enacted its own continuance for seven."

SEPTENTRIO, or *Septentriones*, in astronomy, a northern constellation of stars. See the *System*, Sect. VIII.

SEPTICS, among physicians, an appellation given to all such substances as promote putrefaction. From the many curious experiments made by Dr. Pringle to ascertain the septic and antiseptic virtues of natural bodies, it appears that there are very few substances of a truly septic nature: see *PUTREFACTION*.

SEPTUAGESIMA, in the calendar, denotes the third Sunday before Lent, or before quadragesima; and quinquagesima is the next before quadragesima, then sexagesima, and leptuagesima: these were all days appropriated by the church to acts of penance and mortification, by way of preparing for the devotion of the Lent ensuing.

SEPTUAGINT, the name given to a Greek version of the books of the Old Testament, from its being supposed to be performed by seventy-two Jews, who are usually called the *seventy interpreters*. The history of this version is expressly written by Aristeas, an officer of the guards to Ptolemy Philadelphus, the substance of whose account is as follows: Ptolemy having erected a fine library at Alexandria, which he took care to fill with the most curious and valuable books from all parts of the world, was informed that the Jews had one containing the laws of Moses, and the history of that people; and being desirous of enriching his library with a Greek translation of it, applied to the high-priest of the Jews; and to engage him to comply with his request, set at liberty all the Jews whom his father, Ptolemy Soter, had reduced to slavery. After such a step he easily obtained what he desired; Eleazar the Jewish high-priest sent back his ambassadors with an exact copy of the Mosaic law, written in letters of gold, and six elders of each tribe, in all seventy-two; who were received with marks of respect by the king. This version was in use to the time of our blessed Saviour, and is that out of which all the citations in the New Testament, from the Old, are taken. It was also the ordinary and canonical translation made use of by the Christian church in the earliest ages; and it still subsists in the churches both of the East and West. It is however

observable, that the chronology of the Septuagint is different from the Hebrew text.

SEPTUM, in anatomy, an inclosure, or partition; a term applied to several parts of the body, which serve to separate one part from another; as, *septum narium*, or partition between the nostrils, &c.

SEPULCHRE, *Sepulchrum*, a tomb, or place destined for the interment of the dead. The term is chiefly used in speaking of the burying-places of the ancients; those of the moderns we usually call tombs. The pyramids are supposed to have been built as sepulchres for the kings of Egypt. And the obelisks had generally the same intention. Sepulchres were held sacred and inviolable, and the care taken thereof was deemed a religious duty, grounded on the fear of God, and the belief of the soul's immortality. Those who searched or violated them have been odious to all nations, and always severely punished. The Egyptians called their sepulchres, *eternal houses*, in contradistinction to their houses and palaces, which they call *inns*; by reason of the short sojourn we have in the one, in comparison of our long stay in the other. The eastern pilgrimages are all made with design to visit the holy sepulchre, that is, the tomb of Jesus Christ. Nobody enters here but bare-footed, and with abundance of ceremonies. The Turks exact twenty-four crowns of each pilgrim, whom devotion carries to the holy sepulchre.

SEQUESTRATION, *Sequestratio*, in common law, the act of separating a thing in controversy from the possession of both parties, till the right be determined by course of law.

SERAGLIO, formed of the Turkish word *sarai*, which is borrowed from the Persian *seraw*, signifying a house, among the Levantines, denotes the palace of a prince or lord. At Constantinople they say the seraglio of the ambassador of England, of France, &c. The seraglio is used, by way of eminence, for the palace of the grand signior at Constantinople, where he keeps his court, and where his concubines are lodged, and where the youth are trained up for the chief posts of the empire. It is a triangle, about three Italian miles round, wholly within the city, at the end of the promontory Chrysoceras, now called the Seraglio Point. The buildings run back to the top of the hill, and from thence are gardens that reach to the edge of the sea. It is inclosed with a very high and strong wall, upon which are several watch-towers: and it has many gates, some of which open towards the sea-side, and the rest into the city: but the chief gate is one of the latter, which is constantly guarded by a company of capoachees, or porters: and in the night it is well guarded towards the sea.

The outward appearance, du Loir tells us, is not beautiful, in regard the architecture is irregular, being cantoned out into separate edifices and apartments, in manner of pavilions and domes. No stranger, it is said, has ever yet been admitted into the inmost parts of the seraglio. The old seraglio is the place where the emperor's old mistresses, and the sultanas that have belonged to the deceased grand signiors, are kept. The ladies of the harem, which is the part allotted to the women, are a collection of young beautiful girls, who, on their admission, are committed to the charge of some old lady, and taught music, dancing, and other accomplishments. These frequently play and dance before the grand signior, while others entertain him with their conversation. Besides these ladies, there are a great many black eunuchs and female slaves in the seraglio, whose business it is to guard and wait upon them.

SERENADE, *Serenata*, a kind of concert given in the nighttime, by a lover, at his mistress's door, or under her window. Sometimes it consists wholly of instrumental music; sometimes voices are added, and the pieces composed or played on these occasions, are also called serenades. This is still practised in Spain.

SERJEANT (*Common*), an officer in the city of London, who attends the lord-mayor and court of aldermen in court days, and is in council with them on all occasions, within and without the precincts or liberties of the city. He was to take care of orphans' estates, either by taking account of them, or to sign their indentures, before their passing the lord-mayor and court of aldermen: and he was likewise to let and manage the orphans' estates, according to his judgment, to their best advantage.

SERJEANT, or *Sergeant*, in war, is a non-commissioned or inferior officer in a company of foot, or troop of dragoons; appointed to see discipline observed, to teach the soldiers their exercise and other duty. See the *Treatise on MILITARY AFFAIRS*, Sect. IV.

SERIES, a continual succession of things in the same order, and which have some relation or connection with each other.

SERIES, in algebra, denotes a rank or progression of quantities, increasing or decreasing in some constant ratio, which in its progress, approaching still nearer and nearer to some fought value, and the terms continually decreasing, is called a *converging series*; and, if infinitely continued, becomes equal to that quantity; whence its usual appellation of *infinite series*. See the *System*, throughout.

SERPENT, in astronomy, a constellation in the northern hemisphere, called more particularly *Serpens*. See the *System*, Sect. VIII.

SERPENT, *Serpens*, in amphibiology, a general term for all amphibious

amphibious animals without legs. See COLUBER, ANGUIS, CÆCILIA, AMPHISBÆNA, CROTALUS, &c.

The serpent has from the beginning been the enemy of man; and it has hitherto continued to terrify and annoy him, notwithstanding all the arts which have been practised to destroy it. Formidable in itself, it deters the invader from the pursuit; and from its figure, capable of finding shelter in a little space, it is not easily discovered by those who would venture to try the encounter. Thus possessed at once of potent arms and inaccessible or secure retreats, it baffles all the arts of man, though ever so earnestly bent upon its destruction. For this reason, there is scarce a country in the world that does not still give birth to this poisonous brood, that seems formed to quell human pride, and repress the boasts of security. Mankind have driven the lion, the tiger, and the wolf, from their vicinity; but the snake and the viper still defy their power. Their numbers, however, are thinned by human assiduity; and it is probable some of the kinds are wholly destroyed. In none of the countries of Europe are they sufficiently numerous to be truly terrible. The various malignity that has been ascribed to European serpents of old, is now utterly unknown; there are not above three or four kinds that are dangerous, and their poison operates in all in the same manner. See POISON.

The drowly death, the starting of the blood from every pore, the insatiable and burning thirst, the melting down the solid mass of the whole form into one heap of putrefaction, said to be occasioned by the bites of African serpents, are horrors with which we are entirely unacquainted.

If we take a survey of serpents in general, they have marks by which they are distinguished from all the rest of animated nature. They have the length and the suppleness of the eel, but want fins to swim with; they have the scaly covering and pointed tail of the lizard, but they want legs to walk with; they have the crawling motion of the worm, but, unlike that animal, they have lungs to breathe with; like all the reptile kind, they are resentful when offended; and nature has supplied them with terrible arms to revenge every injury.

Legaut assures us, that he saw one in Java that was 50 feet long. Carli mentions their growing to above 40 feet; and we have now the skin of one in the British Museum that measures 32. Other creatures have a choice in their provision; but the serpent indiscriminately preys upon all; the buffalo, the tiger, and the gazelle. One would think that the porcupine's quills might be sufficient to protect it; but whatever has life, serves to appease the hunger of these devouring creatures: porcupines, with all their quills, have frequently been found in their stomachs when killed and opened. nay, they most frequently are seen to devour each other. A life of savage hostility in the forest, offers to the imagination one of the most tremendous pictures in nature. In those burning countries, where the sun dries up every brook for hundreds of miles round; when what had the appearance of a great river in the rainy season, becomes, in summer, one dreary bed of sand; in those countries, a lake that is never dry, or a brook that is perennial, is considered by every animal as the greatest convenience of nature. When they have discovered this, no dangers can deter them from attempting to quench their thirst. Thus the neighbourhood of a rivulet, in the heart of the tropical continents, is generally the place where all the hostile tribes of nature draw up for the engagement. On the banks of this little envied spot, thousands of animals of various kinds are seen venturing to quench their thirst, or preparing to seize their prey. The elephants are perceived in a long line, marching from the darker parts of the forest; the buffaloes are there, depending upon numbers for security; the gazells relying solely upon their swiftness; the lion and tiger waiting a proper opportunity to seize; but chiefly the larger serpents are upon guard there, and defend the accesses of the lake. Not an hour passes without some dreadful combat; but the serpent, defended by its scales, and naturally capable of sustaining a multitude of wounds, is, of all others, the most formidable. It is the most watchful also; for the whole tribe sleep with their eyes open, and are consequently for ever upon the watch; so that, till their rapacity is satisfied, few other animals will venture to approach their station.

The serpent, instead of shortening the body, bends it into an arch; and this is the principal difference between serpentine and vermicular progression. Indeed, if we consider the length and the weakness of the back-bone in all these animals; if we regard the make of the vertebræ, in which we shall find the junctures all formed to give play, and none to give power; we cannot be of opinion that they have a faculty of springing from the ground, as they entirely want a fulcrum, if we may so express it, from whence to take their spring; the whole body being composed of unsupported muscles, and joints that are yielding. The various calamities that the poison of serpents is capable of producing, are not only inflicted by the animal itself, but by men, more mischievous even than serpents, who prepare their venom to destroy each other. With this the savages poison their arms, and also prepare their revengeful potions. The ancients were known to preserve it for the purposes of suicide; and even among semi-barbarous countries at this day, the venom of snakes is used as a philtre.

Though the generality of mankind regard this formidable race with horror, yet there have been some nations, and there are some

at this day, that consider them with veneration and regard. The adoration paid by the ancient Egyptians to a serpent, is well known: many of the nations at present along the western coast of Africa retain the same unaccountable veneration. Upon the gold and slave coasts, a stranger, upon entering the cottages of the natives, is often surprised to see the roof swarming with serpents, that cling there without molesting, and unmolested by, the natives. But his surprise will increase upon going farther southward, to the kingdom of Widah, when he finds that a serpent is the god of the country. This animal which travellers describe as a huge overgrown creature, has its habitation, its temple, and its priests. These impress the vulgar with an opinion of its virtues; and numbers are daily seen to offer not only their goods, their provisions, and their prayers, at the shrine of their hideous deity, but also their wives and daughters. These the priests readily accept of, and after some days of penance, return them to their suppliants, much benefited by the serpent's supposed embraces. For a particular description of the forms and ceremonies used in the worship of the grand serpent, and especially those attending the grand annual procession to the temple, see Banks's Geography, page 333. For a representation of it, see the Plate annexed.

SERPENTARIUS, in astronomy, a constellation of the northern hemisphere, called also *Ophiuchus*, and anciently *Æsculapius*. See the System, Sect. VIII.

SERRATUS, in anatomy, a name given to several muscles, from their resemblance, in shape, to a saw. Such are the *serratus anticus minor*; *serratus anticus major*; *serratus pecticus inferior*; *serratus pecticus superior*. See the System, Part II. Sect. II. Table of Muscles, Art. 15, 16, 17, 18. For representation, see Plate III. Fig. 1.

SERVANT, a term of relation, signifying a person who owes and pays obedience for a certain time to another; in quality of a master. As to the several sorts of servants, it was observed, under the article LIBERTY, that pure and proper slavery does not, nay, cannot, subsist in Britain; such, we mean, whereby an absolute and unlimited power is given to the master over the life and fortune of the slave. And indeed it is repugnant to reason, and the principles of natural law, that such a state should subsist any where. The three origins of the right of slavery, assigned by Justinian, are all of them built upon false foundations. As, first, slavery is held to arise *jure gentium*, from a state of captivity in war; whence slaves are called *mancipia*, *quasi manu capti*. The conqueror, say the civilians, has a right to the life of his captive; and, having spared that, has a right to deal with him as he pleases. But it is an untrue position, when taken generally, that, by the law of nature or nations, a man may kill his enemy: he has only a right to kill him in particular cases; in cases of absolute necessity, for self-defence; and it is plain this absolute necessity did not subsist, since the victor did not actually kill him, but made him prisoner. War is itself justifiable only on principles of self-preservation: and therefore it gives no other right over prisoners, but merely to disable them from doing harm to us, by confining their persons: much less can it give a right to kill, torture, abuse, plunder, or even to enslave an enemy, when the war is over. Since, therefore, the right of making slaves by captivity, depends on a supposed right of slaughter, that foundation failing, the consequence drawn from it must fail likewise.—There are several kinds of servants, as men-servants, apprentices, labourers, stewards, bailiffs, &c.

SERVITOR, in the University of Oxford, a scholar or student, who attends and waits on another for his maintenance there.

SERUM, a thin, transparent, watery liquor, somewhat salish, which makes a considerable part in the mals of blood. The blood consists of two kinds or parts; the *crutor*, or red part; and the *serum*, or wheyish, limpid part. See the System of ANATOMY, Part V. Sect. V. and the article BLOOD.

SESSION, *Sessio*, denotes each sitting, or assembly, of a council. In quoting councils, we say, in such a session, such a canon, &c.

SESSION of Parliament, is a season, or space, from its meeting to its prorogation, or dissolution. See PARLIAMENT.

The Court of SESSION, otherwise called the *College of Justice*, is the supreme court in Scotland for all civil causes. It consists of one constant president, who has an annual salary of 1200l. and fourteen other judges, at 700l. per annum, each, who are lords by their office, which they hold by patent *quamdiu se bene gesserint*. The lord high-chancellor presides here when present. The king names several other extraordinary lords, who sit, but are not obliged to attendance, because they have no salaries; but they may vote among the rest. An appeal lies from this court to the house of lords.

Court of Quarter SESSIONS. See QUARTER Sessions.

SETON, *Setaceum*, in surgery, &c. a kind of topical remedy, like a cautery, or an issue, to divert defluxions from the eyes, &c. by making a wound in the skin of the hind part of the neck, which is kept suppurating, by means of little skain of silk, or cotton, passed through it. Setons are also sometimes applied to such as are apt to fall into epileptic fits. They are of more efficacy than a common issue, but are prescribed with much the same intention. The like operation is frequently practised on horses, &c. and called by the farriers, *rowelling*. Setons evacuate with a gentle pain; make the nerves discharge serum, and give vent to repletions and coacervation of humours.

SETTING, in astronomy, the withdrawing of a star or planet; or its sinking below the horizon. See the *System*, Sect. III.

SETTING of Wheat, in agriculture, is a method of cultivating wheat. See the *System*, Sect. III.

Act of SETTLEMENT, in British history, a name given to the statute 12 & 13 W. III. cap. 2, whereby the crown was limited to his present majesty's illustrious house; and some new provisions were added, at the same fortunate era, for better securing our religion, laws, and liberties; which the statute declares to be the birth-right of the people of England, according to the ancient doctrine of the common law.

SEX, something in the body, which distinguishes male from female. The number of persons, of the two sexes, are exceedingly well balanced; so that every man may have his wife, and every woman her husband. It is expressly forbidden by the law of Moses to disguise the sex.

SEXTANS, the *Sextant*, in astronomy, a constellation of the southern hemisphere. See the *System*, Sect. VIII.

SEXTANT, in mathematics, denotes the sixth part of a circle, or an arch comprehending sixty degrees: sextant is more particularly used for an astronomical instrument, made like a quadrant, excepting that its limb only comprehends sixty degrees. For description and uses, see the *System of NAVIGATION*, Sect. V. For representation, see *System of ASTRONOMY*, Plate V. fig. 4.

SEXUAL System, in botany, denotes that system which is founded on a discovery that there is in vegetables, as well as in animals, a distinction of the sexes; or that plants propagate themselves by means of male and female organs, either growing upon the same tree, or upon different trees of the same species. For the principal parts which conduce to fructification, see the *System*, Sect. II. For the doctrine of the sexual system, see the *System of BOTANY*, Sect. III.

SHADOW, in perspective, a certain space deprived of light, where the light is weakened by the interposition of some opaque body before the luminary. See the *System*, Sect. VII. and Plate III.

SHAMMY, *Chammy*, or *Chamois*, a kind of leather, either dressed in oil, or tanned; much esteemed for its softness, pliancy, &c. It is prepared from the skin of the chamois, a species of the genus *Capra*; and appropriated to a great variety of uses.

SHARP, in music, a kind of artificial note or character (thus formed, *): this, being prefixed to a note, shews that it is to be sung or played a semitone, or half a note, higher than the natural note would have been. See the *System*, under *DEFINITIONS*, Article IV. and Plate II.

SHEARING. The best time for shearing sheep is about the middle, or the latter end of June, because it is good for them to sweat in the wool before it is cut. They must be very well washed before the shearing, for this is a great addition to the price of the wool; after the washing, let them go three or four days in a clean dry ground. When they are cut, the shearer must be very careful not to wound their skins, because this gives occasion to the flies to tease the poor creatures in a terrible manner. Some shear their lambs, the first year especially, behind; but before the doing of this they ought to be carefully tagged, as it is called; that is, their tails and thighs behind should be well cleared of wool, that the dung may not hang there, which would else make them sore, and subject them to flies, which would blow them, and make them full of maggots. In Gloucestershire they house their sheep every night, and litter them with clean straw. Their dung makes this a very good manure for the land, and the wool of the sheep is rendered so much finer by it, that the farmers have a double advantage from the practice. See *System of AGRICULTURE*, Sect. II.

SHECHINAH, in the Jewish history, the name of that miraculous light, or visible glory, which was a symbol of the special presence of the Deity. This shechinah, after it had conducted the Israelites through the wilderness, had its more stated residence in the tabernacle and the temple. See *ARK of the Covenant*.

SHEEP, the English name of the genus *Ovis* in the system of mammalia. See *Ovis*. For the breeding, feeding, and management of this animal, see the *System of AGRICULTURE*, Sect. XXIV.

SHELL, a hard calcareous crust, serving to cover and inclose a kind of animal, hence called *TESTACEOUS*. For the properties of shells as a manure, see *System of AGRICULTURE*, Sect. II.

SHELL-Fish. These animals are in general oviparous. Among the oviparous kinds, anatomists have found that some species are of different sexes in the different individuals of the same species, but others are hermaphrodites, every one being in itself both male and female: in both cases their increase is very numerous, and scarce inferior to that of plants, or of the most fruitful of the insect class. The eggs are very small, and are hung together in a sort of clusters by means of a glutinous humour, which is always placed about them, and is of the nature of the jelly of frog's spawn; by means of this they are not only kept together in the parcel, but the whole cluster is fastened to the rocks, shells, or other solid substances, and thus they are preserved from being driven on shore by the waves, and left where they cannot succeed.

SHERIFF, or *Shire-Reve*, an officer in each county in England, of very great antiquity. Sheriffs were formerly chosen by the

inhabitants of the several counties; in confirmation of which it was ordained by 28 Edw. I. c. 8, that the people should have election of sheriffs in every shire, where the shrievalty is not of inheritance; for anciently, in some counties, the sheriffs were hereditary, as judge Blackstone apprehends they were in Scotland, till the statute 20 Geo. II. c. 43, and still continue in the county of Westmoreland to this day; the city of London having also the inheritance of the shrievalty of Middlesex vested in their body by charter. By four several statutes, it is enacted that no one shall be sheriff, except he have sufficient land within the shire to answer the king and his people in any matter of complaint. 9 Edw. II. st. 2; 4 Edw. III. c. 9; 5 Edw. III. c. 4; 14 & 15 Car. II. c. 21. It has been adjudged, that an attorney is exempted from the office of sheriff by reason of his attendance on the courts of Westminster. By 2 Geo. III. c. 20, no person, during the time he is acting as a militia officer, shall be obliged to serve the office of sheriff. Protestant dissenters, who are exempted by the *TOLERATION act*, from the obligation of complying with the requisition of the *CORPORATION act*, and who can plead their non-compliance as a reasonable and sufficient excuse, are not compellable to serve this office, nor of course to pay any fine for refusal. See *Furneas's Letters to Blackstone*, ed. 2, and particularly the Appendix, containing lord Mansfield's speech in the house of lords 1767, on the cause between the city of London and the dissenters, when the house affirmed the unanimous judgment of the commissioners' delegates, who delivered their opinions, *seriatim*, on the 5th of July, 1762, after hearing counsel several days.

By a bye-law of the city of London, no freeman chosen sheriff, &c. shall be excused, unless he voluntarily swears he is not worth 10,000*l.* &c.; and if he refuses to take the office, he incurs a forfeiture of 400*l.* The sheriff, before he exercises any part of his office, and before his patent is made out, is to give security in the king's remembrancer's office in the exchequer, under the penalty of 100*l.* for the payment of his proffers, and all other profits of the sheriffwick; he must also take the oaths of allegiance and abjuration, and all, except the sheriffs of Wales and Chester, an oath appointed by 3 Geo. I. c. 15, sect. 18, for the due execution of their office. This oath may be administered in pursuance of a writ of *dedimus potestatem*.

The power and duty of a sheriff are those that belong to him as a judge, as a keeper of the king's peace, as a ministerial officer of the superior courts of justice, or as the king's bailiff. In his judicial capacity he is to hear and determine all causes of forty shillings value and under, in his *County Court*; and he has also a judicial power in divers other civil cases. He is likewise to decide the elections of knights of the shire (subject to the control of the house of commons) of coroners, and of verderors; to judge of the qualification of voters, and to return such as he shall determine to be duly elected, but incapable of being elected himself for the county, &c. of which he is returning officer. As the keeper of the king's peace, both by common law and special commission, he is the first man in the county, and superior in rank to any nobleman therein, during his office. He may apprehend and commit to prison all persons who break the peace, or attempt to break it; and may bind any one in a recognizance to keep the peace. He may, and is bound, *ex officio*, to pursue and take all traitors, murderers, felons, and other misdoers, and commit them to gaol for safe custody. He is also to defend his county against any of the king's enemies when they come into the land; and, for this purpose, as well as for keeping the peace and pursuing felons, he may raise the *posse comitatus*. However, by the express directions of the great charter, the sheriff, together with the constable, coroner, and certain other officers of the king, are forbidden to hold any pleas of the crown, or, in other words, to try any criminal offence; for it would be highly unbecoming, that the executioners of justice be also the judges; should impose as well as levy fines and amercements; should one day condemn a man to death, and personally execute him the next. Neither may he act as an ordinary justice of the peace during the time of his office, for this would be equally inconsistent, he being, in many respects, the servant of the justices. In his ministerial capacity, the sheriff is bound to execute all process issuing from the king's courts of justice. In the commencement of civil causes, he is to serve the writ, to arrest, and to take bail: when the cause comes to trial, he must summon, and return the jury; when it is determined, he must see the judgment of the court carried into execution. In criminal matters, he also arrests and imprisons; he returns the jury; he has the custody of the delinquent; and he executes the sentence of the court, though it extend to death itself. To execute these various offices, the sheriff has under him many inferior officers, an under-sheriff, bailiffs, and gaolers, who must neither buy, sell, nor farm their offices, on forfeiture of 500*l.* 3 Geo. I. c. 15. The under-sheriff usually performs all the duties of office, few excepted, with regard to which the personal presence of the high-sheriff is necessary. But no under-sheriff shall abide in his office above one year by 44 Edw. III. c. 9; and if he does, by 23 Hen. VI. c. 8, he forfeits 200*l.* And no under-sheriff, or sheriff's officer shall practise as an attorney, during the time he continues in such office, by 1 Hen. V. c. 4. But these regulations are evaded, by practising in the names of other attorneys, and putting in their deputies by way of nominal under-sheriffs.

SHIELD, in heraldry, denotes the escutcheon or field, whereon the bearings of the armory are placed, and serve as marks of distinction, valour, honour, &c. See the *System*, Sect. I.

SHIP, a general name for all great vessels with sails, fit for navigation on the sea; but, in sea-language, the term is more particularly applied to a vessel furnished with three masts, each of which is composed of a lower mast, top-mast, and top-gallant-mast, with the usual machinery thereto belonging. For the construction of ships in general, see the *Treatise of NAVAL AFFAIRS*, Sect. IV. For a section of the internal parts of a first-rate ship of war, representation of the same lying at anchor, and also of a ship with three masts in full sail, see the plate annexed, Fig. 1 and 2.

SHOPLIFTER, a person who, on pretence of buying goods or otherwise, takes an opportunity to steal them; and if the goods amount to the value of five shillings, though no person be in the shop, he is guilty of felony without benefit of clergy, by 10 & 11 Will. III. c. 23.

SHORTSIGHTEDNESS, a defect in the conformation of the eye, wherein the crystalline, &c. being too convex, the rays reflected from different objects are refracted too much, and made to converge too fast, so as to unite before they reach the retina, by which means vision is rendered dim and confused. See the *System of OPTICS*. The ordinary remedy for shortsightedness is a concave lens, held before the eye, which, making the rays diverge, or at least diminishing much of their convergency, makes amends for the too great convexity of the crystalline.

SHRUB, *Frutex*, a little, low, dwarf tree, or a woody vegetable, of a size less than a tree; and which instead of one single stem, frequently from the same root puts forth several sets or stems. See *PLANT*.

SHWAN Pan, the name of a Chinese instrument, composed of a number of wires, with beads upon them, which they move backwards and forwards, and which serves to assist them in their computations. See *ABACUS*.

SIDERIAL Day, is the time in which any star revolves from the meridian to the meridian again; viz. 23 hours, 56 minutes, 4 seconds, 6 thirds of mean solar time. There are 366 sidereal days in a year, or in the time of 365 diurnal revolutions of the sun.

SIDUS (*Georgium*), in astronomy, a new primary planet, discovered by William Herschel, esq. of Bath, in the year 1781; for which he obtained from the Royal Society the honorary recompence of Sir Godfrey Copley's medal; and so called in honour of his majesty king George III. who has taken Dr. Herschel under his patronage, and granted to him an annual salary. For a particular account of this planet, see the *System*, Sect. VIII. Art. *NEW PLANET, or GEORGIUM SIDUS*.

SIGHING, an effort of nature, by which the lungs are put into greater motion, and more dilated, so that the blood passes more freely, and in greater quantity, to the left auricle, and thence to the ventricle. Hence we learn, says Dr. Hales, how sighing increases the force of the blood, and consequently proportionably cheers and relieves nature, when oppressed by its too slow motion, which is the case of those who are dejected and sad. *Hale's Statistical Essay*, vol. ii. p. 6.

SIGHT, the exercise, or act, of the sense of seeing. For a copious description of the organ of vision, see the *System of ANATOMY*, Part VII. Sect. V. For representation, see Plate XI. For explanation of the nature of vision, and what relates to sight, see the *System of OPTICS* throughout.

SIGN, in astronomy, a twelfth part of the ecliptic, or zodiac; or a portion containing thirty degrees thereof. See the *System*, Sect. IX.

SIGNAL, a certain sign agreed upon for the conveying intelligence to places to which the voice cannot reach. Signals are given for the beginning of a battle, or an attack; usually with drums and trumpets: at sea they are given by cannon or musquet shot, by lights, sails, flags, &c. All signals may be reduced into three different kinds; viz. those which are made by the sound of particular instruments; as the trumpet, horn, or fife, to which may be added, striking the bell, or beating the drum; those which are made by displaying pendants, ensigns, and flags of different colours; or by lowering or altering the position of the sails; and those which are executed by rockets of different kinds; by firing cannon or small arms; by artificial fire-works, and by lanterns.

SIGNALS at Sea, are signs made by the admiral, or commander in chief of a squadron of ships, either in the day, or by night, whether for sailing, for fighting, or for the better security of the merchant ships under their convoy. The signals are very numerous, and important; being all appointed and determined by order of the lord high admiral, and lords of the admiralty, and communicated in the instructions sent to the commander of every ship of the fleet, or squadron, before their putting out to sea. It is by the combination of signals, previously known, that the admiral conveys orders to his fleet; every squadron, every division, and every ship of which has its particular signal. The instructions, may, therefore, occasionally be given to the whole fleet, or to any of its squadrons, or to any division of those squadrons, or to any ship of these divisions. Hence the signal of command may at the same time be dif-

played for three divisions, and for three ships of each division; or for three ships in each squadron, and for only nine ships in the whole fleet. For the general signal of the fleet being shewn, if a particular pendant be also thrown out from some remarkable place on the same mast with the general signal, it will communicate intelligence to nine ships that wear the same pendant. The preparatory signal given by the admiral to the whole, or any part of his fleet, is immediately answered by those to whom it is directed; by shewing the same signal, to testify that they are ready to execute his orders. Having observed their answer, he will shew the signal which is to direct their operations; as, to chase, to form the line, to begin the engagement, to board, to double upon the enemy, to rally, or return to action, to discontinue the fight, to retreat, and save themselves. The dexterity of working the ships in a fleet depends on the precise moment of executing these orders, and on the general harmony of their movements; a circumstance which evinces the utility of a signal of preparation.

SILK, *Sericum*, a very soft, fine, bright, delicate thread; the work of an insect called bombyx, or the silk-worm. The ancients were but little acquainted with the use and manufacture of silk. It was in the Isle of Cos that the art of manufacturing silk was first invented; and Pamphila, daughter of Platis, is honoured as the inventress. The discovery was not long unknown to the Romans. *Silk* was brought thence from *Serica*, where the worm was a native. But so far were they from profiting by the discovery, that they could not be induced to believe so fine a thread should be the work of a worm, and thereupon formed a thousand chimerical conjectures of their own. *Silk* was a very scarce commodity among them for many ages; it was even sold weight for weight with gold: inasmuch that Vopiscus tells us, the emperor Aurelian, who died A.D. 275, refused the empress, his wife, a suit of silk, which she solicited of him with much earnestness, merely on account of its dearth.

In 1521, the French being supplied with workmen from Milan, commenced a silk manufacture; but it was long after this time before they could obtain raw silk from the worms; and even in the year 1547, silk was scarce and dear in France; and Henry II. is said to have been the first who wore a pair of silk knit stockings; though the first invention originally came from Spain, whence silk stockings were brought over to Henry VIII. and Edward VI. of England.

The great advantages which the new manufacture afforded, made our king James I. very earnest for its being introduced into England; accordingly it was recommended several times from the throne, and in the most earnest terms, particularly in the year 1608, to plant mulberry-trees, &c. for the propagation of silk-worms, but unhappily without effect; though from the various experiments we meet with in the *Philosophical Transactions*, and other places, it appears that the silk-worm thrives and works as well, in all respects, in England, as in any other part of Europe. However, towards the latter end of this king's reign, i.e. about the year 1620, the broad silk manufacture was introduced into this country, and prosecuted with great vigour and advantage. In 1629, the silk manufacture was become so considerable in London, that the silk-throwsters of the city and parts adjacent were incorporated, under the name of master, wardens, &c. of the silk-throwsters; and in 1661, this company of silk-throwsters employed above forty thousand persons. The revocation of the edict of NANTS, in 1685, contributed in a great degree to promote the silk manufacture in this kingdom; as did also the invention of a silk-throwing machine at Derby in 1719. The silkworm is an insect not more remarkable for the precious matter it furnishes for divers stuffs, than for the many forms it assumes, before and after its being enveloped in the rich cod or ball which it weaves for itself. From a small egg, about the size of a pin's head, which is its first state, it becomes a pretty big worm, or caterpillar; of a whitish colour, inclining to yellow. In this state it feeds on mulberry leaves, till, being come to maturity, it winds itself up in a silken bag, or case, about the size and shape of a pigeon's egg, and becomes metamorphosed into an aurelia; in this state it remains without any signs of life or motion; till at length it awakes to become a butterfly, after making itself a passage out of its silken sepulchre; and, at last, dying indeed, it prepares itself, by an egg which it casts, for a new life, which the warmth of the summer weather assists it in resumming. In many other respects it resembles the caterpillar. See *CATERPILLAR*.

SILPHA, in the Linnæan system of entomology, a genus of the coleoptera order of insects. For description and classification, see the *System*, Order I. Genus VIII.

SILVER, called also *Luna* by chymists; a white rich metal; being the finest, purest, most ductile, and most precious of all metals, except gold: silver contracts no rust, nor does it admit any change of its colour and brilliancy from the combined action of air and water: however, its surface is apt to tarnish, and even to become black, by the contact of the phlogiston of several inflammable matters, or of their exhalations, because it has the property of impregnating itself with the inflammable principle, even in the cold, to a greater degree than any other metal. See the *System*, Part III. Chap. II. Sect. VI. The effect of the vapour of putrefied urine, &c. in

been the occasion of many abuses with regard to wire and laces: for preventing which several edicts have been issued in France. There are silver mines in all the four quarters of the world. Europe has its share: nor is our own island quite destitute thereof, though it has none yet discovered of much value. Although we have no silver mines, properly speaking, in Great Britain, we have plenty of lead, from which silver is, in some places, extracted with considerable advantage. The Derbyshire lead has been said to contain two grains of silver in a pound of lead; and, it is said, that there are some lead ores in Great-Britain, which, though very poor in lead, contain between three and four hundred ounces of silver in a ton of lead. Silver has formerly been extracted from lead in many places in this island. In the reign of Edward I. near sixteen hundred pounds weight was obtained in the course of three years from a mine in Devonshire; and the lead mines in Cardiganshire have at different periods afforded great quantities of silver: sir Hugh Middleton is said to have cleared from them two thousand pounds a month, and thus to have been enabled to undertake the great work of bringing the New River from Ware to London. These same mines yielded, in the time of the great rebellion, eighty ounces of silver out of every ton of lead, and part of the king's army was paid with this silver, which was minted at Shrewsbury.

The mines of Peru and some other parts of America, are much the richest, and most abundant; they appeared almost inexhaustible; particularly those of Potosi, which, although decayed, continue to be dug with considerable advantage, with this only difference, that the veins which were formerly almost in the surface of that famous mountain, are now sunk to prodigious depths, the workmen going into them by a painful descent of four or five hundred steps. Many millions of Indians have perished in them; and prodigious numbers continue to be destroyed there yearly. The assay of silver is also made by the coppel, in the same manner as the refining by lead. If the silver, after this assay, preserve its weight, it is standard; if it lose, the grains or pennyweights of its diminution are accounted. See the article ASSAY.

SILVERING, the covering any work with silver leaf or powder. See the articles LACQUER, and GILDING.

SILURUS, in ichthyology, a genus belonging to the order *Abdominales*. For classification, see the System, Order V.

SIMIA, the second genus of the order *Primates*, in the system of mammalia. This race of animals which is very numerous, is almost confined to the torrid zone; they fill the woods of Africa from Senegal to the Cape, and from thence to Ethiopia; they are found in all parts of India, and its islands; in Cochinchina, in the south of China, and in Japan; and one kind is met with in Arabia; they swarm in the forests of South America, from the Isthmus of Darien as far as Paraguay. These animals are lively and full of frolic, chatter, and grimace: from the structure of their members, they have many actions in common with the human kind: most of them are fierce and untameable; some are of a milder nature, and will shew a degree of attachment, but in general they are mischievous, filthy, lascivious and thieving. They feed on fruits, leaves, and insects; inhabit woods, and live in trees; are in general gregarious, and go in large companies: the different species never mix with each other, but always keep apart: They leap with great activity from tree to tree, even when loaded with their young, which cling to them: they are the prey of leopards, and other animals, of the feline race, and also of serpents, which pursue them to the summits of the trees and swallow them entire; they are not carnivorous, but for the sake of mischief, will rob the birds' nests of the eggs and young; and it is observed that in those countries where apes most abound, the feathered tribe discover singular sagacity in fixing their nests beyond the reach of these invaders. See MOTACILLA.

Linnaeus enumerates thirty-three species of this genus, amongst which the following are the most remarkable: 1. The satyrus, orang-outang, or great ape, has a flat face, and a deformed resemblance of the human; ears exactly like those of a man; the hair on the head longer than on the body. The body and limbs are covered with reddish and shaggy hair; longest on the back, thinnest on the fore-parts. The face and paws are swarthy; the buttocks covered with hair. They inhabit the interior parts of Africa, the isles of Sumatra, Borneo, and Java. Are solitary, and live in the most desert places. They grow to the height of six feet: have prodigious strength, and will overpower the strongest man. The old ones are shot with arrows, the young alone can be taken alive. They live entirely on fruits and nuts. They will attack and kill the negroes who wander in the woods; will drive away the elephants, and beat them with their fists and pieces of wood; and will throw stones at the people that offend them. They sleep in trees; and make a sort of shelter from the inclemency of the weather. They are of a grave appearance and melancholy disposition, and even when young not inclined to frolic. They go erect, and are vastly swift and agile. Froger, a French naturalist, informs us, "that those on the banks of the river Ganges are larger and more mischievous than in any part of Africa: the negroes dread them, and cannot travel alone in the country, without running the hazard of being attacked by these animals. I have heard the Portuguese say, that they have often seen them hoist up young girls, about

seven or eight years old, into trees, and that they could not be wrestled from them without a great deal of difficulty." When taken young, they are capable of being tamed, and taught to perform many menial offices. Francis Pyard relates, "that in the province of Sierra Leona there is a species, so strong limbed, and so industrious, that, when properly trained and fed, they work like servants; that they generally walk on their two hind-feet; that they pound any substance in a mortar; that they go to bring water from the river in small pitchers, which they carry full on their heads. But when they arrive at the door, if the pitchers are not soon taken off, they allow them to fall; and when they perceive the pitchers overturned and broken, they weep and lament." They are taken with snares, taught to walk on their hind-feet, and to use their fore-feet as hands in performing different operations, as rinsing glasses, carrying drink round the company, turning a spit, &c. "I saw at Java," says another naturalist, "a very extraordinary ape. It was a female. She was very tall, and often walked erect on her hind-feet. Except the eyebrows, there was no hair on the face, which pretty much resembled the grotesque female faces I saw among the Hottentots at the Cape. She made her bed very neatly every day, lay upon her side, and covered herself with the bedclothes. When her head ached, she bound it up with her handkerchief; and it was amusing to see her thus hooded in bed. I could relate many other little articles which appeared to me very singular." Gemelli Careri tells us, that he saw one of these apes, which cried like an infant, walked upon its hind feet, and carried a mat under its arm to lie down and sleep upon.

An orang-outang, which Buffon saw, is described by him as mild, affectionate, and good-natured. His air was melancholy, his gait grave, his movements measured, his dispositions gentle, and very different from those of other apes. He had neither the impatience of the Barbary ape, the maliciousness of a baboon, nor the extravagance of the monkeys. "It may be alleged (says our author) that he had the benefit of instruction; but the other apes which I shall compare with him, were educated in the same manner. Signs and words were alone sufficient to make our orang-outang act: but the baboon required a cudgel, and the other apes a whip; for none of them would obey without blows. I have seen this animal present his hand to conduct the people who came to visit him, and walk as gravely along with them as if he had formed a part of the company. I have seen him sit down at table, unfold his towel, wipe his lips, use a spoon or fork to carry the victuals to his mouth, pour his liquor into a glass, and make it touch that of the person who drank along with him. When invited to take tea, he brought a cup and saucer, placed them on the table, put in sugar, poured out the tea, and allowed it to cool before he drank it. All these actions he performed without any other instigation than the signs or verbal orders of his master, and often of his own accord. He did no injury to any person; he even approached company with circumspection, and presented himself as if he wanted to be caressed." See Plate I. Genus II. Species 2. Variety 1.

There is another variety of this species, called Chimpanzee, an animal very much approaching to the human figure; but of a fierce disposition, and remarkably mischievous. In the year 1738, we had one of these creatures brought over into England, by the captain of a ship in the Guinea trade; it was of the female sex, and was two feet four inches high; but they grow in their native country, to the height of five feet; it naturally walked erect, and was hairy on some parts of the body and limbs, and of a strong muscular make. It would eat very coarse food, and was very fond of tea, which it drank out of a cup with milk and sugar, as we do; it slept in the manner of the human species, in which it resembles the animal before described; in its voice it made some imitation of the human speech when people speak very hastily, but without any articulate sound. The males of this species are very bold, and will fight a man, though they see him armed. It is said that they often set upon, and ravish, the negro-women, when they meet them in the woods. See Plate I. Genus II. Species 2. Variety 2.

3. The innuus, magot, or Barbary ape, has a long face, not unlike that of a dog; canine teeth, long and strong; ears like the human: nails flat: buttocks bare: colour of the upper part of the body, a dirty greenish brown; belly, of a dull pale yellow: grows to above the length of three feet. They inhabit many parts of India, Arabia, and all parts of Africa, except Egypt, where none of this genus are found. A few are found on the hill of Gibraltar, which breed there: probably from a pair that had escaped from the town; as they are not found in any other part of Spain. They are very ill-natured, mischievous, and fierce; agreeing with the character of the ancient Cynocephali. These are a very common kind in exhibitions. By force of discipline, are made to play some tricks; otherwise, they are more dull and sullen than the rest of this genus. Apes were worshipped in India, and had magnificent temples erected to them. When the Portuguese plundered one in Ceylon, they found in a little golden casket the tooth of an ape; a relic held by the natives in such veneration, that they offered 700,000 ducats to redeem it, but in vain; for it was burnt by the viceroy, to stop the progress of idolatry. For representation of this animal, see Plate I. Genus II. Species 3.

4. The nemestrina, or pig-tail baboon, with a pointed face, which is naked, of a swarthy redness: two sharp canine teeth: ears

ears like the human; hair on the ribs and body, brown, inclining to ash-colour, palest on the belly: fingers black: nails long and flat: thumbs on the hind feet very long, connected to the nearest toe by a broad membrane: tail four inches long, slender, exactly like a pig's, and almost naked; the bar spades on the rump red, and but small: length from head to tail 22 inches. Inhabits the Isles of Sumatra and Japan: is very docile. In Japan it is taught several tricks; and carried about the country by mountebanks. For representation of this animal, see Plate I. Genus II. Species 4.

6. The sphynx or great wood baboon, with a long dog-like face, covered with a small glossy black skin; hands and feet naked, and black like the face; hair on all parts long, elegantly mottled with black and tawny; nails white. About three feet high when erect; tail not three inches, and very hairy on the upper part. Inhabits Guinea, where it is called the *man of the wood*. For representation, see Plate I. Species 6.

8. The hamadryas, or dog-faced baboon. The colour of the greater part of the hair of this animal is grey and olive-brinded; the hands and feet are dusky, the buttocks are very bare, and covered with a skin of a bloody colour. We need not enter into a description of the form and proportion of this animal, as they are accurately represented in Plate I. Species 8. They inhabit the hottest parts of Africa and Asia; where they keep in vast troops, and are very fierce and dangerous. They rob gardens. They will run up trees when prisoners go by, shake the boughs at them with great fury, and chatter very loud. They are excessively impudent, indecent, lascivious: most detestable animals in their manners as well as appearance. They range the woods in hundreds; which obliges the owners of the coffee-plantations to be continually on their guard against their depredations. One of them was shown in London, some years ago: it came from Mokha, in the province of Yeman, in Arabia Felix, in the Persian Gulf; and was above five feet high. It was very fierce and untameable; so strong, as easily to master its keeper, a stout young man. Its inclinations to women appeared in the most violent manner. A footman, who brought a girl to see it, in order to teize the animal, kissed and hugged the girl: the beast, enraged at being so tantalized, caught hold of a quart pewter pot, which he threw with such force, and so sure an aim, that, had not the man's hat and wig softened the blow, his skull must have been fractured; but he fortunately escaped with a common broken head.

18. The *fabæa*, or green monkey, has a black and flat face: the side of it bounded by long white hairs, falling backwards, and almost covering the ears, which are black; and like the human: head, limbs, and whole upper part of the body and tail, covered with soft hair, of a yellowish green colour at their ends, cinerous at their roots: under side of the body and tail, and inner side of the limbs, of a silvery colour: tail very long and slender: size of a small cat: inhabit different parts of Africa: keep in great flocks, and live in the woods: they are very common in the Cape Verd islands. For representation, see Plate I. Species 18.

19. *Cephus*, or white eyelid monkey, has a long, black, naked, and dog-like face: the upper eyelids of a pure white: ears black, and like the human: no canine teeth. For representation, see Plate I. Species 19.

24. The *iaccus*, or striated monkey, with a very round head: about the ears two very long full tufts of white hairs standing out on each side: irides reddish: face a swarthy flesh colour: ears like the human: head black: body ash-coloured, reddish, and dusky; the last forms striated bars across the body: tail full of hair, annulated with ash-colour and black: body seven inches long: tail, near eleven: hands and feet covered with short hairs: fingers like those of a squirrel: nails, or rather claws, sharp. Inhabits Brasil: feeds on vegetables; will also eat fish: makes a weak noise: very restless: often brought over to Europe. For representation, see Plate I. Species 24.—The two following species are not enumerated in the System of Linnæus, having been discovered by other naturalists, since his time.

34. The *mico*, or white monkey, with a small round head: face and ears of the most lively vermilion colour: body covered with most beautiful long hairs, of a bright and silvery whiteness, of matchless elegance; tail of a shining dark chestnut: head and body eight inches long: tail twelve. Inhabits the banks of the Amazons; discovered by M. de Condamine. For representation, see Plate I. Species 34.

35. *Nasus niger*, black-nosed monkey or talapoin, is a native of the East-Indies, where it is suffered to multiply without molestation, owing to the religious superstition of the brahmins, which forbids them to take the life of any kind of animal whatever. They are so tame and familiar, that numbers of them frequently come into their towns, enter the houses, and, if not prevented, help themselves to whatever they meet with that is agreeable to them, such as fruits, sweetmeats, &c. The talapoin is about twelve inches long: its head is round; ears black, and shaped like the human; eyes of a bright hazel colour, with black pupils; the nose remarkably black at the tip; the hair on the back, upper part of the body, and limbs, of a dusky yellow, tinged with green; the belly lighter: its tail very long, slender, and of an olive colour. For representation see Plate I. Species 35.

SIMILE, or *Similitude*, in oratory, a comparison of two things, which, though different in other respects, yet agree in some one. As, *He shall be like a tree planted by the water side*, &c. so that in every *similitude* three things are requisite; two things that are compared together; and a third, in which the likenesses or *similitude* between them consists. The difference between a *simile* and a *comparison* consists in this, the *simile* belongs to what we call the quality of the thing, and the comparison to the quantity. And the difference between a metaphor and *similitude* consists in this, that a *metaphor* has not those signs of comparison which are expressed in a *similitude*. For the effect of simile, in oratory, see the Treatise, Part III. Sect. II. Art. 3.

SIMONIAICAL, is applied to a person guilty of simony; that is, of purchasing a benefice, or other sacred matter, with money.

SIMONY, *Simonia*, the crime of trafficking with sacred things; particularly the corrupt presentation of any one to an ecclesiastical benefice for money, gift, or reward. The word is borrowed from Simon Magus, who is mentioned in the Acts of the Apostles, as offering to buy the power of working miracles with money: though the purchasing of holy orders seems to approach nearer to his offence. By the English canons, anno 1229, *simony* is not only committed by an agreement for money in hand, or to be paid yearly; but by any other profit or emolument; any reward, gift, or benefit, directly or indirectly; or by reason of any promise, grant, bond, &c. and this either in the acceptance of a living, or in an exchange or resignation. Simony was by the canon law a very grievous crime; and it is so much the more odious, because, as Sir Edward Coke observes, it is ever accompanied with perjury; for the presentee is sworn to have committed no *simony*. However, it was not an offence punishable in a criminal way at the common law; it being thought sufficient to leave the clerk to ecclesiastical censures: but many acts of parliament have been made to restrain it by means of civil forfeitures. Farther, by the statute 12 Ann. stat. 2, c. 12, if any person, for money or profit, shall procure, in his own name, or the name of any other, the next presentation to any ecclesiastical living, and shall be presented thereupon, this is declared to be a simoniacal contract, and the party is subjected to all the ecclesiastical penalties of *simony*, is disabled from holding the benefice, and the presentation devolves to the crown.

SIMPLICITY, in writing. If we examine the writers whose compositions have stood the test of ages, and obtained that highest honour, "the concurrent approbation of distant times and nations," we shall find that the character of simplicity is the unvarying circumstance which alone hath been able to gain this universal homage from mankind. Among the Greeks, whose writers in general are of the simple kind, the divinest poet, the most commanding orator, the finest historian, and deepest philosopher, are, above the rest, conspicuously eminent in this great quality. The Roman writers rise towards perfection according to that measure of simplicity which they mingle in their works; indeed, they are all inferior to the Greek models. But who will deny that Lucretius, Horace, Virgil, Livy, Terence, and Tully, are at once the simplest and best of Roman writers? It is this simplicity hath given to Boileau the most lasting wreath in France, and to Shakespeare and Milton in England; especially to the last, whose writings are more unmixed in this respect, and who had formed himself entirely on the simple model of the best Greek writers and of the sacred scriptures.

As it appears from these instances, that simplicity is the only universal characteristic of just writing, so the superior eminence of the sacred scriptures in this prime quality hath been generally acknowledged. One of the greatest critics in antiquity, himself conspicuous in the sublime and simple manner, hath borne this testimony to the writings of Moses and St. Paul; and by parity of reason we must conclude, that had he been conversant with the other sacred writers, his taste and candour would have allowed them the same encomium.

It hath been often observed, even by writers of no mean rank, that the "Scriptures suffer in their credit by the disadvantage of a literal version, while other ancient writings enjoy the advantage of a free and embellished translation." But in reality those gentlemen's concern is ill-placed, and groundless: for the truth is, "that most other writings are impaired by a literal translation; whereas, giving only a due regard to the idiom of different languages, the sacred writings, when literally translated, are then in their full perfection." Now this is an internal proof, that in all other writings there is a mixture of local, relative, exterior ornament, which is often lost in the transfusion from one language to another.—But the internal beauties, which depend not on the particular construction of tongues, no change of tongue can destroy. Hence, the Bible-composition preserves its native beauty and strength alike in every language, by the sole energy of unadorned phrase, natural images, weight of sentiment, and great simplicity.

It is in this respect like a rich vein of gold, which, under the severest trials of heat, cold, and moisture, retains its original weight and splendour, without either loss or alloy; while baser metals are corrupted by earth, air, water, fire, and assimilated to the various elements through which they pass. This circumstance, then, may be justly regarded as sufficient to vindicate the composition of the sacred scriptures, as it is at once their chief excellence and greatest security.

SECURITY. It is their excellence, as it renders them intelligible and useful to all; it is their security, as it prevents their being disguised by the false and capricious ornaments of vain or weak translators. We may safely appeal to experience and fact for the confirmation of these remarks on the superior simplicity, utility, and excellence of the style of the holy scripture. Is there any book in the world so perfectly adapted to all capacities; that contains such sublime and exalted precepts, conveyed in such artless and intelligible plain; that can be read with such pleasure and advantage by the lettered sage and the unlettered peasant?

SIN, denotes want of conformity to the law of God in the things which that law requires, or the transgression of that law in those things which it forbids; and under this definition are comprehended both the sins of omission and sins of commission.

SINCERITY, in ethics, is that excellent habitude and temper of mind, which gives to virtue its reality, and makes it to be what it appears. Sincerity has respect to two sorts of objects: persons and things. Of the first kind are God; other men; and every man's self. Sincerity with regard to God, signifies, that the form of religion is accompanied with the power of it, and that piety and obedience are substantial and unaffected; proceeding from principles, right in themselves, and uniform in their influence. Sincerity, as it regards men, implies an honesty and openness in our dealings with them, extending to the springs and motions of our actions, as well as the actions themselves. As to things, truth and goodness are the principal objects of sincerity. The extremes of this virtue are over-frankness and hypocrisy.

SINCIPIUT the fore-part of the head, reaching from the forehead to the coronal suture. See the System of ANATOMY, Part I. Sect. II. Art. 1.

SINE, or *Right-SINE*, in trigonometry, a rightline drawn from one extremity of an arch, perpendicular to the radius drawn from the other extremity: or, the sine is half the chord of twice the arch. See the Treatise on TRIGONOMETRY.

SINGING, the act of making divers inflexions of the voice, agreeable to the ear, and correspondent to the notes of a song, or piece of melody. The first thing done in learning to sing, is to raise a scale of notes, by tones and semitones, to an octave; and descend again by the same notes; and then to rise and fall by greater intervals; as a 3d, 4th, and 5th, and to do all this by notes of different pitch. Then these notes are represented by lines and spaces, to which the syllables *fa, sol, la, mi*, are applied, and the pupil is taught to name each line and space thereby; whence this practice is usually called *sol-fa-ing*. See the System of MUSIC, Plate I.

SINGING of Birds. It is worthy of observation, that the female of no species of birds ever sings: with birds it is the reverse of what occurs in human kind. Among the feathered tribe, all the cares of life fall to the lot of the tender sex: their's is the fatigue of incubation, and the principal share in nursing the helpless brood: to alleviate these fatigues, and to support her under them, nature hath given to the male the song, with all the little blandishments and soothing arts; these he fondly exerts, even after courtship, on some spray contiguous to the nest, during the time his mate is performing her parental duties. But that she should be silent is also another wise provision of nature, for her song would discover her nest; as would a gaudiness of plumage, which, for the same reason, seems to have been denied her. On the song of birds several curious experiments and observations have been made, by the Hon. Daines Barrington. See Philosophical Transactions, vol. lxiii.

SINISTER, in heraldry. The sinister side of an escutcheon is the side answering to the right-hand of the person who looks at it. See the System, Sect. I.

SINKING FUND. See FUND.

SINUS, in anatomy, denotes a cavity in certain bones, and other parts, the entrance whereof is very narrow, and the bottom wider, and more spacious.

SIPHON, in hydraulics. For description, see the System, Part II. Art. 2. For representation, see Plate I. fig. 12, 13, 14, 15, and 16.

SIREX, in entomology, a genus of the hymenoptera class of insects. For description and classification, see the System, Sect. VIII.

SIRIUS, in astronomy, the *Dog-star*; a very bright star of the first magnitude, in the mouth of the constellation *Canis Major*, or the Great Dog. See the System, Sect. VIII.

SITTA, in ornithology, a genus belonging to the order *Picæ*. There are three species, the most remarkable of which is, the *Europæa*, or nut-hatch, which is in length near five inches three quarters, breadth nine inches. This bird runs up and down the bodies of trees, like the woodpecker tribe; and feeds not only on insects but nuts, of which it lays up a considerable provision in the hollows of trees. It is a pretty sight, says Mr. Willoughby, to see her fetch a nut out of her hoard, place it fast in a chink, and then, standing above it with its head downwards, striking it with all its force, break the shell, and catch up the kernel. For representation, see Plate II. Genus 24.

SIX-CLERKS, officers in chancery, of great account, next in degree below the twelve masters; whose business is to enroll commissions, pardons, patents, warrants, &c. which pass the great seal, and to transact and file all proceedings by bill, answer, &c.

SKELETON, *Σκελετον*, formed from *σκελλω*, I dry, in anatomy,

an assemblage or arrangement of all the bones of a dead animal, dried, cleaned, and disposed in their natural situation; and kept in that disposition by means of wires, &c. Skeletons serve for good purpose in learning the osteology. For the several bones of which a human skeleton consists, see the System, Part I. Plate I. Figures in general.

We have, in the Philosophical Transactions, an account of a human skeleton, all the bones of which were so united, as to make but one articulation from the back to the os sacrum, and downwards a little way. On sawing some of them, where they were unnaturally joined, they were found not to cohere throughout their whole substance, but only about a sixth of an inch deep all round. The figure of the trunk was crooked, the spine making the convex, and the inside of the vertebræ the concave part of the segment. The whole had been found in a charnel-house, and was of the size of a full-grown person.

We have sufficiently explained the human skeleton, and its several parts, in the System of ANATOMY, Part I. and illustrated them by the plates thereto annexed. Respecting the skeletons of quadrupeds, birds, fishes, &c. we have given, in five plates, several accurate and faithful representations, which will serve to convey a better idea of them than any verbal description that could possibly be given. As the muscles, viscera, organs of generation, &c. of these animals are better understood from description than representation, the reader will find them fully explained in the System of COMPARATIVE ANATOMY. We shall only subjoin a few remarks relative to some of the skeletons we have introduced in the work.

In Plate I. of Comparative Anatomy, we have given a representation of the skeleton of a monkey, which tends to shew, in many instances, the affinity of this race of animals, in point of structure, to the human form. In the same plate is a representation of the skeleton of a bear, in which it is curious to remark the great strength of the jaws, the neck, and fore-feet, and the shortness of the uppermost ribs, which renders the animal so strong as to be able to grasp any object with the utmost force; and is therefore its principal means of defence.

In Plate IV. is the skeleton of a hedgehog. This animal is remarkably formed for folding his body round; the action represented in the plate, is that when he begins to unfold himself. This furnishes him with a power of defence; as, being possessed of little strength or agility, he does not attempt to fly from or assail his enemies, but erects his bristles, and rolls himself up like a ball, exposing no part of his body that is not furnished with sharp weapons of defence.

From the representation of the skeleton of a rabbit, Plate III. it appears that the bones are so constructed as to bring the hind feet easily under the centre of gravity of the whole body, while the animals scratch their holes; and for this reason the fore-feet are bent from the earth to pass easily underneath them; and their jaws are particularly constructed for their feeding on the bark of trees as well as on grass.

The skeleton of the mole is represented in the same plate, in two views, to shew the vast strength of the fore-feet for digging; the slenderness of the head; the back-bones with small processes, and the posture of the hind-legs; all contrived for their passing easily along the holes they dig.

The skeleton of the camelion, Plate III. stands in the same posture as they usually do in trees, where they live by catching flies, and for their drink they thrust forwards their lower jaw, and receive the drops of dew that fall down their foreheads.

In Plate II. is the skeleton of an ostrich, which being a bird formed for walking or running, the bones of the legs are made exceedingly strong, and when standing straight, unlike other birds, almost under the centre of gravity. The wings, though small, are very useful when they run fast, or leap.

The skeleton of a thornback, a little dried, is represented in Plate V. with such care and accuracy, that there is not one rib or joint more or less than in the life.

Next to the representation of the thornback, are the bones of the head of a pike, which being loosely connected, and the lower jaw composed with an additional bone on each side, like the jaw of a viper, their jaws are thereby capable of being vastly extended, when they swallow their prey, which they do whole, and oftentimes things of a greater diameter than themselves.

SKIN, in anatomy, a large thick membrane, spread over the whole body, serving as the external organ of feeling, and as a cover and ornament of the parts underneath. For a particular description, see the System, Part II. Sect. I.

The cuticle, or scarf-skin of the human body is remarkable for its scales, and for its pores; its scales are wholly a microscopical discovery, for being so very minute that two hundred of them may be covered with a grain of sand, they never could have been discovered by the naked eye. These are placed on our skin as on fishes, that is, three deep, or each scale so far covered by two others, that only a third part of it appears; and their lying in this manner over one another, seems to be the reason of the skin appearing white; for about the mouth and lips, where they only just meet together, and do not fold over, the blood-vessels are seen through, and the parts appear red. The perspirable matter is supposed to issue from between these scales, which lie over the pores, or excretory vessels, through which the watery and oily matters perspire: and these may

find vent in a hundred places round the edges of each scale; so that if a grain of sand can cover two hundred of these scales, it may cover twenty thousand places through which perspiration may issue forth. See PERSPIRATION.

SKIN, in commerce, is particularly used for this membrane stripped off the animal, to be prepared by the tanner, skinner, currier, parchment-maker, &c. and converted into leather, &c.

SKULL, *Cranium*, in anatomy, that great boney cavity of the head, which contains the brain. See the System, Part I. Sect. II. Art. 1.

SKY, the blue expanse of air or atmosphere. The azure colour of the sky, Sir Isaac Newton attributes to vapours beginning to condense therein, which have got consistence enough to reflect the most reflexible rays, viz. the violet ones; but not enough to reflect any of the less reflexible ones.

SLATE, a bluish fissile stone, very soft when dug out of the quarry, and on that account easily cut and split into thin long squares or scollops, to serve in lieu of tiles for the covering of houses; sometimes also to make tables, and for paving.

SLAVE, a person in the absolute power of a master, either by war or conquest.

We find no mention of slaves before the deluge; but immediately after, viz. in the curse of Canaan, Gen. ix. 25; whence it is easily inferred, that servitude commenced soon after that time; for in Abraham's days we find it generally established. Some will have it to have commenced under Nimrod, because it was he who first began to make war, and of consequence to make captives; and to bring such as he took, either in his battles or irruptions, into slavery. Among the Romans, a slave, when he was set at liberty, changed his name into a surname, and took the nomen or prænomen of his master; to which he added the cognomen he had been called by when a slave. Great part of the Roman wealth consisted in slaves; they had the power of life and death over them, which no other nation had; but this severity was afterwards moderated by the laws of the emperors. The slaves were esteemed the proper goods of their masters, and all they got belonged to them; but if the master was too cruel in his correction, he was obliged to sell his slave at a moderate price. The Romans not only approved of, but even invented new ways of making slaves; for instance, a man born free among them, might sell his freedom, and become a slave. There were generally three ways of obtaining slaves; either when they bought them with the booty taken from the enemy, distinct from the share reserved for the public: or of those who took them prisoners in war; or of merchants who dealt in them, and sold them at fairs. Slavery is absolutely abolished in Britain, particularly as to personal servitude. See SERVANT.

SLAUGHTER, See MANSLAUGHTER, HOMICIDE, MURDER, &c.

SLEEP, that state of the body in which, though the vital functions continue, the senses are not affected by the ordinary impressions of external objects. Under the article DREAMS the nature of sleep has been investigated so fully, that little remains to be said in this place, besides the obviating a few objections that may be made to the account of it there given. Sleep we have shewn to arise immediately from the communication between our sentient principle and external objects being cut off; in consequence of which memory is also lost, and the person becomes insensible of existence. This state may be induced either by such causes as affect the brain, the nervous system, or the blood; though it probably depends, in most cases, on the state of the vital fluid. The greatest difficulties that occur in giving a solution of the phenomenon of sleep is that it may be brought on by seemingly opposite causes.—Thus, though moderate fatigue will induce a propensity to sleep, the same may be brought on by eating a full meal, without any fatigue at all. In like manner, though moderate fatigue will induce sleep, too great a degree of fatigue will prevent it altogether. This, however may easily be solved, on the principles laid down in the abovementioned article. It is there supposed that the mass of blood contains the vital principle, or what is called the animal-spirits, like a general reservoir, to be distributed through the whole body. Part of the blood is sent to the brain, where another collection or reservoir is made, serving in a particular manner for the purposes of reason, memory, and the rest of our mental faculties. The rest of the blood is distributed through the whole body, where some part of the vital spirit is taken up by each of the small extremities of the nerves, and by means of the nerve communicates a certain sensation to the brain when these extremities are affected by any external object. As long as the blood continues in a sound state, and can supply a certain quantity of these spirits, the person remains awake; but when the supply is interrupted, by whatever means, he necessarily falls asleep. This is the case with a person when moderately fatigued; the blood being then deprived in some measure of part of that animating principle which is necessary to the exercise of our external senses, or for keeping us awake. If the fatigue be carried to too great a length, the crisis of the blood itself is injured, and it becomes incapable of retaining the necessary quantity for carrying on the operations of life; which though independent of our senses, are maintained by means of the same principle with them. Hence, though the person remains awake, he is far from being in health; and if the watchfulness continues

for any considerable time, he is in great danger of becoming delirious. After a person has taken a full meal, he is seized with drowsiness, because the fresh chyle continually pouring into the subclavian vein, requires the exertion of great part of the vital power to assimilate it to the blood, so that enough is not left to affect the senses so readily as usual. In like manner may we understand the sleep which follows the immoderate use of spirituous liquors, of large doses of opium, &c. These seem to act by rarefying the blood to such a degree, that the fine vessels are over-stretched, and compress the small nervous fibres which everywhere accompany them, so as to destroy, for a time, their power of action. In the same manner do the vapours of charcoal or fixed air, in any manner applied, seem to act. Hence the best cure for persons affected by these things is to cool them as much as possible; and hence also we may see the reason why drunken people will bear an exposure to much greater degrees of cold, without injury, than such as are sober. How cold itself induces sleep, is easily understood. The whole body is then so benumbed, that neither the blood can part with its animating principle, nor can the nerves take it up even if it should do so; and hence the fatal sleep which ensues in such cases. From what has been advanced concerning the nature of sleep, we may easily see, that its uses are to restore the spirits and strengthen the body, though too great indulgence in this respect has a contrary effect. The night is the most proper time for sleep, by reason of the absence of the solar light, which animates the whole creation, and in some measure prevents that waste of spirits which is the consequence of watching for any length of time. Hence we see why a person who has sat up all night finds a revival of his spirits in the morning; and why nocturnal watchings are prejudicial to health, even though a person should indulge himself in sleeping throughout the day. Perspiration, during the time of sleep, is twice as great as at other times: upon sleeping too long, the head grows heavy, the senses dull, the memory weak, with coldness, pituitousness, an indispotion of the muscles for motion, and a want of perspiration. Much sleeping will sustain life a long time, without either meat or drink; for upon a laudable sleep there always follows an expansion of all the muscles, frequently a repeated yawning, and the muscles and nerves acquire a new agility. Fœtuses always sleep; children often; youth more than grown persons, and they more than old men; and people recovering from violent distempers, sleep much more than when perfectly in health.

Some animals require much more sleep than others, and many continue even for months in this state. For the human species, six or seven hours are generally sufficient; though from habit many require eight, nine, or even ten hours. Those who addict themselves to study, in general require much sleep, on account of the great waste of spirits which intense thought occasions.

SLEEP of the Soul, in theology, denotes that insensible, unconscious, and inactive state into which some have supposed that mankind are removed at death, and in which they remain till the period of the general resurrection and last judgment. The term sleep has been used by way of contradistinction to that which has been commonly called the intermediate or separate state. Of the advocates of this opinion, some have allowed the essential distinction between body and spirit, and the natural immortality of the human soul; so that, being a substance and not a mode, it will go on to exist, till by some positive act of the Creator it is annihilated. They cannot admit the supposition, that the whole man becomes extinct at death, or that death destroys or annihilates the thinking substance; because, they say, the resurrection, on this hypothesis, will not be a resurrection, but a creation of a new set of beings: if death annihilates us in this sense, there can be no future state, because, a being who has lost his existence cannot be recovered. Accordingly, they maintain, that what happens to the soul at death can be no more than a suspension of the exercise of its faculties, or an incapacitation, from which it will, by the power of Christ, be delivered at the resurrection: and they allege, that there is an infinite difference between the annihilation of the soul at death, and its incapacitation; because, one who believed the former, could not possibly entertain the hope of a future state; but one who believes the latter might reasonably entertain such a hope. Death, they say, is a distress in which our species has been involved by extraordinary causes, and from which we have obtained the hope of being saved by the most extraordinary means, viz. by the interposition of Jesus Christ, who taking upon him our nature, and humbling himself to death, has acquired the power of destroying death, and is on this account styled the Saviour of the world. However, most of those who deny the notion of an intermediate state of conscious perception between death and the general resurrection, reject the supposition of two distinct natures in man, and consider that principle which is called the soul, not as a spiritual substance, but as a quality or property, either superadded to matter by the Creator of our frame, or resulting from the organization of the human body, and particularly of the brain. See SOUL.

Accordingly, they allege that when the organized system, to which the power of thinking, &c. is annexed, on which it depends, and from the organization of which, as some maintain, it necessarily results, is dissolved by death; all the percipient and thinking powers of man, all his capacities of action, and of suffering,

being, or of enjoyment, must be extinguished and cease, of course. And if the property of thinking necessarily attends the property of life, as some apprehend, nothing can be requisite to the restoration of all the powers of the man, but the restoration of the body (no particle of which can be lost) to a state of life. Whatever is decomposed, it is said, may certainly be recomposed, by the same Almighty Power that first composed it, with whatever change in its constitution, advantageous or disadvantageous, he shall think proper; and then the powers of thinking, and whatever depended upon them, will return of course, and the man will be, in the most proper sense, the same being that he was before. Those who hold this opinion, maintain that, according to the Scriptures, life and immortality were brought to light by the Gospel of Christ, in a sense, exclusive of all other teachers, and all other revelations, at least from the birth of Moses downwards; exclusive, likewise, of all information from the light of nature, or the result of philosophical disquisition on the substance or qualities of the human soul. They hold, moreover, that the sentence pronounced on our first parents denoted a total deprivation of life, without any reserve, or saving to the life of the soul; and consequently that eternal life, or a restoration and redemption from the consequences of this sentence, was effected for, revealed, consigned, and insured to many in and through Christ, and will be accomplished in no other way than that spoken of by Christ and his apostles, who, they say, have left no room to conclude that there is a separate or intermediate life for the soul, when disunited from the body. The learned Dr. Law, formerly bishop of Carlisle, having, with a particular view to the controversy concerning the intermediate state, enumerated the several passages, both in the Old and New Testament, in which the words that are translated soul or spirit in our version occur, maintains, that none of them ever stand for a pure, immaterial principle in man, or substance wholly separable from, and independent of the body; and after examining the account which the scriptures give of that state to which death reduces us, he observes that it is represented by sleep, by a negation of all life, thought, or action; by rest, resting-place, or home, silence, oblivion, darkness, destruction, or corruption; he adds, that the scripture, in speaking of the connection between our present and future being, doth not take into account our immediate state in death; no more than we, in describing the course of any man's actions, take in the time he sleeps; and that, therefore, the scriptures (in order to be consistent with themselves) must affirm an immediate connection between death and judgment. As for those texts that are usually alleged on the other side of the question, which he has cited, and endeavoured to accommodate to his own opinion, he thinks that they are either quite foreign to the point, or purely figurative, or capable of a clear and easy solution on the principle which he adopts, viz. that the times of our death and resurrection are coincident; and that they cannot be fairly opposed to the constant, obvious tenor of the sacred writings. With respect to philosophical arguments, deduced from our notions of matter, and urged against the possibility of life, thought, and agency, being so connected with some portions of it, as to constitute a compound being, or person, he imagines that they are merely grounded on our ignorance, and that they will equally prove against known fact and observation, in the production of various animals, as against the union of two such heterogeneous principles as those of the soul and body are supposed to be.

With respect to the consequences of either opinion, he says, that on the one side there is nothing more than a temporary cessation of thought which can hurt nobody, except the self-interested papist, or the self-sufficient deist; but on the other side there is a manifest derogation from, if not a total subversion of, that positive covenant which professes to entitle us to everlasting life. He adds, that all proper and consistent notions of death, resurrection, and a future judgment; are confounded, and in fine, all the great sanctions of the gospel rendered unintelligible and useless.

The doctrine of the New Testament, says an eminent writer, against a separate state, is that man shall become immortal by the way of a resurrection of the dead, a restoration of the whole man to life; and the New Testament is so far from acknowledging any intermediate consciousness in man, between death and the resurrection, that it always speaks of that interval as a sleep, which implies a suspension of the thinking faculty, a rest from those labours which require thought, memory, consciousness, &c. during which those faculties are useless. Besides, the scriptural system of immortality supposes that man had forfeited his original title to immortality by the fall, and would never have received it, but for the interposition of a Redeemer. The consequence of this doctrine is, that between the time of the forfeiture, and the actual appearance of the Redeemer, the dead could have life in no sense at all; and that neither before nor after the appearance of the Redeemer, dead men were, or would be, restored to life, otherwise than in the way revealed by him, namely, a resurrection of the dead. On the other hand, the advocates of a separate state insist, that the soul, being an active, simple, uncomposed, immaterial substance, is immortal in its own nature, and capable of an active and conscious existence, in a state of disunion and separation from the body; that this natural capacity of the soul was not impaired or affected at all by any thing that happened upon the transgression of our first parents; that the

death to which they were condemned was only the death of the body; hence, they infer, that there is, and would have been, a future immortal state of being beyond the present life, and (the moral attributes of God presupposed) a just retribution therein, independent of the doctrine of a resurrection of the dead; and that in the interval between death and the general resurrection, there is an intermediate state, in which the departed souls of good men are supposed to have an imperfect reward, and the souls of the wicked an imperfect punishment; but that every one at the period of the re-union of the soul and body, and of final judgment, will receive a full and complete recompence for the deeds done in the body. In proof of this opinion they allege a variety of passages, both from the Old and New Testament, the principal of which we shall here enumerate; several of them they think cannot be consistently explained on the other hypothesis:—Gen. ii. 7; xv. 15; xxxvii. 35. Exod. iii. 6. 1 Sam. xxviii. 11—19. 1 Kings, xvii. 21, 22. Pf. xxxi. 5. Ecclef. iii. 21; xii. 7. Matt. x. 28; xvii. 3. Luke, xvi. 19; xx. 38; xxiii. 43; xxiv. 39. Acts, i. 25; vii. 59. 2 Cor. v. 8; xii. 2. Phil. i. 21—24. 1 Pet. iii. 19; iv. 6. Heb. xi. 40; xii. 23. Rev. vi. 9, 10; xiv. 13.

To these authorities of scripture, they add the testimony of the fathers of the church, who lived in or near the times of the apostles, who are said to be unanimous in this opinion, and persuaded that the soul of every man, upon the dissolution of the body, died not, but had a proper place to go to, and that accordingly this doctrine is to be found in the most ancient Christian liturgies. Great stress has been laid in this controversy on the meaning of the term death, as it occurs in scripture, and particularly in the sentence denounced against the first parent of the human race. The bishop of Carlisle observes, that the word *death*, in its original and obvious sense, implies a cessation of all natural life, or a real dissolution and destruction of the whole man. But Mr. Farmer, a well known and excellent writer, in the introduction to his learned work of the General Prevalence of the Worship of Human Spirits, &c. 1783, has taken some pains to ascertain the meaning of the word death, in the threatening denounced against Adam. To this purpose he says, that if human spirits were worshipped in the age of Moses, particularly in Egypt and Phœnicia, the word death could not at that time, and in those countries, denote more than the destruction of bodily life; for, if this term had farther included in it the insensibility or extinction of the soul, the dead would not have been honoured as gods. And if Moses had used it in this extensive sense, he would have been misunderstood by the Egyptians, who asserted the immortality of the soul, and by the Hebrews who dwelt among them, and had adopted their system of religion.

This learned writer, in confirmation of this interpretation of death, observes, that although one great design of Moses, in giving an account of the introduction of death into the world was to guard against the worship of departed spirits, and though nothing could have answered this design more effectually than representing the soul of Adam as a mere quality, or the result of the peculiar structure and organization of his body, yet so far is he from supposing this to be the case, that, according to him, after the body of the first man was perfectly organized by the immediate hand of the Almighty, he did not become a living soul or person, till God breathed into his nostrils the breath of life; a principle distinct from the dust out of which his body was formed, and, therefore, capable of subsisting in a state of separation from it. Nor does Moses use the same language in relating the formation of any other living creatures: which proves that the principle of life in man is of a superior kind to that in brutes.

Besides, the ancient patriarchs did not believe that the soul of man perished with his body. Agreeably to the most ancient opinion concerning departed spirits, the sacred writers supposed the souls of the dead to exist in *sheol*, or *hades*, a place invisible to human sight, and that in the distribution of them, regard was had to the former relation in which they stood to each other. Moreover, Moses himself believed the separate subsistence of the soul, and has even given it a divine sanction. Gen. xv. 15. Nor do any of the sacred writers ever describe death in terms different from those used by persons, who certainly acknowledge the continuance of the soul after it. *Sleep*, by which it is described, is not a state of non-existence, but of rest; and it is well known that this soft image of death was commonly used to express the thing itself by those who asserted the existence of souls in *hades*. Silence, oblivion, darkness, and corruption, by which the state of the dead is described, refer only to the body, or to the supposed state of the soul while it was in *sheol*, and are not peculiar to the sacred writers, but were common in all countries, where both the popular belief, and the established worship, were inconsistent with the notion of the soul perishing with the body. And many of the terms, by which death was described in all countries, clearly imply, and are built upon, a belief of the distinction between soul and body, and of their being separated at death. According to the Greeks, to die was to depart, to go away; and the writers of the New Testament describe death by a departure, Luke, ix. 31, that is of the soul from the body to another state. To all which it may be added, that the Jews, from the time of their return from Babylon, asserted the separate existence of the soul after death; as appears from their imitation of the heathen idolatry, from their evocation of the dead, and from the early references

references in scripture to the receptacle of departed souls, and many other proofs. This was the opinion not only of a few eminent individuals, such as Philo, but of the learned sects, the Essenes and Pharisees, and of the whole body of the people, almost without exception, in the time of our Saviour.

And if, in or near the time of Christ, the terms resurrection, reviviscence, or living again, as used both by Jews and Gentiles, denoted the reunion of a soul to a human body, the same terms, when adopted by Christ and his apostles, must have the same meaning: and every one would understand them in their common and ordinary signification. Consequently, if life, as expressing the resurrection, signifies the soul's return to a human body, death, its opposite, denotes its separation; both terms imply the continuance of the soul after death; a principle, says Mr. Farmer, held in the most ancient times, by Heathens and Jews, by patriarchs and prophets, and by the people, particularly in the times of Moses and the Messiah, and which gives great probability to the doctrine of a resurrection. The advocates of the sleep of the soul, on the other hand, earnestly contend that it was the opinion of the apostles and early Christians, that, whatever be the nature of the soul, its percipient and thinking powers cease at death; and that they had no hope of the restoration of those powers, but in the general resurrection of the dead.

However, Peter Pomponatius, a philosopher of Mantua, published a book in 1516, on the immortality of the soul, in which, after stating the moral arguments against the mortality of the soul, and endeavouring to shew that they are weak and inconclusive, infers, upon the whole, that the immortality of the soul, being a problematical question, we can have no assurance of it but from revelation, and that they who would build immortality upon any other foundation, only verify the character given to certain self-sufficient reasoners by the apostle, viz. professing themselves wise, they became fools. In 1520, Luther, in the defence of his propositions, which had been condemned by a bull of Leo X. ranks the natural immortality of the soul among the monstrous opinions of popery; and he afterwards made use of the doctrine of the sleep of the soul as a confutation of purgatory and saint-worship, and he is said to have continued in that belief to the last moment of his life. William Tyndall, also, the famous translator of the bible into English, in defending Luther's doctrine against Sir Thomas Moore's objections, considers the sleep of the soul as the doctrine of the Protestants in his time, and founded on the scriptures: though in consequence of the opposition given to this doctrine, by Calvin in his *Psychopannychia*, published in 1534, and the turn hereby given to the sentiments of the Reformed in general, he seems to have recanted his opinion. Calvin, however, seems to have been embarrassed with the souls of the wicked, and says, he would only be responsible for the faithful. The first express condemnation of the doctrine of the sleep of the soul, in a protestant confession, occurs in the fortieth of king Edward's Articles, composed in 1552. After the long prevalence of the doctrine of the intermediate state, that of the sleep of the soul has of late years been revived, and, as one of its zealous advocates affirms, gains ground, not so much from considerations of philosophy, as from a close attention to the sense of the scriptures.

We shall close this article with observing, that a singular hypothesis was advanced a few years ago, by Dr. Caleb Fleming, and of late vindicated by an anonymous writer; and this is, that the resurrection of the soul takes place immediately after death. On this subject see Law's Appendix and Postscript to his Considerations on the Theory of Religion, &c. 1774. Historical View of the Controversy concerning an intermediate State, &c. 1772. Priestley's Disquisitions on Matter and Spirit, 1777. Correspondence between Dr. Price and Dr. Priestley, 1778, and the publications of Steffe, Warburton, Goddard, Coward, Peckard, Jortin, &c. on both sides of the question, cited by the author of the Historical View, &c. Fleming's Search after Souls.

SLEEPERS, in natural history, a name given to some animals which sleep all the winter; such as bears, marmots, dormice, bats, hedgehogs, &c. These do not feed in winter, have no sensible evacuations, breathe little, or not at all, and most of the viscera cease from their functions. Some of these creatures seem to be dead, and others to return to a state like unto that of the fetus before birth. In this condition they continue, till by length of time maturing the process, or by new heat, the fluids are attenuated, the solids stimulated, and the functions begin where they left off. See Dr. Stevenson in Med. Edinb. Vol. V. Art. 177.

SLOATH, or **SLOTH**, the English name of the genus *Bradypus*, in the system of mammalia. For a description of the genus, &c. see *BRADYPUS*; for representation, see Plate II. Genus 7.

SLOOP, in sea-language, a small vessel furnished with one-mast, the main-sail of which is attached to a gaff above, to the mast on its foremost edge, and to a long boom below; by which it is occasionally shifted to each quarter. This kind of vessel is convenient for the coast trade.

SLUICE, a frame of timber, stone, or other matter, serving to retain and raise the water of a river, &c. and on occasion to let it pass. Such is the sluice of a mill, which stops and collects the water of a rivulet, &c. to let it fall, at length, in the greater plenty

upon the mill-wheel; such also are those used as vents or drains to discharge water off land. See the System of AGRICULTURE, Sect. XIX. under the head of *DRAINING*.

SLUR, in music, a mark like the arch of a circle, drawn from one note to another, comprehending two or more notes in the same or different degrees.

SMALLPOX, *Variole*. For description, prognosis, and cure, see the System of MEDICINE, Genus 26.

SMELL, *Odor*, with regard to the organ, is an impression made on the nose by little particles continually exhaling from odorous bodies. With regard to the object, it is the figure and disposition of odorous effluvia, which, sticking on the organ, excite the sense of smelling. The principal organs of smelling are the nostrils and the olfactory nerves, the minute ramifications of which latter are described throughout the whole concave of the former: see the System of ANATOMY, Part VII. Sect. III.

SMEETING, among metalists, the melting of a metal from the ore in a melting furnace; in order to separate the metallic parts from the sulphur and arsenic, and the earthy and strong substances of all kinds with which they are combined. *Smelting*, in propriety, is restrained to large works, wherein ores from the mines are melted down, and separated. In speaking of works in a lesser way, we do not say smelting, but melting.

SMOKE, or **SMOAK**, *Fumus*, a humid matter exhaled in form of vapour by the action of heat, either external or internal; or smoke consists of palpable particles, elevated by means of the rarefying heat, or by the force of the ascending current of air, from bodies exposed to heat; and these particles vary much in their properties, according to the substances from which they are produced. See *FLAME*.

Smoke, Sir Isaac Newton observes, ascends in the chimney by the impulse of the air it floats in: for that air being rarefied by the fire underneath, has its specific gravity diminished; and thus, being determined to ascend itself, it carries up the smoke along with it. The tail of a comet, that great author takes also to ascend from the nucleus, after the same manner. See the System of ASTRONOMY, Sect. XIII. There are various inventions for preventing and curing smoking chimneys; as the æolipiles of Vitruvius, the ventiducts of Cardan, the windmills of Bernard, the capitals of Serlio, the little drums of Paduanus, and several artifices of De Lorme, &c.

SMUT, a disease in corn, in which the grains, instead of being filled with flower, are full of a black stinking powder. For the causes and most approved methods of remedying and preventing this disease, see the System of AGRICULTURE, Sect. III.

SNAIL, the English name of the genus *Helix*; in the order *Vermes Testacea*: see *HELIX*.

Snails are great destroyers of fruit in our gardens, especially the better sorts of wall-fruit. Lime and ashes sprinkled on the ground where they most resort, will drive them away, and destroy the young brood of them; it is a common practice to pull off the fruit they have bitten, but this should never be done, for they will eat no other, till they have wholly eat up this, if it be left for them. The Romans were fond of snails, and had them fed on purpose for their tables. The pomatize were preferred for this purpose; and they were fed with bran and soddened wine. Their taste is not delicious, but rather disagreeable; but this they disguised by means of good sauces, and had other reasons for the receiving them into the list of foods. They used them as provocatives, or inciters to venery. The eastern nations at present run much into the opinion of the Romans of old, as to provocatives; they use, as the others did, every thing that serves to the purposes of generation in other animals, and every thing that has but the resemblance of the external figure of the parts subservient to it.

SNAKE, the English name of the genus *Anguis*, belonging to the order *Amphibia Serpentes*. For description, see *ANGUIS*.

SNIPE, the English name of a species of the genus *Scolopax*. See *SCOLOPAX*.

SNORING, in medicine, otherwise called *Rhencos* or *Stertor*, is that sound like that of the cerchnon, but greater and more manifest. A stertor is that sound which is supposed to be made betwixt the palate and nostrils, by persons asleep; cerchnon or cherchnon, is that bubbling noise which is made in respiration, from the larynx, or the aspera arteria. These affections are owing to a weakness of nature. Expectoration is suppressed either by the viscosity of the humour, which requires to be discharged, and which, adhering to the aspera arteria, and being there agitated by the breath, excites that bubbling noise or stertor; or by an obstruction of the bronchia; or lastly, by a compression of the aspera arteria and throat; whence the passage is straitened, in which the humours being agitated, excite a kind of noise.

SNOW, a well-known meteor, formed by the freezing of the vapours in the atmosphere. It differs from hail and hoarfrost in being, as it were, crystallized, which they are not. This appears on examination of a flake of snow by a magnifying glass; when the whole of it will appear to be composed of fine shining spicula, diverging like rays from a centre. As the flakes fall down through the atmosphere, they are continually joined by more of these radiated spicula, and thus increase in bulk like the drops of rain or hailstones. Dr. Grew, in a Discourse of the Nature of Snow, ob-

observ
most p
perfect
each of
as the
irregul
regula
thawed
if the
larly fi
drops,
meetin
each de
into se
meetin
contin
them as
intangl
The
excess
it; as
the lea
snow d
of cold
and th
figures
reflette
cause I
is capa
jecture
munity
well as
electric
not bee
intense
hail m
snow,
fall fr
others,
From
snow,
bulk,
for lev
tation,
commo
them.
to rain
contain
for the
influen
earth i
earth,
of plan
sides,
had be
to put
it to co
tion.
Bart
does n
always
the Al
tions o
they ar
the out
public
appella
the art
In I
Snow
ground
barley
with fl
experi
in hot
In E
pole;
served
tainme
SNU
powder
the hea
matters
The ki
ones ar
impossi
are thro
pable p
after fi
umatu
No.

observes that many parts thereof are of a regular figure, for the most part so many little rowels or stars of six points, and are as perfect and transparent ice as any we see on a pond, &c. Upon each of these points are other collateral points, set at the same angles as the main points themselves; among which there are divers other irregular, which are chiefly broken, points, and fragments of the regular ones. Others also, by various winds, seem to have been thawed, and frozen again into irregular clusters; so that it seems as if the whole body of snow were an infinite mass of icicles irregularly figured. That is, a cloud of vapours being gathered into drops, the said drops forthwith descend; upon which descent, meeting with a freezing air as they pass through a colder region, each drop is immediately frozen into an icicle, shooting itself forth into several points; but these still continuing their descent, and meeting with some intermitting gales of warmer air, or in their continual wastage to and fro touching upon each other, some of them are a little thawed, blunted, and again frozen into clusters, or tangled so as to fall down in what we call flakes.

The lightness of snow, although it is firm ice, is owing to the excess of its surface, in comparison to the matter contained under it; as gold itself may be extended in surface, till it will ride upon the least breath of air. According to signior Beccaria, clouds of snow differ in nothing from clouds of rain, but in the circumstance of cold that freezes them. Both the regular diffusion of the snow, and the regularity of the structure of its parts (particularly some figures of snow or hail which fall about Turin, and which he calls *raffette*) show that clouds of snow are acted upon by some uniform cause like electricity; and he endeavours to show how electricity is capable of forming these figures. He was confirmed in his conjectures by observing, that his apparatus for ascertaining the electricity of the atmosphere never failed to be electrified by snow as well as rain. Professor Winthrop sometimes found his apparatus electrified by snow when driven about by the wind, though it had not been affected by it when the snow itself was falling. A more intense electricity, according to Beccaria, unites the particles of hail more closely than the more moderate electricity does those of snow, in the same manner as we see that the drops of rain which fall from thunder-clouds, are larger than those which fall from others, though the former descend through a less space.

From some late experiments on the quantity of water yielded by snow, it appears that the latter gives only about one-tenth of its bulk. In the northern countries, the ground is covered with snow for several months; which proves exceedingly favourable for vegetation, by preserving the plants from those intense frosts which are common in such countries, and which would certainly destroy them. The peculiar agency of snow as a fertilizer, in preference to rain, may, without recurring to nitrous salts supposed to be contained in it, be rationally ascribed to its furnishing a covering for the roots of vegetables, by which they are guarded from the influence of the atmospherical cold, and the internal heat of the earth is prevented from escaping. Snow may also fertilize the earth, agreeably to the hypothesis of those who make oil the food of plants, by means of the oily particles which it contains: besides, snow, in melting, moistens and pulverizes the soil which had been bound up by the frost; and as its water has a tendency to putrefaction, it seems, on many accounts, without admitting it to contain any nitre, to be admirably fitted to promote vegetation. Watson's Chem. Ess. vol. ii. p. 77, &c.

Bartholin ascribes great virtues to snow-water, but experience does not seem to warrant his assertions. Snow or ice water is always deprived of its fixed air, and those nations who live among the Alps, and use it for their constant drink, are subject to affections of the throat, which are thought to be occasioned by it: they are called *Bronchiæ*; and in form appear as large tumours on the outside of the throat; like those of the people imposed on the public a few years ago as natives of an unknown clime, under the appellation of *Monstrous Crows*. For the mode of treatment, see the article *BRONCHIE*.

In Italy they cool their wines all the summer with snow-water. Snow may be preserved by ramming it down in a dry place underground, and covering it well with chaff. At Leghorn they use barley chaff for this purpose. Snow and ice also preserved with straw or reeds. Mr. Boyle has described the manner in his experimental history of cold. See *ICE* and *ICE-house*. It is usual in hot countries to mix snow and ice with their wine.

In England, large quantities of ice are preserved for that purpose; and it is esteemed a great luxury, and therefore frequently served up at the tables of the great and most sumptuous entertainments.

SNUFF, a preparation of tobacco, made by reducing it into a powder, fit to be taken in at the nose, in order to purge or clear the head of pituita. Ordinarily, tobacco is the basis of snuff; other matters being only added to give it a more agreeable scent, &c. The kinds of snuff, and their several names, are infinite; and new ones are daily invented; so that it would be difficult, not to say impossible, to give a detail of them. We shall only say, that there are three principal sorts: the first granulated; the second an impalpable powder; and the third the bran, or coarse part remaining after sifting the second sort. The many mischiefs attending the unnatural practice of taking this powder of tobacco at the nostrils, No. 139.

have been described by the writers in general on these subjects; since this pernicious custom has reigned in the world: but one of the most remarkable accidents, occasioned by it, is related in the *Acta Eruditorum*, which was the forming a polypus in the oesophagus, and which killed the patient, by starving him, from an inability of swallowing. *Act. Erudit. an. 1715, p. 475*.

SOAL, or **SOLEA**, a species of the genus *Pleuronectes*. For the generic characters and classification, see the *System*, Order 4. The soal is found on all our coasts, but those on the western shores are much larger than those of the north. They are usually taken in a trawl-net; they keep much at the bottom, and feed on small shell-fish. The small soals are much superior in goodness to the larger ones. They are common in the Mediterranean, English, and German Seas. The chief fishery for them on the English coast is at Brixham in Torbay. Soals may be taken at any time of the year, but they must not be under seven inches from the eye to the end of the tail. 1 & 2 Geo. i. cap. 18.

SOAP, or **SOPE**, a kind of paste, sometimes hard and dry, and sometimes soft and liquid, much used in washing and whitening linens, cleansing woollen cloths from oil, whitening silk, and freeing it from the resinous varnish with which it is naturally covered; and for various other purposes, by the dyers, perfumers, hatters, fullers, &c. The alkaline lixiviums, being capable of dissolving oils more effectually than soap, might be employed for the same purposes; but when this activity is not mitigated by oil, as it is in soap, they are capable of altering, and even destroying entirely, by their causticity, most substances, especially animal matters, as silk, wool, and others; whereas soap cleanses from oil almost as effectually as pure alkali, without danger of altering or destroying, which renders it very useful. The manufacture of soap in London first began in the year 1524; before which time this city was served with white soap from foreign countries, and with grey soap, speckled with white, from Bristol, and sold for a penny a pound, and also black soap for a halfpenny the pound. The principal soaps of our own manufacture, are, the soft, the hard, and the ball soap. The soft soap again is either white or green.

SOCIETY, **SOCIETAS**, an assemblage or union of several persons in the same place, for their mutual assistance, security, interest, or entertainment. See **GOVERNMENT**.

The social principle in man is of such an expansive nature, that it cannot be confined within the circuit of a family, of friends, of a neighbourhood; it spreads into wider systems, and draws men into larger communities and commonwealths; since it is in these only that the more sublime powers of our nature attain the highest improvement and perfection of which they are capable. Of societies, we have a great many kinds, distinguished by the different ends proposed by them: *civil societies, trading societies, religious societies, literary societies, &c.*

SOCIETY, in trade, is a contract or agreement between two or more persons, whereby they bind themselves together for a certain time, and agree to share equally in the profits or losses which shall accrue in the affairs for which the society or co-partnership is contracted. We have several very considerable societies of this kind: as the Merchant Adventurers, the Turkey, East-India, Muscovy, Eastland, Greenland, Spanish, African, South Sea, and Hudson's Bay, companies; the institutions, policies, &c. whereof, see under the article **COMPANY**.

Royal Society. See **ROYAL SOCIETY**.

SOCINIANS, in church-history, a sect of Christian heretics, so called from their founder Faustus Socinus. They maintain, "That Jesus Christ was a mere man, who had no existence before the Virgin Mary; that the Holy Ghost is no distinct person, but that the Father is truly and properly God." They own that the name of God is given in the holy scriptures to Jesus Christ; but contend, that it is only a deputed title, which, however, invests him with an absolute sovereignty over all created beings, and renders him an object of worship to men and angels. They deny the doctrines of satisfaction and imputed righteousness; and only say that Christ preached the truth to mankind, set before them in himself an example of heroic virtue, and sealed his doctrines with his blood. Original sin and absolute predestination they esteem scholastic chimeras. They likewise maintain the sleep of the soul, which they say becomes insensible at death, and is raised again with the body at the resurrection, when the good will be established in the possession of eternal felicity, while the wicked will be consigned to a fire that will not torment them eternally, but consume both their souls and bodies for a certain duration proportioned to their demerits. The only society of Socinians in England was that formed by Mr. John Biddle, under the patronage of Mr. Thomas Firmin, and his adherents were called *Bidellians*; but this name was lost in the more common appellation of Socinians, or what they preferred, Unitarians. This society does not appear to have subsisted after the death of Biddle; nor have the Socinians, though their sentiments have been adopted by several, made any figure as a community in England. The most distinguished Socinian writers, in Poland, were Crellius, Smalcus, Volkelius, Slichtingius, Wolzogenius, Przypcovius, and Stanislaus Lubianicus: to this number, some have added Grotius; in latter times we might enumerate Le Clerc, Biddle, Lardner, Lowman, Fleming, Lindsey, Priestley, &c. See on this subject, Socini. Oper. tom. i. & ii. passim. Moheim's

heim's Eccl. Hist. vol. iv. p. 167, &c. 8vo. Toulmin's Life of Socinus, passim. See UNITARIANS.

SOCRATIC Philosophy, the doctrines and opinions with regard to morality and religion, maintained and taught by Socrates. See PHILOSOPHY.

SODOMY, an unnatural crime: thus called from the city of Sodom, which was destroyed by fire for the same. The Levitical laws adjudged those guilty of this execrable evil to death, Lev. xviii. 22, 23; xx. 15, 16; and the civil law assigns the same punishment to it. Our laws also make it felony. 25 Hen. VIII. cap. 6. 5 Eliz. cap. 17.

SOIL, **SOLUM**, in agriculture and gardening, denotes earth, or ground, considered with regard to the quality of its mould for the production and growth of vegetables. For a particular description of the nature, qualities, and properties of the various kinds of soils, and the modes of adopting them to the important purposes of vegetation, see the System of AGRICULTURE, Sect. I. and II. and the Treatise on GARDENING, Part II. throughout.

SOL, in music, the fifth note of the gamut: ut, re, mi, fa, sol, la. See the System, Definition I.

SOL, in astronomy, signifies the sun. See the System of ASTRONOMY throughout.

SOLÆUS, or **SOLEUS**, in anatomy, a large fleshy flat muscle, nearly of an oval figure, and thicker at the middle than the edges. It has its name from its supposed likeness to a sole. It is situated on the backside of the leg, lower down than the gastrocnemii, by which it is covered, and with which it forms the calf of the legs. For its origin, insertion, and use, see the System, Part II. Table of Muscles, Art. 26.

SOLDER, is a metallic or mineral composition, used in soldering or joining together other metals. For this purpose it is required that folders melt sooner than the metal to be soldered, and that they approach as near as may be to the metal foldered in hardness and colour.

The different folders are made of gold, silver, copper, tin, bismuth, and lead; usually observing, that in the composition there be some of the metal to be soldered, mixed with some higher and finer metals. Goldsmiths usually make four kinds of folder; viz. folder of eight, where, to seven parts of silver, there is one of brass or copper; folder of six, where only a sixth part is copper; folder of four, and folder of three. It is the mixture of copper in the folder that makes raised plate always come cheaper than flat. As mixtures of gold with a little copper are found to melt with less heat than pure gold itself, these mixtures serve as folders for gold: two pieces of fine gold are foldered by gold that has a small admixture of copper; and gold alloyed with copper is foldered by such as is alloyed with more copper; the workmen add a little silver as well as copper, and vary the proportions of the two to one another, so as to make the colour of the folder correspond, as nearly as may be, to that of the piece. A mixture of gold and copper is also a folder for fine copper as well as for fine gold.

We were favoured with the following improved methods of making that kind of folder which is called tin-man's, or soft-foldering, as also that of silver-foldering with hard-folder, by Mr. Nathaniel Merriman, tin-plate-worker in Crutchedfriars.—Tin-man's, or soft-foldering: this folder is best made by mixing an equal quantity of grain tin and lead, in an iron ladle, over a fire till it is pretty hot, but not quite red, then skim it and pour it off for use; if a little rosin is thrown in when hot, and stirred well about, it clears the metal. To folder therewith, provide a common tile and two irons, with square bits of copper fixed in the ends, about $\frac{1}{4}$ of an inch square, and two or three inches long, and drawn to a square point, like that of a poker, which must be filed bright, and then tinned by heating them in a charcoal fire, till they are but just hot enough to melt the folder; then cover the tile and folder with plenty of rosin, and by applying the bright part of the copper to it, cut off a small piece, and rub it about the tile with the iron, or rather copper, till it is well tinned; which operation must be repeated every time the tin gets burnt off, by being too hot, which it certainly is when it appears the least red. Any metal that is covered with tin, will readily folder, by laying rosin upon it, and then taking a small drop of folder from the tile, with the hot iron; but if the thing you wish to folder is impaired by rust, &c. or the metal has never been tinned, it must be scraped or filed bright; and tinned by laying on plenty of rosin, and rubbing it over with the tinned iron, with a small piece of folder thereon, before it will folder sound. But iron being difficult to tin, many use moistened sal ammoniac to that metal, in preference to rosin; be careful not to heat the iron in a sea-coal fire, as it shortly destroys the tin, and prevents its foldering.

Silver-SOLDERING, is performed both with soft and hard folder, the soft is made as before directed, and the parts which are to be joined, being neatly tinned, apply them together, and then laying on the folder covered with a little sal-ammoniac, rosin, or Venice turpentine, convey a small blast from a lamp, &c. with a blowpipe, upon the parts you wish to folder, and it will be much neater, and equally as strong, as those done with the iron; this metal is used chiefly in foldering French plate, &c.

Silver-SOLDERING, with *hard folder*; supposing a buckle, spoon, &c. let the parts to be foldered, be filed bright, and wet them with a little borax, dissolved in water, and bind them together with

iron wire; then lay on the folder covered with the borax, and placing it near the fire, let it dry hard; then lay it on charcoal, and convey a blast from a large spouted lamp, with a blowpipe, directly under the buckle, heating it as quick as you conveniently can, keeping the folder as cool as possible, till the part of the buckle which the folder lays on, is of a blood-red heat, then direct the greatest heat on the folder, which will flow into the joints, and be as sound as ever; be careful not to suffer the folder to melt before the work is red hot, as it will be apt to curdle, and must be scraped off again, and if too long in heating, the borax perishes, and must be supplied with fresh. Brass, iron, &c. is foldered in the same manner, but, instead of silver folder, use spelter with the borax, and in foldering brass, leave off immediately the spelter, that flows freely, or slight work will be apt to melt. The best silver folder, and spelter, &c. is to be had at the watch tool shops.

SOLDIER, a military man, lifted to serve a prince or state, in consideration of a certain daily pay. For a description of the rank, duties, discipline, and immunities of the soldiery in general, see the Treatise on MILITARY AFFAIRS throughout. For representations of the figures illustrative of the directions for performing the *Manual Exercise*, see the plates annexed to the Treatise.

SOLECISM, in grammar and oratory, a gross impropriety in speech, contrary to the use of language, and the rules of grammar, either in respect of declension, conjugation, or syntax. See Treatise on the Art of ORATORY, Part III. Art. I.

SOLEN, a genus belonging to the order of Vermes Testacea. For description see VERMES; for the shell, as it forms a branch of conchology, see the System, Order II. Genus 5.

SOLICITOR, a person employed to follow, and take care of, other persons' suits depending in courts of law or equity; formerly allowed only to nobility, whose menial servants they were; but now regularly admitted to practise in the court of chancery. See ATTORNEY. The king has a solicitor-general, who holds his office by patent, during the king's pleasure. The solicitor-general has the care and concern of managing the king's affairs, and hath fees for pleading, besides other fees arising by patents, &c. He hath his attendance on the privy-council; and the attorney-general and solicitor were anciently reckoned among the officers of the exchequer: they have audience, and come within the bar, in all other courts.

SOLID, in philosophy, a body whose parts are so firmly connected together, as not to give way or slip from each other upon the smallest impression: in which sense solid stands opposed to fluid. Geometricians define a solid to be a third species of magnitude, or that which has three dimensions, viz. length, breadth, and thickness or depth. Solids are commonly divided into regular and irregular. The regular solids are those terminated by regular and equal planes, and are only five in number, viz. the tetrahedron, which consists of four equal triangles; the cube, or hexahedron, of six equal squares; the octahedron, of eight equal triangles; the dodecahedron, of twelve; and the icosihedron, of twenty equal triangles. The irregular solids are almost infinite, comprehending all such as do not come under the definition of regular solids; as the sphere, cylinder, cone, parallelogram, prism, parallelepiped, &c.

SOLIDS, in anatomy, &c. denote all the continuous and continent parts of the body; thus called, in opposition to the fluids, or parts contained therein. Of the solid kind, are the bones, cartilages, ligaments, membranes, fibres, muscles, tendons, arteries, veins, nerves, glands, lympheducts, and lacteals. The solid parts of the body, though equally composed of vessels, are different with regard to their consistence; some being hard, and others soft. The hard, as the bones and cartilages, give firmness and attitude to the body, and sustain the other parts; the soft parts, either alone or together with the hard, serve to execute the animal-functions. For description of these several parts of the human frame, see the System of ANATOMY, in the several parts to which they respectively belong. For representations, see the Plates of Osteology, Myology, and those of the Nerves, Veins, Arteries, &c.

SOLIDITY, that property of matter, or body by which it excludes all other bodies from the place which itself possesses; and as it would be absurd to suppose that two bodies could possess one and the same place at the same time, it follows, that the softest bodies are equally solid with the hardest. Among geometricians, the solidity of a body denotes the quantity or space contained in it, and is called also its solid content.

SOLILOQUY, **SOLILOQUIUM**, a reasoning, or discourse, which a man holds with himself. Papias says, that soliloquy is properly a discourse by way of answer to a question that a man has proposed to himself. Soliloquies are become very common things on the modern stage; yet nothing can be more inartificial, or more unnatural, than an actor's making long speeches to himself, to convey his intentions, &c. to the audience. Where such discoveries are necessary to be made, the poet should rather take care to give the dramatic persons such confidants, as may necessarily share their inmost thoughts; by which means they will be more naturally conveyed to the audience. Yet is even this a shift an accurate poet would not be found to have occasion for. The use and abuse of soliloquies

Soliloquies is well delivered by the duke of Buckingham in the following lines:

*Soliloquies had need be very few,
Extremely short, and spoke in passion too.
Our lovers talking to themselves, for want
Of others, make the pit their confidant:
Nor is the matter mended yet, if thus
They trust a friend, only to tell it us.*

SOLO, in the Italian music, is frequently used in pieces consisting of several parts, to mark those that are to perform alone: as *fauto solo*, *violino solo*. It is also used for *sonatas*, composed for one violin, one German flute, or other instruments, and a bass: thus we say, *Corelli's solos*, *Geminiani's solos*, &c.

SOLSTICE, in astronomy, the time when the sun is in one of the *solstitial points*; that is, when he is at his greatest distance from the equator, which is twenty-three degrees and a half: thus called, because he then appears to *stand still*, and not to change his place in the degrees of the zodiac, any way: an appearance owing to the obliquity of our sphere, and which those who live under the equator are strangers to. The *solstices* are two in each year; the *spring* or *summer solstice*, and the *hyemal*, or *winter solstice*. See the *System*, Sect. IV. and Plate III. Fig. 3.

SOLSTITIAL Points, in astronomy, are those points of the elliptic whereby the sun's ascent above the equator and his descent below it are terminated. See the *System*, Sect. IX. Art. XII.

SOLUTION, in chymistry, is sometimes used for the analysis or reduction of a natural body into its chymical principles. See the *System*, Part I.

SON, a relative term, applied to a male **CHILD**, considered in the relation he bears to his **PARENTS**. See **PARENT** and **CHILD**.

SONATA, in music, a piece or composition, intended to be performed by instruments only; in which sense it stands opposed to *cantata*, or a piece designed for the voice only. There are sonatas from one to eight parts; but usually they are performed by a single violin, or with two violins and a thorough-bass for the harpsichord, and frequently a more figured bass for the base-viol. Sonatas, though extremely numerous, are reduced by the Italians to two kinds: 1. Those proper for church music, which usually begin with a grave and solemn motion, and afterwards strike into a brisker and gayer manner; these are what they more particularly call *sonatas*. 2. Those for the chamber, being little pieces for dancing.

SONG, in poetry, a little composition, consisting of simple, easy, natural verses, set to a tune, in order to be sung. Each stanza of a song is called a couplet. The song bears a great deal of resemblance to the madrigal, and more to the ode; which is, indeed, nothing but a song, according to the ancient rules. Its object is usually either wine or love, whence M. le Brun defines a modern song, to be either a soft and amorous, or a brisk and Bacchic, thought, expressed in a few words. Indeed, this is to restrain it to too narrow bounds: for we have satirical songs, and panegyric songs. But be the song what it will, the verses are to be easy, natural, and flowing; and are to contain a certain harmony, which neither shocks the reason nor the ear; and which unites poetry and music agreeably together.

SONNET, in poetry, a kind of composition properly contained in fourteen verses; viz. two stanzas, or measures, of four verses each, and two of three: the eight first verses being all in two rhymes. The sonnet is of Italian origin: it is held the most difficult and artful of all poetical compositions, as requiring the utmost accuracy and exactness. It is to end with some pretty ingenious thought: the close must be particularly beautiful, or the sonnet is defective. Of twenty-three sonnets which were written by our great poet Milton, that addressed to Henry Laws is one of the best; and yet this shews how difficult and unnatural the construction of this species of poem is in the English language; whereas, from the great number of similar terminations in the Italian tongue, it has long been the favourite measure of Italy for short compositions.

SOOT, an earthy volatile matter, arising from wood, coals, and other fuel, along with the smoke, by the action of fire; or rather, it is the smoke itself, fixed and detained on the sides of the chimney. Soot is a collection of substances formed by the matter of the flame of inflammable bodies, but which have escaped combustion, from not having sufficient contact with the air. This matter is always of a black colour, more or less brownish, which colour it acquires from an oil that is burnt, and half reduced to the state of coal. Its different qualities and appearances are owing to the nature in which they are burnt. For the uses of soot in manure, see the *System* of **AGRICULTURE**, Sect. II.

SOPHISM, *Σοφισμὸς* in logic, a captious and fallacious reasoning; or an argument, which, with some subtilty, carries much appearance of truth, but little solidity.

SOPHIST, *Σοφιστής* a person who frames sophisms, that is, uses subtle arguments, with design to deceive those he would persuade or convince. The term *sophist* was anciently honourable, and assumed by the philosophers, but it was afterwards discarded, as conveying an idea derogatory to their character, and therefore became a term of reproach.

SOPORIFIC or **SOPORIFEROUS**, a medicine that has the faculty of procuring sleep. Such are opium, laudanum, &c. The

word is formed from the Latin *sopor*, *sleep*. The Greeks, in lieu hereof, use the word *hypnotic*.

SORCERY, the crime of witchcraft or divination by the assistance of evil spirits: see **MAGI** and **MAGIC**.

Our forefathers were strong believers when they enacted, by stat. 33 Hen. VIII. c. 8, all witchcraft and sorcery to be felony without benefit of clergy; and again, by stat. 1 Jac. I. c. 12, that all persons invoking any evil spirit, or consulting, covenanting with, entertaining, employing, feeding or rewarding any evil spirit; or taking up dead bodies from their graves, to be used in any witchcraft, sorcery, charm, or enchantment; or killing, or otherwise hurting any person by such infernal arts; should be guilty of felony without benefit of clergy, and suffer death. And if any person should attempt by sorcery to discover hidden treasure, or to restore stolen goods, or to provoke unlawful love, or to hurt any man or beast, though the same were not effected, he or she should suffer imprisonment and pillory for the first offence, and death for the second. These acts continued in force till lately, to the terror of all ancient females in the kingdom; and many poor wretches were sacrificed thereby to the prejudice of their neighbours and their own illusions, not a few having, by some means or other, confessed the fact at the gallows. But all executions for this dubious crime are now at an end: our legislature having at length followed the wife example of Louis XIV. in France, who thought proper by an edict to restrain the tribunals of justice from receiving informations of witchcraft. And accordingly it is with us enacted, by statute 9 Geo. II. c. 5, that no prosecution shall for the future be carried on against any person for conjuration, witchcraft, sorcery, or enchantment. But the misdemeanour of persons pretending to use witchcraft, tell fortunes, or discover stolen goods, by skill in the occult sciences, is still deservedly punished with a year's imprisonment, and standing four times in the pillory.

SOREX, the **SHREWMOUSE**; a genus of quadrupeds, belonging to the order *Fera*. The most remarkable species are the two following: 1. The *araneus*, or field shrewmouse: inhabits Europe: lives in old walls, heaps of stones, or holes in the hearth; is frequently near hayricks, dunghills, and necessary-houses; lives on corn, insects, and any filth; is often observed rooting in ordure, like a hog; from its food, or the places it frequents, has a disagreeable smell; cats will kill, but not eat it; it brings four or five young at a time. The ancients believed it was injurious to cattle; an error now detected. There seems to be an annual mortality of these animals in August, numbers being then found dead in the paths. For representation, see the *System* of **MAMMALIA**, Plate VI. Genus, XIX. Species 5.

The *cæcus*, or blind mouse, inhabits Mexico; burrows and makes such an number of cavities, that travellers can scarce tread with safety; if it gets out of its hole, does not know how to return, but begins to dig another; grows very fat, and is eatable; feeds on roots, kidney-beans, and other seeds. For representation, see Plate VI. Genus XIX. Species 6.

SOVEREIGN, in matters of government, is applied to the supreme magistrate or magistrates of an independent government or state; by reason their authority is only bounded by the laws of God, of nature, and the fundamental laws of the state: such are kings, princes, &c.

SOVEREIGN Power, or **SOVEREIGNTY**, in the British polity, is the power of making laws; for wherever that power resides, all others must conform to it, and be directed by it, whatever appearance the outward form and administration of the government may put on. For it is at any time in the option of the legislature to alter that form and administration by a new edict or rule, and to put the execution of the laws into whatever hands it pleases; and all the other powers of the state must obey the legislative power in the execution of their several functions, or else the constitution is at an end. *Blackst. Com.* Vol. I. p. 49. In our constitution the law ascribes to the king the attribute of sovereignty; but that is to be understood in a qualified sense, i. e. as supreme magistrate, not as sole legislator; as the legislative power is vested in the king, lords, and commons, not in any of the three estates alone.

SOUL, a spiritual substance which animates the bodies of living creatures: it is the principle of life and activity within them. Various have been the opinions of philosophers concerning the substance of the human soul. The Cartesians make thinking the essence of the soul. Others again hold, that man is endowed with three kinds of souls, viz. the rational, which is purely spiritual, and infused by the immediate inspiration of God; the irrational, or sensitive, which is common to man and brutes; and lastly the vegetative soul, or principle of growth and nutrition.

That the soul is an immaterial substance appears from hence, that its primary operations of willing and thinking have not only no connection with the known properties of body, but seem plainly inconsistent with some of its most essential qualities. For the mind discovers no relation between thinking and the motion and arrangements of parts. As to the immortality of the human soul, the arguments to prove it may be reduced to the following heads: 1. The nature of the soul itself, its desires, sense of moral good and evil, gradual increase in knowledge and perfection, &c. 2. The moral attributes of God. Under the former of these heads it is urged, that the soul, being an immaterial intelligent substance, does not depend

depend on the body for its existence; and therefore may, nay, and must, exist after the dissolution of the body, unless annihilated by the same power which gave it a being at first. This argument, especially if the infinite capacity of the soul, its strong desire after immortality, its rational activity and advancement towards perfection, be likewise considered, will appear perfectly conclusive to men of a philosophical turn; because nature, or rather the God of nature, does nothing in vain. But arguments drawn from the latter head, viz. the moral attributes of the Deity, are not only better adapted to convince men unacquainted with abstract reasoning, but equally certain and conclusive with the former: for as the justice of God can never suffer the wicked to escape unpunished, nor the good to remain always unrewarded; therefore, arguments drawn from the manifest and constant prosperity of the wicked, and the frequent unhappiness of good men in this life, must convince every thinking person that there is a future state wherein all will be set right, and God's attributes of wisdom, justice, and goodness fully vindicated. We shall only add, that had the virtuous and conscientious part of mankind no hopes of a future state, they would be of all men most miserable: but as this is absolutely inconsistent with the moral character of the Deity, the certainty of such a state is clear to a demonstration.

The doctrine of the materiality of the human soul has been adopted and maintained by several modern writers; and even by those who have distinguished themselves as able and zealous advocates in the cause of religion both natural and revealed. In this number we may reckon Dr. Priestley, who, rejecting the commonly received notion of MATTER, as an absolutely impenetrable, inert substance, and premising, that the powers of sensation or perception, and thought, as belonging to man, have never been found but in conjunction with a certain organized system of matter, maintains that those powers necessarily exist in, and depend upon, such a system. In proof of this doctrine, it is alleged, that perception and thought are not incompatible with the properties of matter, considered as a substance extended and endued with the powers of attraction and repulsion; and, therefore, if one kind of substance be capable of supporting all the known properties of man, true philosophy, which will not authorize us to multiply causes or kinds of substance, without necessity, will forbid us to admit of any substance in the constitution of human nature essentially different from matter. The proper seat of the powers of perception and thought, according to this writer, is the brain; because, as far as we can judge, the faculty and thinking in a certain state of the brain always accompany and correspond to one another: and there is no instance of any man retaining this faculty, when his brain was destroyed; and whenever this faculty is impeded or injured, there is sufficient reason to believe that the brain is disordered in proportion. Dr. Priestley apprehends that sensation and thought necessarily result from the organization of the brain, when the powers of mere life are given to the system, and that they follow of course as much as the circulation of the blood follows respiration; but he professes to have no idea at all of the manner in which the power of perception results from an organization of life.

To this reasoning it has been replied in general, that Dr. Priestley's account of matter does not answer to the common ideas of matter, or that it is not solid extension, or an impenetrable and inert substance, which is the only matter that is the object of natural philosophy; but something not solid, that exists in space, and so far agreeing with spirit; and consequently, if such matter is, as he asserts, the only matter possible, it will follow, not that we have no souls distinct from our bodies, but that we have no bodies distinct from our souls, and that all in nature is spirit. Besides, it has been farther urged, that a connection and dependence by no means prove sameness. From the dependence of actual sensations and thought on the brain, we have no more reason to conclude that the brain is the mind, than a savage who had never heard the music of a harpsicord, and did not see the hand that played upon it, would have to conclude, that it played upon itself, and was the musician; because he could trace all the sounds to the instrument, and found that when the strings were out of order, the music was disturbed or destroyed. What experience teaches us is, that the exercise of the mental powers depends on the brain and the nerves; not that the mind is the brain and the nerves. We are sure the mind cannot be the brain, because the brain is an assemblage of beings; whereas the mind is one being.

Dr. Priestley farther argues, that all our ideas either proceed from the bodily senses, or are consequent upon the preceptions of sense: and hence infers, that the notion of the possibility of thinking in man, without an organized body, is not only destitute of all evidence from actual appearances, but is directly contrary to them. Moreover, if the mind was naturally so independent of the body, as to be capable of subsisting by itself, and even of appearing to more advantage after the death of the body, as some of the advocates for an intermediate state have maintained, it might, he says, discover some signs of its independence before its death, and especially when the organs of the body were obstructed, so as to leave the soul more at liberty to exert itself, as in a state of sleep or swooning, which most resembles the state of death, in which it is pretended that the soul is most of all alive, most active, and vigorous; but judging by appearances, the reverse of all this is the case. Besides,

if the mental principle was, in its own nature, immaterial and immortal, all its particular faculties would be so too; whereas we see that every faculty of the mind, without exception, is liable to be impaired, and even to become wholly extinct before death. Whence he infers, that the substance, or principle in which these faculties exist, must be pronounced to be mortal too. He adds, if the sentient principle in man be immaterial, it can have no extension, but every thing within it, or properly belonging to it, must be simple and indivisible; and if this is not the case, the soul would be liable to corruption and death.

Dr. Priestley alleges also, in favour of the system of materialism, that we hereby get rid of many difficulties, which must embarrass the opposite system; such, e. g. as these—what becomes of the soul during sleep, in a swoon, when the body is seemingly dead (as by drowning or other accidents), and especially after death? also what was the condition of it before it became united to the body, and at what time did that union take place? what are the nature and the state of the souls of brutes? what is the use of the human body, &c. The system of materialism, he says, which revelation uniformly supposes, is clogged with no difficulties of this kind. Man, according to this system, is no more than what we now see of him. His being commences at the time of his conception, or perhaps at an earlier period. The corporeal and mental faculties, inhering in the same substance, grow, ripen, and decay together; and whenever the system is dissolved, it continues in a state of dissolution, till it shall please that Almighty Being, who called it into existence to restore it to life again. Accordingly, the Christian system provides no reward for the righteous till the general resurrection of the just, nor any punishment for the wicked till the end of the world. Hence also the doctrine of the pre-existence of human souls, and that of the pre-existence of Christ, are rejected, as having no other foundation than the notion of there being something in man quite different from his corporeal organized system.

Dr. Priestley argues in many parts of his work on the supposition, that, according to the ideas of modern immaterialists, spirit can have no relation to place, and is incapable of being present any where. But Dr. Clarke, and some others of the best modern writers, did not entertain these ideas of spirit. Time and place are necessary to the existence of all things; and hence Dr. Clarke infers, that infinite space and duration are the essential properties of the Deity. Sir Isaac Newton was also of the same opinion; and Dr. Price observes, that if spirit exists at all, it must exist somewhere, as well as in some time. Dr. Priestley deduces another argument in favour of the material system, from the consideration that the spirit and body have no common property, and that it must therefore be impossible for them to act upon one another; against which it has been objected, that his principles tend to prove, that the Deity is material, as well as all inferior beings: and if matter be a power of attraction and repulsion, united to extension, the Deity must be the same. But if this maxim be not universally true, and the Deity be immaterial, as Dr. Priestley himself asserts, it will follow, that spirit may act upon matter, without having any other common property with it than being locally present to it; and one of his chief arguments for the materiality of the soul will be given up. Besides, allowing this maxim, how is it possible to avoid asserting the impossibility of the creation of the world out of nothing? For what common property can the Creator have with nothing?

Dr. Priestley has laboured to prove, that the scriptures, both of the Old and New Testaments, suppose and inculcate the doctrine of the uniform composition of man, or of the materiality of the human soul, and that in conformity to this doctrine, the state of retribution does not take place till after the general resurrection. Accordingly his system leads him to deny the natural immortality of the soul, and its conscious existence in the intermediate state. To those who object, that if the soul be not naturally capable of surviving the body, or if death is unavoidably its destruction, then resurrection must be the resurrection of a nonentity; he replies, that though the power of thinking cannot exist without its substance, which is an organized system, yet if this property of thinking necessarily attends the property of life, nothing can be requisite to the restoration of all the powers of the man, but the restoration of the body to a state of life. And he apprehends that a resurrection properly so called (because this can be only a resurrection of something that had been dead; viz. the body), is manifestly useless, upon the supposition of there being a soul distinct from the body, it being upon this hypothesis, the soul and not the body, that is the seat of all perception, and the source of all action. See *SLEEP of the Soul*.

SOUND, **SONUS**, a perception of the soul, communicated by means of the ear; or the effect of a collision of bodies, and a tremulous motion, consequent thereon, communicated thence to the circumambient fluid, and propagated through it to the organs of hearing. For the nature and properties of **SOUNDS**, see the System of **ACOUSTICS**, throughout.

SOUND, in geography, denotes a strait or inlet of the sea, between two capes or headlands. The Sound is used, by way of eminence, for that famous strait which joins the German Sea to the Baltic. See the System, under *Natural Divisions of the Earth*.

SOUP, or *Sopp*, a kind of pottage made of bread and broth.

or of the juice of flesh, or other matters, usually served at the beginning of a meal.

Portable Soup, is a kind of cake, formed of concentrated broth, which being freed from all fat, and having by long boiling evaporated the most putrescent parts of the meat, is reduced to the consistency of a glue, as in reality it is, and will like other glues, in a dry place, keep sound for many years together. Sir John Pringle inclines to believe, that the gelatinous parts of animal substances, such as compose these cakes, are not of a nature much disposed to putrify. But however that be Captain Cook observes, that, in his voyage, this soup was the means of making his people eat a greater quantity of greens than they would have done otherwise, and so far we must allow it to have been virtually antiseptic.

SOWING, in Agriculture. For directions concerning the manner of sowing the different kinds of grain, see the System, on the several articles from Sect. III. to Sect. XIV. inclusive: see also the Treatise on GARDENING, Article *Kitchen Garden* throughout the year. For description of an universal *Sowing Machine*, see Sect. XXVIII. and Plate II.

SPA, or **SPAW**, in Geography, a town in the bishopric of Leige in Germany, famous for its mineral waters. Those of the Pouhon spring in Spa have been preferred, by our chief physicians, to any others in or near the country of Leige; particularly to the waters of Bru, which they complain have been imposed on the public, to their patients frequent disappointment. However, as the Spa waters are impregnated with different proportions of the same ingredients, they may be chosen differently, according to the intentions with a view to which they are used. The Pouhon is the strongest chalybeate. This is in its most perfect and natural state in cold dry weather; but in warm moist weather it loses its transparency, appears turbid or wheyish, contains less fixed air, and is partly decomposed. This water, which is colder by many degrees than the heat of the atmosphere, is supposed to contain the greatest quantity of fixed air of almost any acidulous water; and in consequence of this ingredient it has a remarkable sprightliness and vivacity, and boils by mere warmth; but this soon flies off if the water be left exposed, though it may in a great measure be preserved in well-corked bottles. It is capable of dissolving more iron than it naturally contains, and of thus becoming a stronger chalybeate, on account of the great quantity of fixed air which it contains; and for the same reason an ebullition is raised in it on the addition of acids, which disengage its fixed air. This water mixes smoothly with milk, whether it be cold or of a boiling heat. The Tonnelet and Gerontferre waters are weaker chalybeates, but brisker and more spirituous. The Groesbeck, Sauveniere, and Wartroz, are still weaker chalybeates, but highly impregnated with calcareous and selenitical earths, and contain also a greater proportion of the fossil alkali. The Geromont is likewise a weak chalybeate, but contains a great deal of calcareous and selenitical earth, and about three times as much alkaline salt as any of the others. The four last waters, therefore, will be better in disorders arising from an acid cause, and as diuretics, particularly the Geromont. The Bru, or Churon water, approaches to the nature of the Tonnelet, and though it has been denied, is said, in consequence of every trial, not to be inferior to any of the Spa waters. All the waters that are comprehended under this denomination, abound with fixed air; they also contain more or less iron, fossil alkali, and calcareous and selenitical earths, together with a small portion of sea salt, and an oily matter common to all waters. All these ingredients are kept suspended, and in a neutral state, by means of the fixed air, on which their virtues chiefly depend; though they are probably rendered more active and penetrating both in the first passages, and also when they enter the circulation, by means of that small portion of iron, earth, salt, &c. with which they are impregnated. These waters are diuretic, and sometimes purgative; and, like other chalybeate waters, they tinge the stools black. They exhilarate the spirits much better than wine or spirituous liquors, and their general operation is by strengthening the fibres. They cool and quench thirst much better than common water. They are found excellent in cases of universal languor or weakness, proceeding from a relaxation of the stomach, and of the fibres in general, and where the constitution has been weakened by diseases, or by a too sedentary life; in weak, relaxed, gross habits; in nervous disorders; at the close of fits of the gout and rheumatism; in such asthmatic disorders and chronic coughs as proceed from too great a relaxation of the pulmonary vessels; in obstructions of the liver and spleen; in scorbutic and other putrid disorders; in hysterical and hypochondriacal complaints; in paralytic disorders; in gleets; in the fluor albus; in fluxes of the belly; in the gravel and stone; in female obstructions; in barrenness, and in most other cases where a strengthening and brisk stimulating resolving chalybeate remedy is wanted: but they are generally hurtful in hot, bilious, and plethoric constitutions, when used before the body is cooled by proper evacuations; they are also hurtful in cases of fever and heat, in hectic fevers, and ulcerations of the lungs, and of other internal parts, and in most confirmed obstructions attended with fever. The usual season for drinking them is in July and August, or from May to September. The quantity to be drank is such as the stomach can bear without heaviness or uneasiness: but it is advisable to begin with drinking a glass or two several times in a day, and so increase the quantity daily, as the stomach can

N^o 140.

bear; and during the course to continue that dose, and to diminish the quantity at the close in the same degree as it was augmented at the beginning. Moderate exercise is proper after drinking. Previous to the use of the water the first passages should be cleansed by gentle purges, and, if necessary, an emetic should be given; and during it the costiveness should be prevented, by occasionally adding Rochelle salts or rhubarb to the first glasses of water in the morning; and a cooling regimen should be observed. The Spa water is also used externally, in a variety of cases, with good success. It is used as an injection in the fluor albus, and in ulcers and cancers of the womb, and also in the gonorrhoea; it is serviceable for washing venereal aphthae, and ulcers in the mouth, phagædenic ulcers, by way of gargle for tonsils, and for fastening loose teeth, and in other cases of relaxation. It is also said to cure the itch, and similar complaints, by washing and bathing, an internal course being observed at the same time. Elliott's Mineral Waters, p. 201, &c. The town of Spa being resorted to by persons from all parts of Europe, on account of its waters, has always been allowed a neutrality during the hottest wars.

SPACE, **SPATIUM**, a simple idea, the modes whereof are distance, capacity, extension, duration, &c. Space, considered barely in length between any two bodies, is the same idea which we have of distance. If it be considered in length, breadth, and thickness, it is properly called capacity. When considered between the extremities of matter, which fills the capacity of space with something solid, tangible, and moveable, it is then called extension. So that extension is an idea belonging to body only; but space, it is plain, may be considered without it: space, therefore, in the general signification, is the same thing with distance considered every way, whether there be any solid matter in it or not. Space and time, according to Dr. Clarke, are attributes of the Deity, and the impossibility of annihilating these, even in idea, is the same with the necessary existence of the Deity. See Watt's Phil. Ess. Ess. 1.

SPACE, in Geometry, denotes the area of any figure; or that which fills the interval or distance between the lines that terminate it.

SPANIEL, a species of the genus *canis*. For description and management, see Dog. For representation, see system of MAMMALIA, Plate III. Genus 12. Species 1. Variety 1.

SPASM, **SPASMA**, or **SPASMUS**, *σπασμα*, a Greek term of equal import with the Latin *convulsio*, and English *convulsion*. Accidental spasms are of short continuance: there are some arising from flatulencies; others from bites of venomous beasts, from the puncture of a nerve, the acrimony of the humours vellicating the stomach, excessive cold, hysterical vapours, &c. And spasm may be either universal, extending itself over the whole body, which is a very rare case: or partial, occupying only some one part of the body: these are very frequent, and seize at times on every part, from the head to the foot. For description, causes, prognosis, &c. see the system of MEDICINE, Genus 39.

SPAVIN, a disease in a horse: being a swelling or stiffness, usually in the ham, which causes him to halt. See the System of FARRIERY, Class I. sect. III.

SPEAKING, the art or act of expressing one's thoughts in articulate sounds or words. For a copious explanation of this subject, see the System of GRAMMAR, and the Treatise on ORATORY, together with the articles, LANGUAGE, and READING.

SPECIAL, something that is particular, or has a particular designation; from the Latin species: in opposition to *general*, or *genus*. The king, in his letters, frequently says, of our special grace, full power, and royal authority.

SPECIES, an idea, which relates to some other more general one, or is comprised under a more universal division of a genus; as in the definition of any thing, we obtain its general nature or genus, by comparing it with other things that are most like to itself, and observing wherein its essence or nature agrees with them; so we obtain the essential or specific difference, by considering the most remarkable and primary attribute, property, or idea, wherein this differs from those other things that are most like it: and this attribute, or specific difference, distinguishes each species from one another, while they stand ranked under the same genus. Linnaeus has strictly adhered to this method of definition throughout the whole of his elaborate and invaluable work, called SYSTEMA NATURÆ.

SPECIFIC, in Philosophy, that which is proper and peculiar to any thing; or that characterizes it, and distinguishes it from every other thing. See PROPER, &c. Thus the attracting of iron is specific to the load-stone, or is a specific property of the load-stone: a just definition should contain the specific notion of the thing defined, or that which specifies and distinguishes it from every thing else.

SPECIFICS, in Medicine. By specifics is not meant such as infallibly and in all patients produce salutary effects. Such medicines are not to be expected, because the operations and effects of remedies are not formally inherent in them, but depend upon the mutual action and re-action of the body and medicine upon each other; hence the various effects of the same medicine in the same kind of disorders in different patients, and in the same patient at different times. By specific medicines we understand such medicines as are more infallible than any other in any particular disorder.

*

4 K

SPECIFIC

SPECIFIC Gravity, in Hydrostatics. See the System, Part I. Section I.

SPECIFIC Names, in Natural History, are those epithets composed each of one or more terms, and placed after the general name, in the denomination of any species of plant, animal, or mineral, expressing those characters by which it differs from all the other species of that genus.

SPECTACLES, an Optic Machine, consisting of two lenses set in a frame, and applied on the nose, to assist in defects of the organ of sight. Old people, and all Presbyters, use spectacles of convex lenses, to make amends for the flatness of the eye, which does not make the rays converge enough to have them meet in the retina. Short-sighted people, or Myopes, use concave lenses, to keep the rays from converging so fast, on account of the great roundness of the eye, which is such as to make them meet before they reach the retina. See the System, Part I. Sect. II.

SPECULUM, *Mirror*, in Optics, any polished body, impervious to the rays of light: such is water in wells, and deep rivers, polished metals, and glasses lined with mercury, or any other opaque matter, popularly called *looking-glasses*. See the System, Part II. Prop. XVII. to XXII. and Plate II.

SPEECH, the act, or art of expressing a man's thoughts, by certain signs invented for that purpose. These signs are principally sounds made by the voice, and letters. See LANGUAGE.

SPEECH, in Grammar, denotes an assemblage of several words ranged in order. The grammarians generally make eight parts of speech, i. e. eight kinds of words used in discourse; viz. *noun, pronoun, verb, participle, adverb, conjunction, preposition, and interjection*; each of which see under its proper article. See the Treatise, Part II. Chap. III. Article ANALOGY.

SPELLING, that part of grammar properly called Orthography. See the Treatise, Part II. Chap. I.

SPERMACEITI, in Pharmacy, is a whitish, flaky, unctuous substance, prepared from oil; principally from that of a cetaceous fish, called by some the *male whale*, by others *cachalot*, and by the Latins *orca*; distinguished from the common whale by its having teeth in lieu of whale-bone, and by a bunch on its back. See PHYSETER. It had its name *spermaceti*, seed or sperm of whale, given it, no doubt, to raise its value, by a notion of its scarcity; the oil it is properly to be made from is found in a large trunk, four or five feet deep, and ten or twelve long, filling almost the cavity of the head, and seeming to supply the office of brain and cerebellum. The method of preparing it is a secret in the hands of a very few. The process is said to be thus: the matter, being taken out of the animal, is melted over a gentle fire, and put into moulds, like those wherein sugar-loaves are formed. When cold and drained, it is taken out, and melted over again, and this they continue to do till it be well purified and become white. It is then cut with a knife for the purpose, and reduced into flakes, such as we have from the druggists. Some of our druggists have now got the art of making it from the sediment or fæces of any kind of oil. It must be chosen white, clear, and transparent, of a sweetish smell, which some fancy to partake of that of the violet: some sophisticate it with wax; but the deceit is discovered, either by the smell of the wax, or by the dulness of the colour. Some also sell a preparation of oil gained from the tail of the whale, instead of that from the brain; which last kind turns yellow, as soon as is opened to the air. In general, there is no merchandize that should be kept closer from the air than spermaceti. Spermaceti is of great use in medicine. Quincy says, it is a noble remedy in the asthma, &c. though chiefly used in bruises, inward hurts, and after delivery. For internal use, it may be dissolved in aqueous liquors into the form of an emulsion, by trituration with almonds, the yolk or white of an egg, and more elegantly by mucilages; or made into a loch, by mixing two drams of it with a suitable quantity of yolk of egg, then adding half an ounce of fresh drawn oil of almonds, and an ounce of balsamic syrup. It is certain its greatest property, and that which makes it so much in vogue in many places, is its softening the skin. Whence it comes to be used by the ladies in pastes, washes, &c. *Spermaceti candles* are of modern manufacture: they are made smooth, with a fine gloss, free from rings and scars, superior to the finest wax candles in colour and lustre; and, when genuine, leave no spot or stain on the finest silk, cloth, or linen.

SPERMATIC, in Anatomy, something belonging to the sperm or seed. The ancients made a general division of the parts of the animal body into spermatic and sanguineous. Spermatic parts are those, which by their colour, &c. bear some resemblance to the seed; and were supposed to be formed thereof; such are the nerves, membranes, bones, &c. Sanguineous are those supposed to be formed of the blood after conception. But the moderns, with much better reason, hold all the parts to be spermatic in this sense, and either formed originally of the ovum of the female, or of the semen of the male.

SPERMATIC Vessels, called also *vasa præparantia*, are certain vessels appointed for bringing the blood to the testicles, &c. to be secreted and prepared into seed, and for carrying back again the blood remaining after the secretion is effected. The spermatic vessels are two arteries, and as many veins. See GENERATION.

The SPERMATIC Arteries arise from the forepart of the trunk

of the aorta, below the emulgents. See the System of ANATOMY, Part V. Sect. I.

SPHENOIDES, in Anatomy, os cuneiforme; a bone of the head common to the cranium and upper jaw. See the System, Part I. Sect. II.

SPHERE, in Geometry, a solid body contained under one single surface, and having a point in the middle, called the centre, whence all lines, drawn to the surface, are equal. The sphere is supposed to be generated by the revolution of a semicircle. See the System, Sect. III.

SPHERE, in Astronomy, that concave orb or expanse which invests our globe, and in which the heavenly bodies, viz. sun, stars, planets, and comets, appear to be fixed at an equal distance from the eye. This is also called the *sphere of the world*; and is the subject of the spherical astronomy. See the System, Sect. IX. throughout.

SPHERE, in Geography, and Astronomy, &c. denotes a certain disposition of the circles on the surface of the earth, with regard to one another, which varies in various parts thereof. See the Treatise on the GLOBES, and the plate annexed, Fig. 3 and 4.

Armillary or Artificial SPHERE, is an astronomical instrument, representing the several circles of the sphere in their natural order; serving to give an idea of the office and position of each of them, and to solve various problems relating to them. It is thus called, as consisting of a number of falcæ or rings of brass, or other matter, called by the Latins *armillæ*, from the resembling of bracelets, or rings for the arm. By this it is distinguished from the globe, which, though it hath all the circles of the sphere on its surface; yet is not cut into armillæ or rings, to represent the circles simply and alone; but exhibits also the intermediate spaces, between the circles. For representation of the *Copernican Armillary Sphere*, see the plate annexed to the Treatise on the GLOBES, Fig. 1. For description and representation of the newly improved *Armillary Sphere*, by Mr. Adams, see Fig. 2, the same Treatise.

SPHEROID, SPHEROIDES, Σφαιροειδης, formed from σφαῖρα, *sphæra*, and εἶδος *eidos*, *shape*, in Geometry, a solid approaching to the figure of a sphere, though not exactly round, but oblong; as having one of its diameters bigger than the other; and generated by the revolution of a semi-ellipsoid about its axis.

SPHINCTER, in Anatomy, a term applied to a kind of circular muscles, or muscles in form of rings, which serve to close and draw up several orifices of the body, and prevent the excretion of the contents. The word is formed from σφινγνῆρ, *sphingnêr*, or *constrictor*, something that binds and constricts a thing very closely; these muscles having an effect much like that of a purse-string.

SPHINCTER Ani, is a circular muscle, serving to shut the anus, and keep the excrements from coming away involuntarily. See the System, Part III. Sect. IV.

SPHINX, in Entomology, a genus of the lepidoptera order of insects. For description and classification, see the System, Order III.

SPIDER, in Entomology, the English name of a genus of the aptera order of insects. For description of the generic and specific characters see ARANEA. For classification, see the System, Part V. Sect. VII.

SPINAL Arteries, in Anatomy, are two arteries, one anterior and one posterior, both produced by the vertebrales; each of which as soon as it enters the cranium, sends out a small branch, by the union of which the posterior *spinalis* is formed. See the System, Part V. Sect. III.

SPINALIS, in Anatomy, the name of several muscles of the spine. See the System, Table of Muscles, Art. XVIII.

SPINE, SPINA *Dors*, in Anatomy, the series or assemblage of vertebrae, or bones of the back, which sustain the rest of the body, and to which are connected the ribs. See the System, Part I. Sect. I. and Plate I. fig. 1. letter a, and fig. 2. letter c.

SPIRACULA, in Entomology, are little holes or pores placed singly on each side of every segment of the abdomen, through which the insect breathes: see the System, Part I. Article Description of an Insect.

SPIRAL, in Geometry, a curve line of the circular kind, which, in its progress, recedes from its centre; as in winding from the vertex, down to the base of a cone.

SPIRAL Pump. See ARCHIMEDIS'S SCREW, in the System of HYDROSTATICS, Part II. Art. IX.

SPIRIT, the most subtle and volatile part, or juice of the body; by means whereof the functions and operations thereof are supposed to be performed.

Vital SPIRITS, are only the finest, and most agitated parts of the blood; whereon its motion and heat depend.

Animal SPIRITS, are an exceedingly thin, subtle, moveable fluid, juice or humour, separated from the blood in the cortex of the brain, and thence received into the minute fibres of the medulla, and by them discharged into the nerves; by which it is conveyed through every part of the body, to be the instrument of sensation, muscular motion, &c. See the System, Part I. Sect. II.

SPIRIT, in Chemistry and Pharmacy, a name applied to every volatile liquid which is not insipid like phlegm or water, and hence the distinction into acid, alkaline and vinous spirits.

SPIRITS, is also a general name, among distillers, for all distilled

tilled liquors that are neither oil nor phlegm. See the Treatise on DISTILLATION.

SPIRITS, in Medicine. Rectified spirit coagulates all the fluids of animal bodies that have been tried, except bile and urine. It hardens the solid and consistent parts, and, being a powerful antiseptic, preserves them from corruption. Applied externally to living animals, it strengthens the vessels, contracts the extremities of the nerves, and deprives them of sensibility; hence its power of restraining hæmorrhages, abating superficial pains, &c. Received into the stomach undiluted, it produces the like effects; thickening the fluid, and contracting all the solid parts which it touches, and destroying, at least for a time, their use and office: if the quantity taken is considerable, a palsy, or apoplexy, follows, and speedily proves mortal. For the method of rectifying SPIRITS, see the Treatise on DISTILLATION, under the article RECTIFICATION.

Foreign SPIRITS, a general name by which our dealers in these things call Brandy and Rum. It is hard to purchase any of these genuine and pure, unless at the first hand, and in large quantities. The dealers generally mix our own spirits with them. When we had little other spirit but that of malt made with us, this cheat was easily discovered, for a nice palate would distinguish the mixture of only a tenth part of this foul spirit among the foreign clean ones; but since we have the molasses spirit so common, and rectified to so great a perfection, the deceit is not easily found out, though a larger proportion is used. All foreign spirits are to be suspected of this adulteration, which have not a uniform taste and grateful odour. But one of the best ways of discovering the mixture, is to burn away all that is inflammable in a small quantity by way of trial, and then examine the phlegm.

SPIRIT of Nitre. See **Nitrous ACID**, in the System of CHEMISTRY.

SPLANCHOLOGY, formed from *σπλγχον*, intestine, and *λογος*, discourse, in Anatomy, a discourse on, or explication of the viscera. For a copious explanation, see the System, Part III. Sect. V. For representation of the several parts of the viscera, see Plate V.

SPLEEN, in Anatomy, a soft, spongy viscus, of a darkish red, or rather livid, colour, ordinarily resembling the figure of a tongue; though sometimes triangular, and sometimes roundish, being about seven or eight fingers breadth in length, and four or five in breadth. See the System, Part III. Sect. V. and Plate V. fig. 3, letter T.

SPLENETIC, a person affected with obstructions of the spleen. In splenic people, the spleen is swelled beyond the natural bulk; or it is hardened so as to shew a scirrhous tumour therein. Splenic people are distinguished by a livid, lead-coloured complexion; and their character is, to be very prone to laughter; which is an expedient nature is supposed to make use of, to evacuate the too redundant humour the spleen is charged withal; whence it is, that the ancients made the spleen the organ of laughter; and hence that popular saying, of a person laughing heartily, that he vents his spleen.

SPLENITIS, in Medicine, the name of a species of fever, in which the blood is powerfully directed toward the spleen by nature, in order to break and dissolve congestions formed there. For description, causes, prognosis, and cure, see the System, Genus XVII.

SPLINT, or **SPLINT**, among Farriers, a callous, insensible excrescence, or gristle, that sometimes sticks to an horse's shankbone; generally on the inside below the knee. For the method of treatment, see the System of FARRIERY, Part II. Sect. IV.

SPONTANEOUS, **SPONTANEUS**, formed from the Latin adverb *sponte*, of one's own accord; in the schools, a term applied to such motions of the body and mind as we perform ourselves without any constraint. Thus, in morality, those actions performed upon an inward and natural principle, conformable to our own inclinations, excluding all constraint, are called spontaneous actions.

SPOON-bill, **Platea**, in Ornithology, the English name of the Genus *Platea*. For description of the Genus, see **PLATEA**.

SPRING, *fons*, in Natural History, a fountain or source of water, rising out of the ground. The origin of springs or fountains is a thing much controverted among naturalists. Dr. Halley refers the origin of springs merely to vapours raised by the heat of the sun, or of subterraneous fires, from the sea, lakes, rivers, &c. Now, to shew that vapour is a sufficient fund to supply all our springs, rivers, &c. the same excellent author makes an estimate of the quantity of vapour raised from the sea, by the action of the sun: for the result of which, see **EVAPORATION**. The perpetuity of divers springs, always yielding the same quantity of water, when the least rain or vapour, is afforded as well as the greatest, is a strong objection to Dr. Halley's system. Dr. Derham mentions one in his own parish of Upminster, which he could never perceive by his eye to be diminished in the greatest droughts, even when all the ponds in the country, as well as an adjoining brook, had been dry for several months together; nor ever to be increased in the most rainy seasons, excepting perhaps for a few hours, or at most for a day, from sudden and violent rains. Had this spring its origin from rain or vapour, there would be found an increase and decrease of its water, corresponding to those of its causes; as we actually find in such temporary springs as have undoubtedly their rise from rain and vapour; add to this another considerable thing in this Upminster

spring and thousand of others: viz. that it breaks out of so inconsiderable an hillock, or eminence, as can have no more influence in the condensation of the vapours, or stopping the clouds, than the lower lands about it have. The very highest ground in the country, he finds, is not above a hundred and thirty-five yards above the level of the sea; and what is such an inconsiderable rise of land, to perennial condensation of vapours, fit to afford so considerable a spring? or the high lands of the whole country, to the maintaining all its fountains and rivulets?

Different sorts of SPRINGS. Springs are either such as run continually, called perennial, or such as run only for a time, and at certain seasons of the year, and therefore called temporary springs. Others, again, are called intermitting springs, because they flow and then stop, and flow and stop again: and reciprocating springs, whose waters rise and fall, or flow and ebb, by regular intervals. It is said that in the diocese of Paderborn, in Westphalia, there is a spring which disappears twice in twenty-four hours, and always returns at the end of six hours, with a great noise, and with so much force, as to turn three mills not far from its source. It is called the *bolder-born*, or boisterous spring. Phil. Trans. N^o. 7, p. 127.

Burning or Boiling SPRINGS. See **BURNING SPRINGS**.

SPRING-Tide. See the System of ANATOMY, Sect. X.

SPRING, in Cosmography, denotes one of the seasons of the year: commencing in the northern parts of the world, on the day the sun enters the first degree of Aries, which is about the twenty-first day of March, and ending when the sun leaves Gemini. Or, more strictly and generally, the spring begins on the day when the distance of the sun's meridian altitude from the zenith, being on the increasing hand, is at a medium between the greatest and least. The end of the spring coincides with the beginning of summer.

SPRING, in Physics, denotes a natural faculty, or endeavour, of certain bodies to return to their first state, after having been violently put out of the same by compressing, bending them, or the like. This faculty philosophers usually called *elastic force*, or **ELASTICITY**. See **ELASTICITY**. Fleas only jump to those excessive heights, by means of a springy membrane, easily visible by a microscope. By the elastic force of this spring they are enabled to leap two hundred times the height of their own body. Nature has provided for the regular sowing of the seeds of several kinds of plants, by furnishing them with a spring, which is wound sometimes round the outside, and sometimes round the inside, of the case wherein the seeds are contained.

SPRUCE Beer, a kind of diet-drink made by infusion or decoction of the leaves and small branches of the black and white spruce fir, and reckoned antiscorbutic.

SQUADRON, a body of horse, whose number of men is not fixed, but is usually from eighty to a hundred and twenty men. See the Treatise on **MILITARY AFFAIRS**, Sect. III.

SQUADRON of Ships, denotes either a detachment of ships employed on any particular expedition, or the third part of a naval armament. The number of ships in a squadron is not fixed: a small number of vessels, if they be in a body, and have the same commander, may make a squadron. If there be a great number, they are usually divided into three squadrons; and if the squadrons be numerous, each squadron is divided into three divisions, distinguished by their flags and colours. See the Treatise on **NAVAL AFFAIRS**.

SQUALUS, the **SHARK-KIND**; a genus belonging to the order of amphibia nantes. There are five spiracula, one on each side of the neck, the body is somewhat oblong and cylindrical; and the mouth is situated in the anterior part of the head. There are 15 species, all inhabitants of the ocean. The most remarkable are, The *squatina*, or angel-fish; has a large head; teeth broad at their base, but slender and very sharp above, and disposed in five rows all round the jaws. Like those of all sharks, they are capable of being raised or depressed by means of muscles uniting them to the jaws, not being lodged in sockets as the teeth of cetaceous fish are. The back is of a pale ash-colour, and very rough; along the middle is a prickly tuberculated line, the belly is white and smooth. The pectoral fins are very large, and extend horizontally from the body to a great distance; they have some resemblance to wings, whence its name. The ventral fins are placed in the same manner, and the double penis is placed in them; which forms another character of the males in this genus.

This is the fish which connects the genus of rays and sharks, partaking something of the character of both; yet is an exception to each in the situation of the mouth, which is placed at the extremity of the head. It is a fish not unfrequent on most of our coasts, where it prowls about for prey like others of the kind. It is extremely voracious; and, like the ray, feeds on flounders and flat-fish, which keep at the bottom of the water. It is extremely fierce and dangerous to be approached. Mr. Pennant mentions a fisherman whose leg was terribly tore by a large one of this species, which lay within his nets in shallow water, and which he went to lay hold of incautiously. The aspect of these, as well as the rest of the genus, have much malignity in them: their eyes are oblong, and placed lengthwise in their head, sunk in it, and overhung by the skin, and seem fuller of malevolence than fire. Their skin is very rough: the ancients made use of it to polish wood and ivory, as we do at present that of the greater dog-fish. The flesh is now but little esteemed

esteemed on account of its coarseness and rankness: yet Archeffratus, (as quoted by Athenæus, p. 319), speaking of the fish of *Milæus*, gives this the first place, in respect to its delicacy, of the whole cartilaginous tribe. They grow to a great size; being sometimes near an hundred weight.

The spinax, or picked dog-fish, takes its name from a strong and sharp spine placed just before each of the back fins, distinguishing it at once from the rest of the British sharks. The nose is long, and extends greatly beyond the mouth, but is blunt at the end. The teeth are disposed in two rows, are small and sharp, and bend from the middle of each jaw towards the corners of the mouth. The back is of a brownish ash-colour; the belly white. It grows to the weight of about 20 pounds. This species swarms on the coasts of Scotland, where it is taken, split, and dried; and is a food among the common people. It forms a sort of internal commerce, being carried on womens backs 14 or 16 miles up the country, and sold or exchanged for necessaries.

The carcharius, or white shark, grows to a very great bulk. Gillius says to the weight of 4000 pounds: and that in the belly of one was found a human corpse entire; which is far from incredible, considering their vast greediness after human flesh. The mouth of this fish is furnished with (sometimes) a sixfold row of teeth, flat, triangular, exceedingly sharp at their edges, and finely serrated. Mr. Pennant has one that is rather more than an inch and an half long. Grew says, that those in the jaws of a shark two yards in length are not half an inch; so that the fish to which this tooth belonged must have been six yards long, provided the teeth and body keep pace in their growth.

This dreadful apparatus, when the fish is in a state of repose, lie quite flat in the mouth; but when he seizes his prey, he has power of erecting them by the help of a set of muscles that join them to the jaw. The mouth is placed far beneath; for which reason these, as well as the rest of the kind, are said to be obliged to turn on their backs to seize their prey. They are the dread of the sailors in all hot climates, where they constantly attend the ships in expectation of what may drop over board: a man that has that misfortune perishes without redemption; they have been seen to dart at him like gudgeons to a worm. A master of a Guinea ship informed Mr. Pennant, that a rage of suicide prevailed among his new-bought slaves, from a notion the unhappy creatures had, that after death they should be restored again to their families, friends, and country. To convince them at least that they should not re-animate their bodies, he ordered one of their corpses to be tied by the heels to a rope and lowered into the sea; and though it was drawn up again as fast as the united force of the crew could be exerted, yet in that short space the sharks had devoured every part but the feet, which were secured at the end of the cord. Swimmers very often perish by them; sometimes they lose an arm or leg, and sometimes are bit quite asunder, serving but for two morsels for this ravenous animal: a melancholy tale of this kind is related in a West-India ballad, preserved in Dr. Percy's *Relics of Ancient English Poetry*.

SQUARE, *Quadratum*, in Geometry, a quadrilateral figure, whose angles are right, and sides equal. See the *System*, Sect. I.

SQUARE Root, a number, considered as the root of a second power or square number: or a number by whose multiplication into itself, a square number is generated. See *ROOT*.

SQUIRREL, the English name of the genus *sciurus*, in the *System of MAMMALIA*, See *SCIURUS*.

STADTHOLDER, *STADTHOLDER*, or *stadholder*, prior to the revolution which took place in consequence of the conquest of the country by the arms of the French Republic in 1795, was a governor or lieutenant of a province, in the United Netherlands, particularly that of Holland, where the word was most used, by reason of the superior importance of the government of that province. The stadholder, i.e. the stadholder of Holland, was the first member of the republic; chief of all the courts of justice, and might preside therein when he pleased. All sentences, judgments, &c. were dispatched in his name. When an office became vacant in any of the courts, the states proposed three persons to the stadholder, who was to chuse one of them. He could even pardon criminals, which is a sovereign prerogative; and he had the choice of scabines, or chief magistrates in each city; to which end the council of the city always presented him two persons, one of whom he appointed. In several cities he had the same right of nominating the burgo-masters and counsellors; as at Rotterdam, Dort, &c. He had also a power to cashier the magistrates, and put others in their room, when he found it necessary for the public good, upon giving a reason for the same.

By article VI. of the union of Utrecht, the states constituted him arbiter of all the differences that arose between the states of the several provinces, or between the cities and the members of the states of the province. To the dignity of stadholder was inseparably annexed that of captain and admiral-general of the province; in which quality he named all the officers, and disposed of all military posts. He took care of the execution of the ordinances of the states; and his authority gave him a right to receive, and give audience to ambassadors from foreign princes, and even to send ambassadors on his own private affairs. The office of stadholder was very ancient; the counts, not being able to reside in Holland, appointed

stadholders to command in their absence in the several provinces; besides a governor-general of all the seventeen provinces of the Netherlands. William I. prince of Orange, was made stadholder of Holland and Zealand, in 1576, and soon after of the provinces of Guelders, Utrecht, and Overijssel, at the time when the Dutch shook off the Spanish yoke; which enabled him to contribute greatly to that happy event.

In 1584, when William I. was assassinated, the same dignity was conferred by the same provinces, on his son prince Maurice, who was succeeded by his brother Frederic-Henry in 1625; upon his death, in 1647, his son, William II. became stadholder, and he possessed this dignity till his death in 1650. The ambitious views of this prince having given offence to the provinces of the republic, they took measures to reduce the authority of the stadholder; and the province of Holland formed a design of excluding his son William III. prince of Orange, afterwards king of England, from the dignity possessed by his ancestors. However, in 1672, Holland, alarmed at the progress of Lewis XIV. declared William stadholder, and captain-general of the forces of the republic, with the same power which his predecessors had enjoyed. Their example was followed by four other provinces; and, in 1674, on account of his signal services to the states of Holland, they declared him hereditary stadholder, and determined that his dignity should descend to his male heirs. He was succeeded by his appointed heir the prince of Nassau-Dietz, hereditary stadholder of the provinces of Friesland and Groningen, from whom the dignity descended to his son William-Charles-Henry-Frison: in 1722, he was named stadholder by the province of Guelderland. In 1747, the stadholdership was extended to all the seven United Provinces, and made hereditary in the male and female representatives of the family of Orange. But this office is now totally abolished, with all its appendages of dignity, authority, and emolument, both civil and military.

STAGGERS, among farriers, a giddiness in a horse's head, which ends in madness. For the causes and methods of cure, see the *System*, Sect. XXV.

STAIRCASE, an ascent inclosed between walls or a balustrade, consisting of stairs or steps, with landing-places and rails; serving to make a communication between the several stories of a house. See the *system of ARCHITECTURE*, on the principles of the air.

STAMINA, in Botany, those fine threads, or capillaments, growing up within the flowers of tulips, lilies, and most other plants, around the style or pistil. See the *System*, Sect. III. These are the male organs of generation in flowers.

STAMINA, in the animal body, are those simple, original parts, which existed first in the embryo, or even in the seed; and by whose distinction, augmentation, and accretion by additional juices, the human body, at its utmost bulk, is supposed to be formed. All that is essential to the animal, are the stamina, which exist in ovo; the rest being foreign, additional, and even accidental. The stamina seem to coincide with the solids, which are surprisingly small in quantity.

STAMINEOUS Flowers, among botanists, are such as are so far imperfect, as to want those coloured leaves, which are called *petala*: see the *System*, Sect. II.

STAMP-Duties, are a tax imposed upon all parchment and paper whereon any legal proceedings, or private instruments of almost any nature whatsoever are written; and also upon licences for retailing wines of all denominations; upon all almanacks, newspapers, advertisements, cards, dice, and pamphlets containing less than six sheets of paper. These imposts are very various, according to the nature of the thing stamped, rising gradually from a penny to ten pounds. This tax, though in many instances very burthensome, is of service to the public in general, by authenticating instruments, rendering it much more difficult than formerly to forge deeds of any standing; since, as the officers of this branch of the revenue vary their stamps frequently, by marks perceptible to none but themselves, a man that would forge a deed of king William's time must know, and be able to counterfeit the stamp of that date also. The first institution of the stamp-duties was by statute 5 & 6 Will. and Mar. cap. 21. and they have since, in many instances, been increased by subsequent statutes to five times their original amount. It would far exceed the limits of this work to recite all the duties of this kind that already exist.

STANDARD, in Commerce, the original of a weight, measure, or coin, committed to the keeping of the magistrate, or deposited in some public place, to regulate, adjust, and try the weights used by particular persons in traffic. The justness of weights and measure is of that consequence to the security and good order of trade, that there is no civilized nation but makes it part of their policy to preserve the equality thereof by means of standards. The standards of weights and measures in England are appointed, by Magna Charta, to be kept in the exchequer by a special officer, called the *CLERK*, or *comptroller of the market*. Whether gold or silver be above or below standard, is found by assaying. See *ASSAYING*.

STANDARD, in War, a sort of banner or flag borne as a signal for joining together of the several troops belonging to the same body. See *FLAG*, &c.

STANNARIES, *STANNARIA*, the mines and works where tin is dug and purified; as in Cornwall, Devonshire, &c. There are four

s;
e-
of
ch
ie

ity
ce,
on
he
ws
b-
r;
on
m
ol-
m
th
x-
c-
ed
d
ir
es
to
ed
t-
d
a-
ll
il

d,
te

s,
g
c.

s,
er
le

s,
y
s,
ll
);
-ll

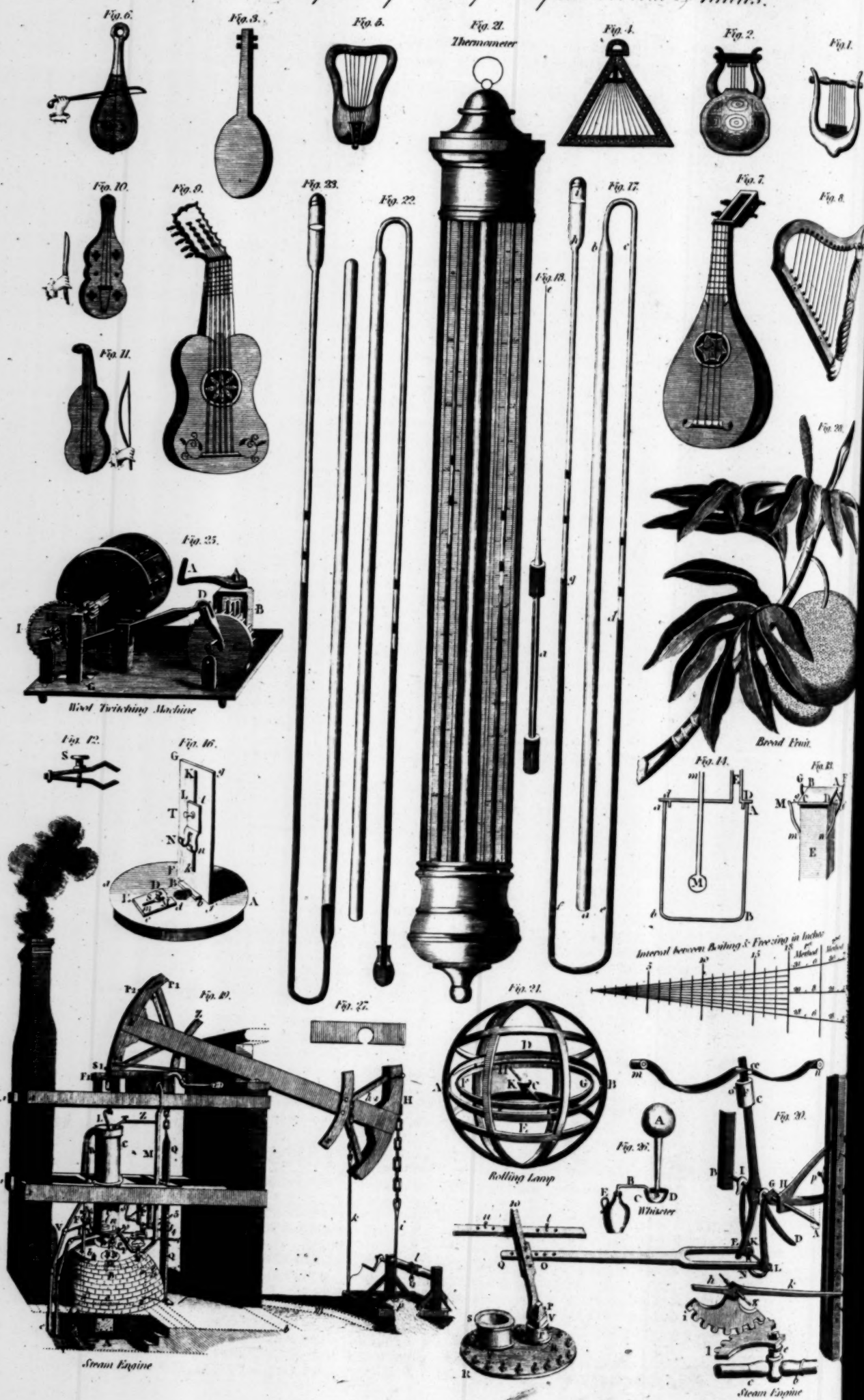
to
d

d
t-
or
i-
n
o
o
t-
e
e
e
s
e
k
s,
ll

-
s
d
f
r
e
-
d
e
l
e

n
e
r

*Miscellaneous Subjects representing the Origin of Musical Instruments, the Thermometer, &c.
See the Alphabet for description of the several Articles.*



four courts of the flanneries in Devonshire, and as many in Cornwall, for the administration of justice among the tanners. These, which are courts of record, are held before the lord warden and his substitutes, in virtue of a privilege granted to the workers in the tanneries there, to sue and be sued only in their own courts, that they may not be drawn from their business, which is highly profitable to the public, by attending their law-suits in other courts.

STANZA, in Poetry, a certain stated number of grave verses, containing some perfect sense, terminated with a rest, or pause. The word is Italian, and literally signifies a stand or station, because of the pause to be made at the end of each stanza, or complete sense. Every stanza ought not only to contain a perfect sense, but to be terminated with some lively and ingenious thought, or some just and pertinent reflection; stanzas were first introduced from the Italian into the French poetry, about the year 1580, and thence they were transferred into the English.

STAPHYLINI, in Anatomy, are two small fleshy ropes, closely united together, as if they made but one muscle, but distinguished in some subjects by a very fine white line. They are fixed by one extremity in the common point of the posterior edges of the ossa palati, and from thence run downward and backward along the middle of almost the whole uvula. For their original, insertion, and use, see the System, Tables of MUSCLES.

STAR, in Astronomy, a general name for all the heavenly bodies, which, like so many brilliant studs, are dispersed throughout the whole heavens. The stars are distinguished, from the phenomena of their motion, &c. into fixed, and erratic or wandering stars; these last are again distinguished into the greater luminaries, viz. the sun, and moon; the planets, or wandering stars, properly so called and the comets; all which have been fully considered and explained in the System of ASTRONOMY, to which the reader is referred. **STAR** is also a badge of honour, worn by the several orders of knighthood: see **KNIGHT** and **KNIGHTHOOD**; and the Plate annexed.

STARCH, a secula, or sediment, found at the bottom of vessels wherein wheat has been steeped in water; of which secula, after separating the bran from it, by passing it through sieves, they form a kind of loaves, which, being dried in the sun, or an oven, is afterwards broken into little pieces, and so sold. The best is white, soft, and friable, easily broken into powder; such as require very fine starch do not content themselves with refuse of wheat; but use the finest grain.

STATE is used for the policy or form of government of a nation, &c. Politicians distinguish several forms of state, viz. the monarchy, as that of England; the democracy, as that of Rome and Athens; the oligarchy, as that of Venice; and the aristocracy, as that of Sparta. See the Article GOVERNMENT.

Council of STATE, in Modern History, was projected by the states of Holland, Zealand, and Utrecht, in conjunction with William I. prince of Orange and erected in 1584 with ample authority. All affairs of state, the army, and revenue, were entrusted to the care of this council; but the states, growing jealous of this extraordinary power, reduced it gradually: and by a new institution, in 1651, the disposition of military affairs, and the command of the army, were in part transferred to the states-general, with the advice of the council. In this council the provinces were represented by such a number of deputies as bore some proportion to the quota of money which each contributed for the support of the whole, Groningen excepted. Guelderland had one, Holland three, Zealand two, Utrecht one, Friesland two, Overijssel one, and Groningen two. These were all changed every three years, except the deputy from the nobility of Holland, and the two from Zealand, who enjoyed their posts for life. Here every member had a decisive voice, and presided for a week in his turn, without regard to the rank of the provinces. The governors or **STADTHOLDERS** of the provinces had a seat, but no decisive vote in this council, in which affairs are determined by a majority of voices. But this form of government at the revolution, which took place in consequence of the conquest of Holland by the arms of the French republic, was totally abolished; and a number of changes introduced in its stead.

STATICS, *statics*, formed of *στασις*, *I weigh*, a branch of mathematics, which considers weight or gravity, and the motion of bodies arising therefrom. Those who define mechanics the science of motion, make statics a member thereof; viz. that part which considers the motion of bodies arising from gravity. Others make them two distinct doctrines, restraining mechanics to the doctrine of motion and weight, in reference to the structure and power of machines; and statics to the doctrine of motion, considered merely as arising from the weight of bodies, without any immediate respect to machines. On which footing, statics should be the doctrine, or theory of motion; and mechanics, the application thereof to machines.

STATIONARY, in Astronomy, the state of a planet when it seems to remain immoveable in the same point of the zodiac. The planets having sometimes a progressive, and sometimes a retrograde motion, there will be some point wherein they appear stationary. See the System, sect. VI.

STATUARY, a branch of sculpture, employed in the making of statues. Statuary is one of those arts wherein the ancients surpassed the moderns; indeed it was much more popular, and more

cultivated among the former than the latter. It is disputed between statuary and painting, which of the two is the most difficult, and the most artful. See SCULPTURE.

STATUTE, in its general sense, signifies a LAW, DECREE, ORDINANCE, &c. Statute, in our laws and customs, more immediately signifies an act of parliament, made by the three estates of the realm; and having the force of a law. See LAW and PARLIAMENT.

STEAM, denotes the smoke, or vapour, proceeding from any thing that is moist and hot. Subterranean steams often affect the surface of the earth in a very remarkable manner, and influence or prevent vegetation more than any thing else. The surface of some ground is so hollow and light, and so swollen by a warm and continually working ferment, that it must needs send up a warming steam, and that it does so, even in the coldest weather, is evident from the immediate melting of the snow that falls on it; nay in many places, the effect of this steam is so great, that it melts the snow before it reaches the ground, so that it falls on it in form of rain. Some stones also, and some waters, impregnate the earth by their innate warmth, sending up a continual succession of warm effluvia from all parts of their surfaces; and other stones have exactly a contrary effect, rendering the places where they lie barren and cold. Streams of water, which have in their subterranean course run through beds of lime-stone, marl, or chalk, are always enriched, and warmed by the steams issuing from those substances, and mixing with them as they pass, and consequently these waters enrich the ground wherever they run; and, on the contrary, some waters are uliginous, or corrosive, from the steams they have received in their channels from the veins of pyrites, or beds of metallic ores.

STEAM-ENGINE, commonly called *fire-engine*, in hydraulics is one of the most useful machines, of which modern art can boast, for draining mines and raising water, &c. by the proper application and use of the steam of boiling water. The Marquis of Worcester, in his Century of Inventions printed A. D. 1663, was probably the first person who proposed raising great quantities of water by the means of fire converting water into steam; and he mentions an engine of this kind of his own invention, which played in a continual stream in the manner of a fountain, forty feet high. He also says, that a person attending it turned two cocks; that, one vessel of water being consumed, another begins to force and refill with cold water, and so successively; the fire being tended and kept constant by the same person in the interim between the several occasions of turning the cocks. Captain Savery, having read this account, immediately attempted to raise water by fire, and erected an engine for that purpose. The captain in order to secure the invention to himself, brought up, as Desaguliers informs us, all the books of the Marquis, which he could find, and burnt them; and then gave out, that he discovered the power of steam by accident. He made many experiments to bring the machine to perfection, and erected several for gentlemen's seats, but could not succeed for mines; the depth from which water was to be raised in this case being so great that it required the steam of such a strength as to be dangerous in its application. Thus the progress of the engine was stopped, till about the year 1705, when Mr. Newcomen, an iron-monger, and Mr. John Cowley, a glazier, at Dartmouth, contrived another way to raise water by fire, where the steam for this purpose, even at the greatest depths of mines, is not required to be greater than the pressure of the atmosphere; and agreeable to this is the structure of the fire engine as it is now used.

In order to explain the principles, construction, and use of this engine, let us suppose a well or mine, (as *p*, in fig. 19, Plate I, of miscellaneous subjects,) one hundred and fifty feet deep. From which water is to be raised with a pump, the diameter of whose barrel is $7\frac{1}{2}$ inches; and, therefore, in this case, the weight of a cylindric column of water one hundred and fifty feet high, and $7\frac{1}{2}$ inches in diameter, will be about three thousand pounds. If now the rod of this pump were hung by a chain to the end of a lever *h b*, as at *H*, and at the other end a power were applied, as at *P*, with a superior force, the pump might be worked, and the water raised. It appears, that this power cannot be supplied by the strength of man or beast; for it will require one hundred men to pull down the beam, each pulling with a force of thirty pounds; but as the pump in a mine must not stand still, there should be one hundred more to relieve these when weary; and even supposing two hundred men to be sufficient, which is far from being the case, the expence would be too great. If we allow horses, and one horse equal to five men, there must be twenty horses working at a time, and twenty more to relieve these, which number of horses would be attended with too great expence for most mines; and neither men nor horses would be able to give more than 15 or 16 strokes in a minute; some other power must therefore be applied. An effectual method of performing this is by means of a steam-engine, the description and use of which is as follows: *B* is a large boiler, whose water by the fire under it is converted into elastic steam. The great cylinder *CC* is 8 or 9 feet long, and 22 inches wide, and is fixed upon the boiler, and communicates with it by the pipe *D d*; on the lower orifice of which (within the boiler) moves a broad plate, by means of the steam-cock or regulator *E* 10, stopping or opening the passage, to prevent or permit the steam to pass into the cylinder, as occasion re-

S T E

quires. In the cylinder is a piston, well leathured, whose rod L is fastened to a chain hanging from the end of a lever at P. The diameter of the pipe D is about four inches. The steam in the boiler ought always to be a little stronger than the air, that when let into the barrel, it may be a little more than a balance to the pressure of the external air, which keeps down the piston at the bottom *d n*. The piston being by this means at liberty, the pump rod will, by its great weight, descend at the opposite end to fetch a stroke, which is more than double the weight of the piston, &c. at the other end. The end of the lever at the pump, therefore, will always preponderate and descend, when the piston is at liberty. The handle of the steam-cock E 10, being turned towards *n*, opens the pipe D to let in the steam; and being turned towards O, shuts it off, that no more can enter. The piston is now raised towards the top of the cylinder at C, and the cylinder is full of steam. The lever O 1 must then be lifted up, to turn, by its teeth, the injecting cock at N, which permits the water, brought from the cistern *g*, by the pipe *g* MN, to enter the bottom of the cylinder at *n*, where it flies up like a fountain, and striking against the bottom of the piston, the drops, being driven all over the cylinder, will by their coldness condense the steam into water again, and precipitate it to the bottom of the cylinder.

Mr. Beighton made an experiment to determine the rarity of steam, and found the contents of a certain cylinder of steam was one hundred and thirteen gallons; and since there were sixteen strokes in a minute, therefore, $113 \times 16 = 1808$ gallons of steam per minute. He also observed, that the boiler, proportioned to that cylinder, required to be supplied with water at the rate of five pints per minute, and since 282 cubic inches make a gallon, $35\frac{1}{2}$ make a pint, and $5 \times 35\frac{1}{2} = 176\frac{1}{2}$ in five pints; and the cubic inches of steam are $1808 \times 282 = 509856$: if then we say, as $176\frac{1}{2} : 509856 :: 1 : 2887$; or one cubic inch of water is expanded into 2887 inches of steam: consequently the steam in the cylinder is reduced to $\frac{1}{2887}$ part, when converted into water by the jet of cold water; and, therefore, a sufficient vacuum is made in the cylinder for the piston to descend unbalanced by the pressure of the atmosphere. The piston, being forced down, raises the other end of the lever, and consequently the piston of the pump, which brings up and discharges the water at *p*. Now the whole operation of opening and shutting the steam regulator and injection cock, may be performed in such a time as will produce very well sixteen strokes in a minute. That the cistern *g* may be always supplied with water, there is an arch *x* fixed near the arch H at the pump end, from which another pump rod *k* with its piston, draws water from a small cistern near the mouth of the pit (supplied from the water raised at *p*) and forces it up the pipe *m m m* into the cistern *g*, which, therefore, can never want water. That the leathers of the piston C may be always supple, and swelled out so as to be always air-tight, a small stream of water is supplied from the injecting pipe M by the arm *z*. On the top of the cylinder is a cup L, to hold the water that lies on the piston, lest it should overflow when the piston is at its greatest height, as at W; at which time, if the cup be too full, the water will run down the pipe V to the waste well at Y. The water in the boiler, which wastes in generating steam, is supplied by a pipe F about three foot long, supplied by the pipe W with water from the top of the piston, which has the advantage of being always warm, and so not apt to check the boiling of the water. That the boiler may not have the surface of the water too low (which would endanger its burning) or too high, which would not leave room enough for steam, there are two gage-pipes at G; one going a little below the surface of the water when at a proper height, and the other standing a little above it. When every thing is right, the stop cock of the shorter pipe being opened, gives only steam, and that of the long one water; but if otherwise, both cocks will give steam when the surface is too low, and both give water when it is too high: and hence the cock which feeds the boiler at F may be so opened as always to keep the surface of the water to its due height. The cold water, constantly injected into the cylinder to condense the steam, is carried off by the eduction-pipe *d* TY, going from the bottom of the cylinder to the waste well Y, where passing a little under water, it has its end turned up with a valve Y to keep out the air from pressing up into the pipe, but allowing the injected water coming the other way to be discharged, whereby the cylinder is kept empty. Lest the steam should become too strong for the boiler and burst it, there is a valve fixed at *b*, with a perpendicular wire standing up from the middle of it, on which are fixed weights of lead, for examining the strength of the steam pushing against it from within. Thus the steam is known to be as strong as the air, if it will raise up so much weight on the valve as is at the rate of fifteen pounds to an inch square. When the steam becomes stronger than what is required, it will lift up the valve and go out. This valve is called the *puppet clack*. The steam is variable in strength, but never one tenth stronger or weaker than common air: for it has been found that the engine will work well, when there is the weight of one pound on every square inch of the valve *b*. This shews that the steam is then one fifteenth part stronger than the common air. Now as the height of the feeding pipe from the funnel F to the surface of the water S is not above three feet, and $3\frac{1}{2}$ feet of water afford one tenth of the pressure of the air; if the steam were one tenth part stronger than air, it would push the water out

S T E

at F: which, not doing, cannot be stronger than air, even in this case, where the regulator being shut, it is most of all confined. When the regulator is opened, the steam gives the piston a push, which raises it up a little way, then occupying a greater space, it becomes of the same strength, and so a balance to the atmosphere; thus the piston, being at liberty, rises to the top W. The steam, now expanded into the whole capacity of the cylinder, is weaker than the air, and would not support the piston, if it were not for the greater weight at the other end of the lever, which keeps it up. The steam, at each stroke, drives the injected water of the preceding stroke out of the eduction pipe *d* TY, and would itself follow and blow out the valve Y, which is not loaded, if it were stronger than the air, which it never does. If it were exactly equal to the strength of the air, it would just drive out all the water at Y, but could not follow itself, the pressure on each side of the valve being equal by supposition. If it be weaker than the air, it will not force all the water out of the pipe *d* TY, but the surface will stand, e. g. at T, where the column of water TY added to the strength of the steam is equal to the pressure of the air. When the steam is one tenth weaker than the air, the height TY = $3\frac{1}{2}$ feet. Now since the whole perpendicular distance from *d* to Y is but four feet, and the steam always sufficient to expel the water; it is plain, that it can never be more than one tenth part weaker than the air, when weakest. There is air in all the water injected; and though that air cannot be taken out or condensed with the steam, yet it will precipitate and fall through the steam to the bottom of the cylinder, as being much heavier. For it has been shewn, that steam is to water as 1 to 2887 in its density; but the density of air is to that of water as 1 to 864: therefore the rarity of steam is to that of air as 2887 to 864: the air will therefore fall through the steam to the bottom, and from thence be driven out through a small pipe opening into the cup at *4*, on which is a valve. Now when the steam first rushes into the cylinder, and is a little stronger than the outward air, it will force the precipitated air to open the valve at *4*, and make its escape; but the steam cannot follow, because it is weaker than the outward air, as the piston gives it room, by ascending, to expand. The valve, on account of the noise it makes, is called the *shifting clack*.

Among the greatest improvements of this engine, we may reckon that contrivance, by which the engine itself is made to open and shut the regulator and injection cock, and even more accurately than any person attending could possibly do it; for this purpose there is fixed to an arch Z, at a proper distance from the arch P, a chain, from which hangs a perpendicular piece or working beam QQ, which comes down quite to the floor, and goes through it in a hole which it very exactly fits. This piece has a long slit in it, and several pin-holes and pins, for the movement of several small levers destined to the office of opening and shutting the cocks, after the following manner. Between two perpendicular pieces of wood, on each side of P, there is a square iron axis AB (fig. 20) which has upon it several iron pieces of the lever kind. The first is the piece CED, called the Y, from its representing that letter inverted by its two shanks E and D; on the upper part is a weight F to be raised higher or lower, and fixed as occasion requires. This Y is fixed very fast upon the iron axis AB. From the axis hangs a sort of iron stirrup IKLG, by its two hooks I, G, having on the lower part two holes K, L, through which passes a long iron pin LK, keyed in the same. When this pin is put in, it is also passed through the holes in the ends E, N, of the horizontal fork or spanner EQN, joined at its end Q to the angle of the regulator V 10. From Q to O are several holes, by which the said handle may be fixed to that part of the end which is most convenient. Upon the axis AB is fixed at right angles to the Y, a handle or lever G 4, which goes on the outside of the piece QQ, and lies between the pins. Another handle is also fastened upon the same axis, viz. H 5, and placed at half a right angle to the former G 4; this passes through the slit of the piece QQ lying on one of its pins. Hence we see, that when the working beam goes up, its pin in the slit lifts up the spanner H 5, which turns about the axis so fast as to throw the Y with its weight F from C to 6, in which direction it would continue to move, after it passed the perpendicular, if it were not prevented by a strap of leather fixed to it at *a*, and made fast at the ends *m* and *n*, in such a manner as to allow the Y to vibrate backwards and forwards about quarter of a circle, at equal distances, on this side and that of the perpendicular. In the representation here given, the regulator is open, its plate TY being shewn on one side of the pipe S, which joins the cylinder and boiler. The piston is now up, and also the working beam near its greatest height: the pin in the slit has so far raised the spanner H 5, that the weight F on the head of the Y is brought so far from *n*, as to be past the perpendicular, and ready to fall over towards *m*; and when it does so, it will, by its shank E, with a smart blow, strike the iron pin KL, and drawing the fork ON horizontally towards the beam Q, will draw the end 10 of the regulator towards *t*, and thereby shut it, by stopping the plate Y under the holes of the throat-pipe S. Immediately after the regulator is shut, the beam rising a little higher, with its pin *s*, on the outside upon the lower part, lifts up the end *k* 1 of the angle of the injection cock, and opens it by the turning of the two parts with teeth. The jet immediately making a vacuum, the beam again descends, and the pin *r* depressing the handle

handle *r* shuts the injection-cock: and the beam continuing to descend, the pin *p* bears down the handle *G* 4, and throwing back the *Y*, its shank *D* throws forward the fork *N Q*, and again opens the regulator to admit fresh steam: after this every thing returns as before, and thus the engine is wonderfully contrived for working itself.

After the engine had been made as above described, for many years, it received another improvement of very great advantage: that was, instead of feeding the boiler with warm water from the top of the cylinder, by the pipe *W* (*fig. 19.*) above, and *F f* below; it was supplied with the scalding hot water which comes out of the eduction-pipe *d T Y*, which now, instead of going to the waste-well at *Y*, was turned into the boiler in the top-part; and as the eduction pipe before went out at the side of the cylinder, it was now inserted in the bottom of the same: and though the pressure of the steam in the boiler be somewhat greater in the cylinder, yet the weight of water in the eduction-pipe, being added to the force of steam in the cylinder, will carry the water down continually, by overcoming the resistance in the boiler.

Ever since Mr. Newcomen's invention of the steam fire engine, the great consumption of fuel with which it is attended, has been complained of as an immense drawback upon the profits of our mines. It is a known fact, that every steam-engine of considerable size consumes to the amount of three thousand pounds worth of coal in every year. But the most important improvements which have been made in the steam-engine for more than thirty years past, we owe to the skill of Mr James Watt. He has contrived to preserve a uniform heat in the cylinder of his engines, by suffering no cold water to touch it, and by protecting it from the air, or other cold bodies by a surrounding case filled with the steam, or with hot air or water, and by coating it over with substances that transmit heat slowly. He makes his vacuum to approach nearly to that of the barometer, by condensing the steam in a separate vessel, called the condenser, which may be cooled at pleasure without cooling the cylinder, either by an injection of cold water, or by surrounding the condenser with it, and generally by both. He extracts the injection water, and detached air, from the cylinder, or condenser by pumps, which are wrought by the engine itself, or blows them out by the steam. As the entrance of air into the cylinder would stop the operation of the engines, and as it is hardly to be expected that such enormous pistons as those of steam-engines can move up and down, and yet be absolutely air-tight in the common engines; a stream of water is kept always running upon the piston, which prevents the entry of the air; but this mode of securing the piston, though not hurtful in the common ones, would be highly prejudicial in the new engines. Their piston is, therefore, made more accurately; and the outer cylinder having a lid, covers it, the steam is introduced above the piston; and when a vacuum is produced under it, acts upon it by its elasticity, as the atmosphere does upon common engines by its gravity. This way of working effectually excludes the air from the inner cylinder, and gives the advantage of adding to the power, by increasing the elasticity of the steam.

In Mr. Watt's engines, the cylinder, the great beams, the pumps, &c. stand in their usual positions. The cylinder is smaller than usual, in proportion to the load, and is very accurately bored. In the most complete engines, it is surrounded at a small distance with another cylinder, furnished with a bottom and a lid. The interstice between the cylinders communicates with the boiler by a large pipe, open at both ends; so that it is always filled with steam, and thereby maintains the inner cylinder always of the same heat with the steam, and prevents any condensation within it, which would be more detrimental than an equal condensation in the outer one.

The inner cylinder has a bottom and piston as usual: and as it does not reach up quite to the lid of the outer cylinder, the steam in the interstice has always free access to the upper side of the piston. The lid of the outer cylinder has a hole in its middle; and the piston-rod, which is truly cylindrical, moves up and down through that hole, which is kept steam-tight by a collar of oakum screwed down upon it. At the bottom of the inner cylinder, there are two regulating valves, one of which admits the steam to pass from the interstice into the inner cylinder below the piston, or shuts it out at pleasure: the other opens or shuts the end of a pipe, which leads to the condenser. The condenser consists of one or more pumps, furnished with clacks and buckets (nearly the same as in common pumps) which are wrought by chains fastened to the great working beam of the engine. The pipe, which comes from the cylinder, is joined to the bottom of these pumps and the whole condenser stands immersed in a cistern of cold water supplied by the engine. The place of this cistern is either within the house, under the floor, between the cylinder and the lever wall; or without the house, between that wall and the engine shaft, as convenience may require. The condenser being exhausted of air by blowing, and both the cylinders being filled with steam, the regulating valve which admits the steam into the inner cylinder is shut, and the other regulator which communicates with the condenser is opened, and the steam rushes into the vacuum of the condenser with violence: but there it comes into contact with the cold sides of the pumps and pipe, and meets a jet of cold water which was opened at the same time

with the exhaustion regulator; these instantly deprive it of its heat, and reduce it to water; and the vacuum remaining perfect, more steam continues to rush in, and be condensed until the inner cylinder is exhausted. Then the steam which is above the piston, ceasing to be counteracted by that which was below it, acts upon the piston with its whole elasticity, and forces it to descend to the bottom of the cylinder, and so raises the buckets of the pumps which are hung to the other end of the beam. The exhaustion regulator is now shut, and the steam one opened again, which, by letting in the steam, allows the piston to be pulled up by the superior weight of the pump rods, and so the engine is ready for another stroke.

The working of these engines is more regular and steady than the common ones, their other advantages are very considerable. The savings amount at least to two thirds of the fuel, which is an important object, especially where coals are dear. The new engines will raise from twenty thousand to twenty-four thousand cubic feet of water, to the height of twenty-four feet, by one hundred weight of good pit coal. The improvements above recited were invented by Mr. James Watt, of Birmingham, in 1764; he obtained his Majesty's letters patent for the sole use of his invention in 1768; but meeting with difficulties in the execution of a large machine, and being otherwise employed, he laid aside the undertaking till the year 1774, when, in conjunction with Mr. Boulton, near Birmingham, he completed both a reciprocating and a rotative or wheel engine. He then applied to parliament for a prolongation of the term of his patent, which was granted by an act passed in 1775, since which Mr. Watt has made other valuable improvements in this machine, and obtained a patent for the same, bearing date the 3d of July 1782, and which we shall in the following pages fully describe. The terms they offer to the public are, to take in lieu of all profits one third part of the annual savings in fuel, which their engine makes, when compared with a common engine of the same dimensions in the neighbourhood. The engines are built at the expence of those who use them, and Messrs. Boulton and Watt furnish such drawings, directions, and attendance, as may be necessary to enable a resident engineer to complete the machine.

Having given a concise account of the rise and progress of the Steam Engine, and a cursory view of the nature of Mr. Watt's improvements, we shall now proceed to give a particular description of all its present improvements, in which state, it must appear evident to all those who have seen or heard of its application and operation at the Albion Mills, that it is one of the most important inventions in mechanics that has taken place this century past.

Before we enter on our description, it will be necessary to premise, that we shall confine ourselves only to Mr. Watt's improvement, as his Engine is in every other respect the same as those commonly used, and which are represented in *Fig. 19* and *20*, of the Miscellaneous Plate; therefore those who attentively read the preceding account of the *Figures 19* and *20*, cannot fail to understand the use and application of the following improvements of Mr. Watt.

The reader is requested to observe, that all the figures, illustrative of the new improvements, are drawn on a scale of proportion, as they will find in the course of the description.

In order that the reader may more clearly conceive the nature of this invaluable improvement, we shall in the following twenty lines give an explanation of the terms used by Mr. Watt, the Patentee, in his description of the machine.

First, the cylinder, or steam vessel, is that vessel wherein the powers of steam or air are employed to work the engine, of whatever form it may be made, though it is most commonly made cylindrical.

Second, the piston is a moveable diaphragm, sliding up and down or to and fro in the cylinder, and fitted to it exactly; on which piston the powers of steam or air are immediately exerted.

Third, the condensers are certain vessels of my invention, in which the steam is condensed either by immediate mixture with water, sufficiently cold, or by contact with other cold bodies; which condensers are situated either in that part of the cylinder itself which the steam never enters, except to be condensed or reduced to water, or they communicate with the cylinder by means of pipes, which are opened or shut at proper times; or those pipes are called eduction pipes, which lead to the air pumps, or other contrivance for carrying off the condensed steam, air, and water of injection, are themselves used for that purpose.

Fourth, the air, and hot water pumps, air pumps, or other contrivances, which serve to extract the air, and heated water, from the cylinders and condensers.

Fifth, the working beam is a double ended lever, a wheel, or wheels, or other machinery, establishing the means of communicating the power, from the piston to the pump work, or other machinery to be wrought by the engine.

My first New Improvement in Steam or Fire Engines, consists in admitting steam into the cylinders or steam vessels of the engine only during some certain part or portion of the descent or ascent of the piston of the said cylinder, and using the elastic forces where- with

with the said steam expands itself in proceeding to occupy larger spaces, as the acting powers on the piston through the other parts or portions of the length of the stroke of the said piston; and in applying combinations of levers or other contrivances to cause the unequal powers wherewith the steam acts upon the piston, to produce uniform effects in working the pumps or other machinery required to be wrought by the said engine, whereby certain large proportions of the steam hitherto found necessary to do the same work are saved; to explain which principle, or improvement, I have delineated a section of a hollow cylinder at *Fig. 12, Plate IV.* the scale of which is one half inch for each foot of the real size of the cylinder.

The cylinder ABCD is perfectly shut at the lower end by its bottom CD, and also at the upper end by its cover AB; the solid piston EF is accurately fitted to the said cylinder, so that it may slide easily up and down, yet suffer no steam to pass by it; the said piston is suspended by a rod, or rods, GH, which is capable of sliding through a hole in the cover AB of the cylinder, and its circumference is made air and steam tight by a collar of oakum, or other proper materials, well greased, and contained in the box O; and near the top of the cylinder there is an opening I, to admit steam from a boiler; also at D there is an opening to let off the steam into the condenser. The whole cylinder, or as much of it as possible, is inclosed in a case MM, containing steam surrounding the cylinder, or otherwise is maintained of the same heat with boiling water, or of the steam from the boiler; likewise N, N, are cases containing steam above and below the cylinder. Those things being thus situated, and the piston placed as near as may be to the top of the cylinder, let the space of the cylinder under the piston be supposed to be exhausted or emptied of air, steam, and other fluids; and let there be a free passage above the piston for the entry of steam from the boiler; and suppose that steam to be of the same density or elastic force as the atmosphere, or able to support a column of mercury of 30 inches high in the barometer, then the pressure or elastic power of the said steam on every square inch of the area, or upper side of the piston, will be nearly 14lb. avoirdupois weight: and that if the said power were employed to act upon the piston through the whole length of its stroke, and to work a pump or pumps, either immediately by the piston rod prolonged, or through the medium of a working beam, or great lever, as is usual in steam engines, it would raise through the whole length of its stroke a column, or columns of water, the weight whereof should be equal to ten pounds for each square inch of the area of the piston, besides overcoming all the frictions and vis-inertiae of water and parts of the machine or engine. But supposing the whole distance from the underside of the piston to the bottom of the cylinder to be eight feet, and the passage which admitted the steam from the boiler to be perfectly shut when the piston has descended to the point K two feet, or one fourth of the length of the stroke or motion of the said piston; I say that when the piston has descended four feet or one half the length of the stroke, the elastic power of the steam would then be equal to seven pounds on each square inch of the area of the piston, or one half of the original power, and that when the piston had arrived at the point P, the power of the steam would be one third of the original power, or four pounds and two thirds of a pound on each square inch of the piston's area; and that when the piston had arrived at the bottom or end of its stroke, that the elastic power of the steam would be one fourth of its original power, or three pounds and one half pound on each square inch of the said area: and I further say, that the elastic power of the steam at the other divisions marked in the length of the said cylinder, are represented by the lengths of the horizontal lines or ordinates of the curve KL, the ordinates of which represent the powers of the steam when the piston is at the respective places, and are also marked or delineated in the said cylinder, and are expressed in decimal fractions of the whole original power, by the numbers written opposite to the said ordinates or horizontal lines: and I also say, that the sum of all these powers is greater than fifty-seven hundred parts of the original power, multiplied by the length of the cylinder; whereby it appears, that only one fourth of the steam necessary to fill the whole cylinder is employed, and that the effect produced is equal to more than one half of the effect which would have been produced by one whole cylinder full of steam, if it had been admitted to enter freely above the piston during the whole length of its descent; consequently that the said *New or Expansive Engine*, is capable of easily raising columns of water, the weights whereof are equal to five pounds on every square inch of the area of its piston, and that with one fourth of the contents of the cylinder of steam. Though, for example sake, I have mentioned the admission of one fourth of the cylinder full of steam (as being the most convenient) yet any other proportion of the fill of a cylinder, or any other dimensions of the cylinder, will produce similar effects; and in practice I actually do vary these proportions, as the case requires, and also in some cases I admit the required quantity of steam to enter below the piston; and I pull the piston upwards by some external power against the elastic force of the steam from the boiler, which then always freely communicates with the upper part of the cylinder, and which produces similar effects to those described. But the powers which the steam exerts being unequal, and the weight of the water to be raised or other work to be done by the engines, being supposed to resist equally throughout

the length of the stroke, it is necessary to render the whole acting powers equal by other means. I perform this first by means of two wheels or sectors of circles, one of which is attached to the pump rods, and the other to the piston rod of the engine, and which are connected together by means of rods or chains, or otherwise, that the levers whereby they act upon one another decrease and increase respectively, during the ascent or descent of the piston in or nearly in the ratios required.

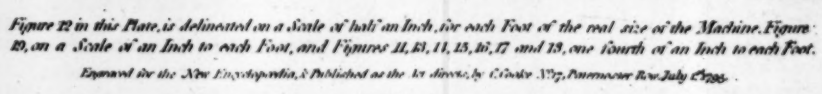
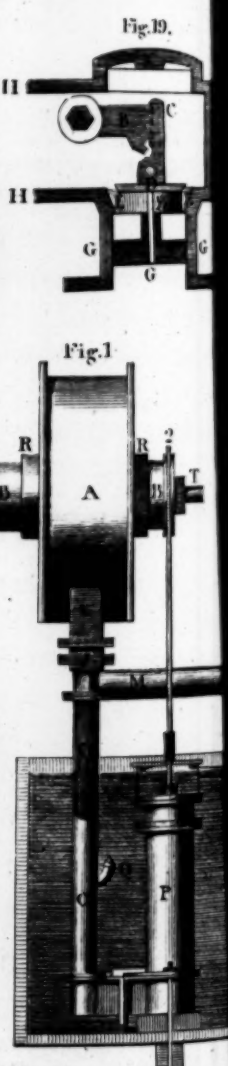
This method, mechanism, or contrivance, is delineated in *Plate II. Fig. 2*, and also its application to one of my New-invented Steam Engines. In order to convey a proper idea of the construction of this machine, we shall introduce the following explanation of its several parts: A, the piston; BB, the cylinder or steam vessel; C, the perpendicular steam pipe, which conveys the steam from the upper to the under end of the steam vessel; D, the place of the top regulating valve; E, the place of the middle regulating valve; F, the place of the exhaustion regulating valve; GG, the eduction pipe; H, the injection pipe; I, the hot water pump; K, the air pump; L, a valve at the eduction pipe foot, to prevent the reflux of the water; M, the passage to the hot water pump; N, the plug tree, by the motion of which the regulating valves are opened and shut; O, one of the posts which guide the plug-tree; P, the piston rod; QRSTU, the wheel to which the piston rod is suspended; VWXYZ, the wheel to which the pump rods are hung; 1, the condenser pump rods; 2, a heavy platform, to which the cylinder is fastened; 3, the spring beams; 4, 4, the springs; 5, the rod which connects the two wheels which form the working beam; 6, the pump rods; 7, the steam case which surrounds the cylinder; 8, the back wall of the engine house; 9, the lever wall; 10, doors and windows.

Having given a description of its several parts, we shall proceed to give an account of the operation of this Engine, with the new mechanism added to it. The above machine has a cylinder 30 inches diameter, which is capable of making strokes 8 feet long, with the first species of the new machinery for equalizing the expansive powers of steam applied thereto. It is delineated upon a scale a quarter of an inch to each foot of the real size of the engine.

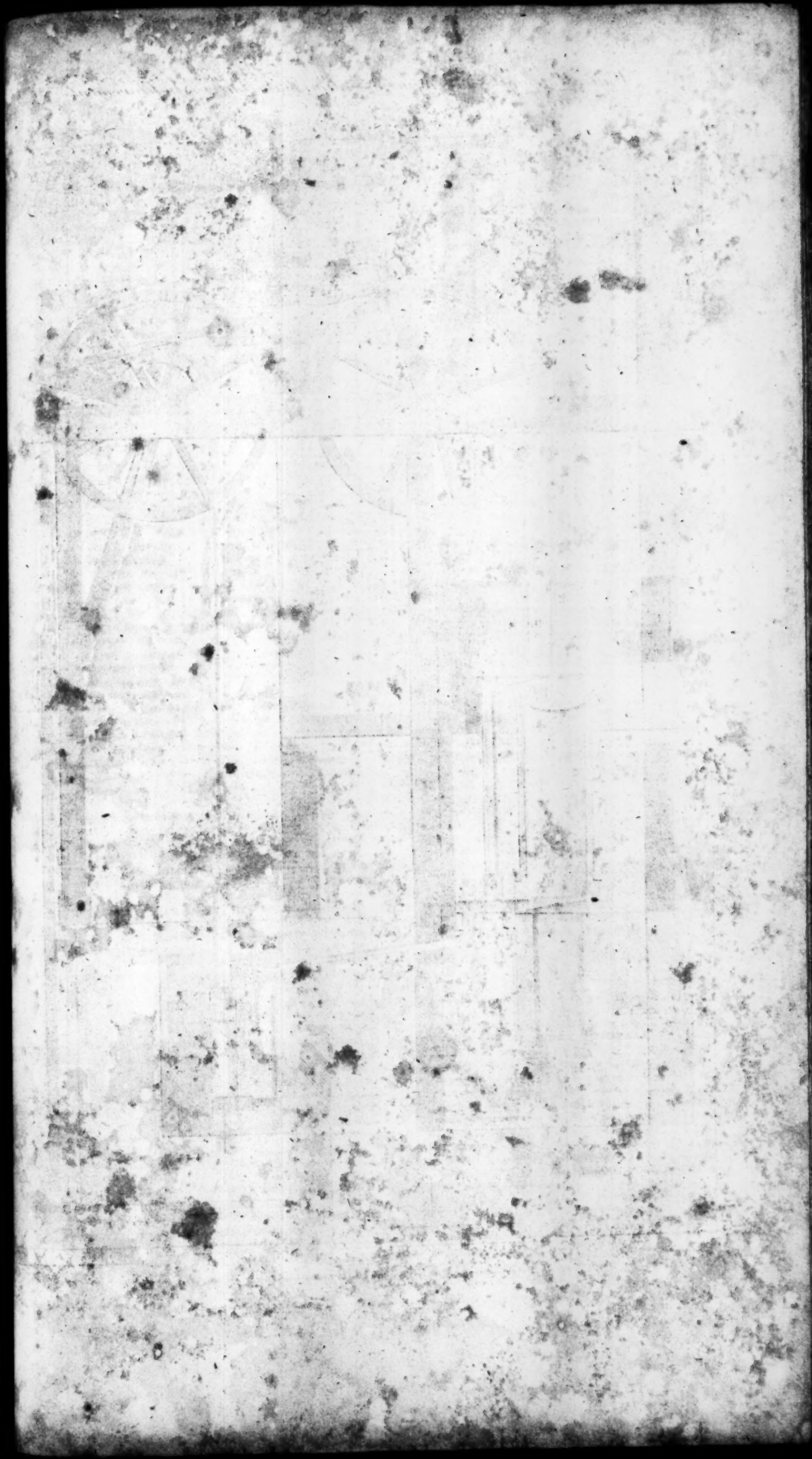
The piston A being at its highest place, and the part of the cylinder under it exhausted of steam and air, the regulating valve which admits the steam to enter below the piston being shut, and the valve F, which allows steam or air to pass to the condenser GK, being open, in order to maintain a good vacuum, the top regulating valve D is opened and permits the steam from the boiler to enter and act upon the piston, which then begins to descend and pull round the wheel or sector of a circle to which it is hung: when the point Q of that wheel has moved to R, the piston has descended two feet; and V of the wheel to which the pump rods, or other machinery, wrought by the engine, are suspended, being pulled by the rod 5, connecting it with the other wheel QRSTU, and form the working beam, will have moved through the space V W, the regulating valve D is then shut, so that no more steam may be admitted from the boiler during that stroke, but the piston continues to descend by virtue of the expansion of the steam; and when the point Q is come to the points R, S, T, U, the point V is come to the points W, X, Y, Z, respectively; describing spaces which are nearly proportional to the powers of the steam, at the corresponding points of the descent of the piston. When the piston has made its stroke, and is come to the bottom of the cylinder, the regulating valve F is shut, and the valve E is opened, by which means the steam passes from the part of the cylinder above the piston to the part below it, by the pipe C, and so, restoring the equilibrium, permits the piston to ascend to its position. The regulating valve E is then to be shut, and the exhaustion regulating valve F is opened; the steam rushes into the eduction-pipe GG, where it meets a jet of cold water, which enters through the injection-pipe H, which is opened immediately before the regulating valve F. The contact of this cold water immediately reduces the steam to water, and produces a vacuum under the piston, and thereby enables the elastic force of the steam to act again upon it, as has been described: or instead of injecting cold water into the condenser or eduction-pipe itself, I bring the steam into contact with thin plates or pipes of metal which have their external surface cooled by contact with water or other cold matter. The condensed steam, the injection water, and the air which entered with it, or any other air which has entered by other means, proceed by the eduction-pipe to the air-pump K, and passing the valves of its bucket or piston, are retained and lifted up by it on the return of the strokes, and thereby are thrown into the hot water pump I, which by the next stroke raises up and delivers them into the atmosphere, from whence part is returned into the boiler to supply its consumption of water; and the remainder is conveyed away for any other purpose, or runs to waste.

The second variety of the first method of the new equalizing machinery, is delineated upon a scale of one sixth of an inch for each foot, *Plate III. fig. 3.*—The piston is suspended from the arch A by means of a chain or rods, and the pump rod is suspended from the arch B. The primary or cylinder arch A by means of the arm OP, and the rod or chain OC acts upon the working beam BC, to the arch of which the pump rods are suspended, by which means while the piston descends through the equal spaces IK, KL, I, M, M, N,

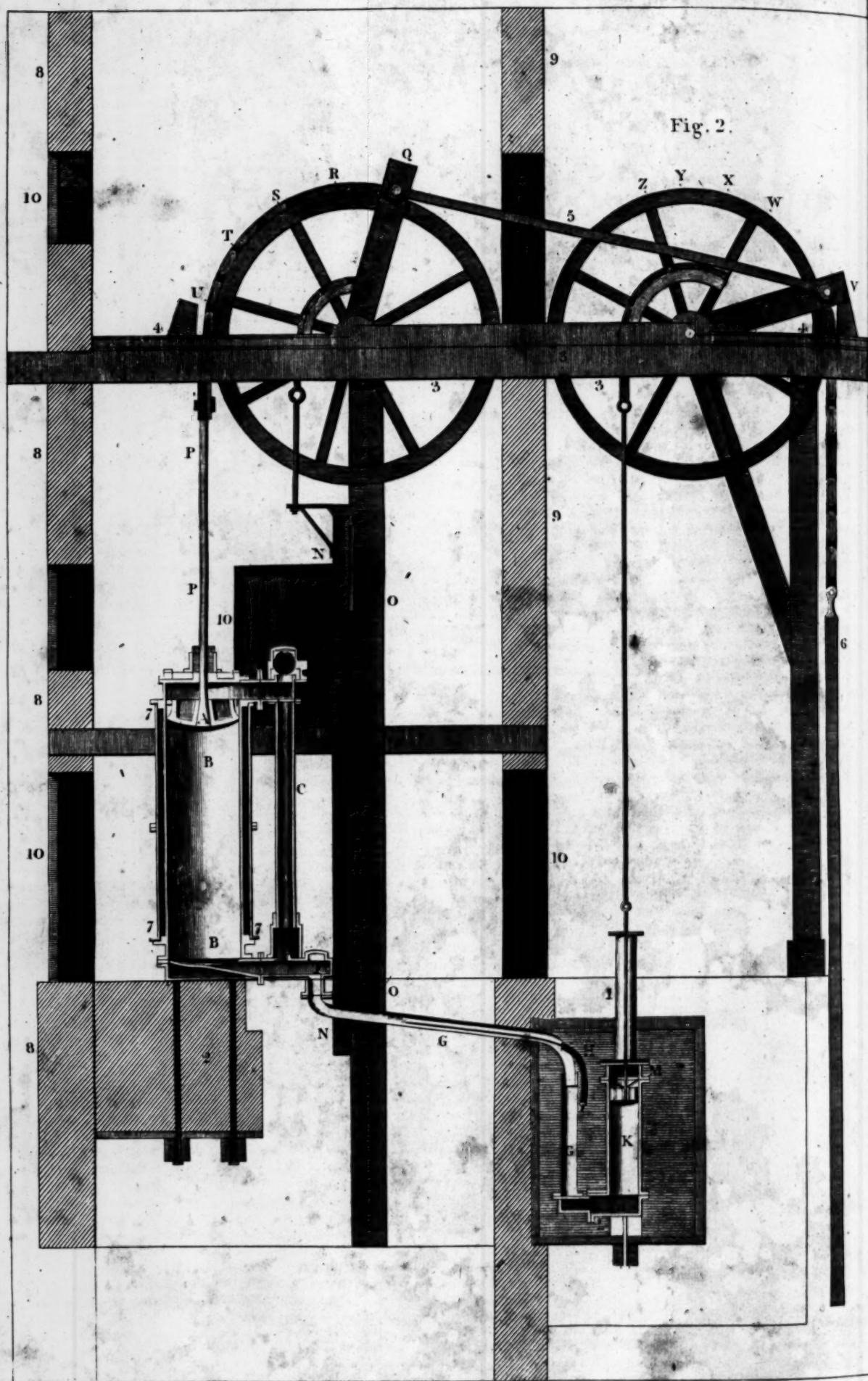
to
d
w
o
a
e.
e
id
er
e.
to
d
s,
g
he
re
ut
e-
m.
U,
he
is
of
-
fo,
ili-
on
igh
gu-
re-
on,
pon
fact
on-
with
ere,
mp-
ther
ma-
each
in A
the
ABC,
means
M,
N,



Fragment of text from the adjacent page, including the letters "G", "T", and "L".



Watts's Patent Steam Engine, according to the latest Improvements.



This Figure is delineated on a Scale of one fourth of an Inch to each Foot, of the real size of the Machine.

Expounded in the New Encyclopædia, & Published as the Act directs, by C. Davis, A27, St. Martin's Row, July 1795.

MN, the pump rod is made to ascend through the unequal spaces DE, EF, FG, GH, which are nearly proportional to the elastic forces of the steam at the respective points.

My Second Method of New Machinery for equalizing the expansive powers of steam is delineated in Plate III. fig. 4, upon a scale of one sixth of an inch for each foot of the real size of the machinery, upon which scale of proportion all the figures of Plate III. are delineated. This piece of mechanism for equalizing the power of the steam, is by means of chains which are wound upon one spiral, and wound off another as the piston descends, which spirals are fixed upon two wheels or sectors of circles, to which the chains of the piston and pump rods are attached. The piston is suspended by chains, or otherwise, from the side A of the wheel AB, and the pump rods from the side C of the wheel DC; which wheel DC being pulled by the chains IRK, passing along the spiral wheels I, P, S, Q, K, the points of the circumference move through the unequal spaces KL, LM, MN, NO, (almost exactly proportional to the powers of the steam) while the points of the circumference of AB move through the equal spaces EF, FG, GH, HI.

My Third Method or Piece of Mechanism for equalizing the powers of the steam is by means of a friction wheel, or wheels attached to or suspended from one sector or wheel, and acting upon a curved or straight part of another sector, wheel, or working beam. Two modes of this contrivance are delineated in Plate III. Fig. 5 and 6, of which it is only necessary to observe the pistons of the engines are suspended from the arches A, A, and the pump rods from the arches of the working beams BB, and by means of the connecting rods EC, the friction wheels C C are pulled down, as also the ends of beams BD, on which they rest; and by the motion of these friction wheels on the beams, the levers are lengthened (nearly) as the powers of steam diminish; and these contrivances afford the means of equalizing the powers of the steam very correctly.

N. B. The arms E, E, and the connecting rods E, C, are supposed to be double in each machine, that the piston chains or racks may go up between them.

My Fourth Method or Piece of Mechanism for equalizing the power of the steam, is by causing the centre or suspension of the working beam, or great lever to change its place during the time of the stroke, whereby the end of the lever to which the piston is suspended becomes longer, and the end to which the pump rods are suspended becomes shorter, as the piston descends in the cylinder. An easy method of doing this is represented in fig. 7. AB represents the working beam; B, the end from which the piston is suspended; A the end from which the pump rods are suspended; CD a hollow curve of wood or metal fixed to the lower side of the working beam; E, the end of a friction roller which is furnished with teeth to keep it from sliding, and rolls between the curve CD, and the plane or support FG. This friction roller is divided into three parts, as may be seen in its horizontal view KLM, the two extremities K, M, which roll upon the supports FG, are fixed firmly upon an axis; the middle part L, which rolls under the curve CD, can turn round on its axis, therefore when by the action of the piston on the working beam, the end B is pulled downwards, the roller proceeds towards C to the part of the curve which is then the highest and thereby lengthens the lever by which the piston acts on the pumps, and shortens that by which the pumps resist the cylinder; and that in any ratio which may be required according to the form of the curve.

My Fifth Method or Piece of Mechanism or Contrivance for equalizing the power of the steam, consists in placing upon, suspending from, or fixing to the working beam of the steam engine, or some other beam, wheel, or level, connected with it, a quantity of heavy matter in such a manner, that the said heavy matter shall not act against the power of the piston at the commencement of the descent of the said piston: and as the piston descends shall gradually move towards that end of the beam from which the piston is suspended, or otherwise shall act in favor of the piston in the latter part of the stroke. Three methods or varieties upon this principle are represented in fig. 8, 9, and 10, Plate III. Fig. 8, operates by means of a heavy cylinder A, of iron, or other material, which rolls in a hollow curve BC, on the back of the working beam CD, whose axis or gudgeon is F; as the piston descends, the weight will change its place, and proceed towards the cylinder end of the beam. In fig. 9, the same is performed by a heavy weight of iron or other matter A, fixed above the wheel BC, as in N^o 1, fig. 9, or above the working beam BC, as in N^o 2, fig. 9, so that its centre of gravity at the beginning of the motion, lies nearer the pump end of the beam than the centre of suspension of the beam, whereby it acts against the piston, and at last comes to be at the same side of that centre, with the end from which the piston is suspended, and thereby acts in its favour; in both of which cases F is the axis or centre of motion. Fig. 10, shews a method of fixing the working beam, so as to perform in some degree the office of the weight in fig. 9, for in this case the working beam AB is placed so high above its centre of motion F, that its own gravity acts the part of the weight A in fig. 9.

Plate IV. fig. 11, is delineated upon a scale of proportions of a quarter of an inch to a foot, and shews a fourth variety of the fifth method whereby I perform the same thing by causing a quantity

of water or other liquid to oppose the ascent of the piston in the beginning of the stroke, and to assist it in the latter part. Here AA and BB represent two cylinders or other formed vessels filled with water, or some other liquid, above their pistons C and D, the rods of which are fixed to or suspended from the opposite end of the axis of the working beam of the engine, or such secondary or auxiliary beam, as may be applied to this use; the centre of motion of the working beam is supported upon the wall EE, and the working beam or secondary beam is so connected with the piston of the engine, that when the said piston descends it raises the opposite end of the working beam, the piston of the water cylinder BB, which is then lowest, and thereby causes the water it contains to run over into the cylinder AA; both cylinders being open at the top and bottom, and at top are connected together by a trough either close or open. Thus the piston C of the cylinder AA becoming loaded in proportion as the piston D of the cylinder BB rises, it gradually comes to assist the piston of the steam vessel in the latter part of its motion. These cylinders containing water may be either placed below the working beam, or above it, or may be suspended to a secondary working beam, constructed or necessary for some other use connected with the piston rod or pump rod, or other part, and placed so that the water cylinders may be in or out of the engine-house, where it may be most convenient.

My Sixth Method or Contrivance for equalizing the powers of the steam, consists in employing the surplus powers of the steam upon the piston in the first parts of its motion to give a proper rotative, or vibratory velocity to a quantity of matter, which retaining that velocity shall act along with the piston, and assist it in raising the columns of water in the latter part of its motion, when the powers of the steam are defective.

Two modes by which I perform this are delineated in fig. 1, Plate I. which represents the New-improved Engine, the piston of which is pressed forcibly both upwards and downwards by the powers of steam, with a 30 inch cylinder and 8 feet stroke. The better to understand the engravings, we have introduced the following explanation of its different parts: A, the piston; BB, the cylinder or steam vessel, C, a pipe which brings steam from the boiler to the lower regulator box or nozzle; D, the place of a regulating valve, which admits steam into the upper end of the steam vessel; E, the place of the regulator which admits steam below the piston; F, the place of a regulator, which lets steam go out from below the piston into the condenser; N, place of a regulator, which discharges the steam from above the piston; GG, the eduction or condenser pipe; H, the injection pipe; I, the hot water pump; K, the air pump; L, a valve at the eduction pipe foot; M, a passage from the air pump to the hot water pump; OO, a toothed rack, which connects the piston rod with the working beam; P, the piston rod; QQ, a toothed sector or arch, which also serves for a weight to assist the piston in its descent; QR, the working beam; SS, the pump rod, which is made double when the rotative machinery is used; T, the connecting rod of the rotative machinery; U, the wheel fixed upon an axis; W, the wheel fixed to the connecting rod; VV, the fly; XX, the fly of the reciprocating rotative motion; Y, the pinion on which it acts and is acted upon by the working beam; 9, the pipe which brings steam from the boiler.

The mode of the Engine's working is as follows:

The heavy fly XX, is put in motion by a means of a pinion, or smaller wheel Y, fixed upon its axis, and the teeth of which pinion or smaller wheel are acted upon by the toothed sector QQ, fixed upon the arch of the working beam QR, which toothed sector also serves for a weight to assist the piston in its descent; or the said fly is by other means connected with the motion of the said working beam. When the piston A, pulls down the end of the working beam, the toothed sector QQ, gives motion to the pinion, and thereby gives velocity to the fly; and when the descending or ascending velocity of the arch, or sector of the working beam becomes less than the velocity which the pinion and fly have acquired, then the velocity of the fly continuing, causes the pinion to act upon the sector in its turn, and assists the powers of the steam until its velocity is spent, or the piston has reached the bottom of the cylinder; and the said fly operates in like manner during the ascent of the piston, but turns then in the contrary direction. In the second variety of this method, a fly or heavy wheel is put into a continued rotative motion, by a crank, according to any of the rotative motions which I have invented, or by any other means which shall or can produce a continued rotative motion; and the said rotative machine is connected with or joined to either end of the working beam, to or with the piston and rod itself, to or with the pump rods, to or with any other moving part of the engine, or pump rods, which is found to work best.

In Fig. 1, Plate I. TUWVV represent the application of my fifth method of producing rotative motions from steam engines, as a method or contrivance for equalizing the powers of the steam. The piston being at the top of the cylinder BB, and the working beam in the situation delineated, the engine begins its stroke, and by means of the connecting rod TT, pulls upwards the toothed wheel W, which is fixed to the connecting rod T, in such a manner that it cannot turn upon its own axis, and is confined by means of a link or chain reaching from its centre to the axis of the other

toothed wheel U, or is otherwise so contrived that it cannot recede from it; therefore when the action of the engine pulls the wheel W, upwards, it revolves round the other wheel U, and causes it U to revolve upon its own axis, and the fly, or heavy wheel VV, being fixed upon the same axis, it is also put into motion; and because of the great power of the steam in the first parts of the stroke, the fly acquires a great velocity, whereby, through the medium of the two wheels, and the connecting rod, it acts upon the working beam, and assists the action of the steam in the latter parts of the stroke. When the piston has completed its stroke downwards, the lower edge of the wheel W, has passed over the upper edge or highest part of the wheel U, and the velocity of the fly continuing, the wheel U, acts upon the wheel W; and assists the unbalanced weight of the pump rod or rods SS, in raising the piston to the top of the cylinder.

My Second New Improvement upon steam or fire engines, consists in employing the elastic power of the steam to force the piston upwards, and also to press it downwards alternately, by making a vacuum above or below the piston respectively, and at the same time employing the steam to act upon the piston in that end, or to be exerted upon the piston only in one direction, whether upwards or downwards. This improvement, as applied to one of the steam engines of my invention, is delineated in *fig. 1*. The lower part of the cylinder BB being exhausted of air, steam, and other fluids, the regulating valve F, which lets steam out from below the piston into the condenser, being open, and the regulating valve E, which admits steam below the piston, and the valve N which discharges steam from above the piston being shut; the regulating valve D is opened, which admits steam from the boiler into the upper end of the cylinder or steam vessel, and thence it presses upon the upper side of the piston; by the action of which steam, the piston descends, pulls down the cylinder end of the working beam, and raises the end from which the pump rods are suspended. When the piston is arrived at the bottom of the cylinder, or end of its stroke, the valve F is shut, and the valve E is opened, which admits the steam under the piston, and at the same time the valve D is shut, which prevents the steam from coming from the boiler into that end of the cylinder; also the other valve N in the upper nozzle or regulator box is opened, which permits the steam to rush from above the piston into the eduction or condenser pipe GG, where it meets the jet or injection water, passing through the injection pipe H, which condenses it, and produces a vacuum in the upper part of the cylinder, which destroying the equilibrium, permits the steam under the piston to force it upwards: then the piston rod P being fast in the piston, and having the toothed rack OO, which connects the piston rod, and the working beam fixed to its upper end, by means of the teeth thereof, which are engaged in the teeth of the toothed sector, which also is fixed to, or forms a part of the arch QQ of the working beam, or by means of double chains or any other practicable method, the piston or its rod raises the cylinder end of the working beam, and also a heavy weight concealed or contained in the arch thereof, or otherwise fixed or attached to it, or suspended therefrom; which weight ought to be equal, or nearly so, to the force or power of the steam, when acting upon the piston in the ascending direction. When the piston is arrived at the summit of its motion, the regulating valves E and N are to be shut, and the regulating valves D and F, opened; whereby the piston again commences its motion downwards, as has been described; and during the descent of the piston, the weight QQ fixed to, or suspended from the working beam, assists the power of the steam on the piston in raising the columns of water in the pumps, or in working other machinery.

The reader should take notice that the *figures 13, 14, 15, 16, 17, and 18*, are all delineated on a scale of a quarter of an inch to each foot of the real size of the machine. In *fig. 13*, is delineated a front view of the cylinder and condenser of *fig. 1*, wherein the same letters are put upon the same respective parts: 88, represent part of the pipes which brings steam from the boiler, and 9 the cross pipe fixed to the upper nozzle or regulator box. N. B. The eduction pipe G is represented as broken off to shew the other parts. This improvement permits the engine to be used either with the uniform exertion of the whole power of the steam on the piston, both in the descent and ascent; or by making the weight of the columns of water in the pumps or the resistance of other machinery, which it may be required to work equal to the full power of the steam upon the piston, when acting in one direction only, and the weight on the working beam equal to half that power. It may be used as a double expansive engine, and wrought in the manner I have herein set forth in the description of my first improvement; and in such case the fourth, fifth, and sixth contrivances, for equalizing the powers of steam (already described) are peculiarly applicable to this mode of constructing the engine. Wherefore I have delineated the two varieties, which I have described of the sixth method as applied to this engine; and either or both of them may be used at the same time, though only one is strictly necessary, and any other two or more of the aforesaid six methods or of the varieties thereof, may be applied to one engine at the same time, that is, such of them whose nature admits of such combination.

My Third New Improvement on steam or fire engines consists in connecting together by pipes or other proper channels of communi-

cation the steam vessels and condensers of two or more distinct steam engines, each of which has its separate working beam and other constituent parts of a steam engine, or is otherwise so constructed that it can work pumps or other machinery, which are either connected with or are independent of those wrought by the other engine; and which two engines can take their strokes alternately, or both together, as may be required. The construction of the said machine is described as follows; and an external front view of the steam vessels, or cylinders and condensers of the two engines is delineated in *fig. 14*. The section or side view of the two engines is not delineated, because when viewed in that direction, only one of them can be seen, the other being hid by it; and the engine which could be seen would appear the same as the engine delineated in *fig. 1*. The compound or double engines admit the application of any of the equalizing machinery, which have been already described.

FIG. 14, represents a front view of the new compound, or double engine, as seen from the lever wall.

Description of the several Parts of this piece of Mechanism.

No. 1. The steam vessel and some other parts of the primary engine; No. 2, the steam vessel, and other parts of the secondary engine; D Q, places of the top regulating valves; C R, the perpendicular steam pipes; E O, places of the middle regulators; E P, places of the exhausting regulators; N G, eduction pipes; K, I, air and hot water pumps; M, a passage from the air pump to the hot water pump; S, a pipe for communicating the steam from the primary engine to the secondary engine, instead of the eduction pipe N; 8, 9, pipes which convey the steam from the boiler.

N. B. The engines may have each a condenser, or the same condenser may serve both, as is here delineated. The side view of these engines would appear the same as *Fig. 2*, or *Fig. 1*, according to the construction of their working beams. The hot water pump is broken off in this figure, to avoid its interfering with the eduction pipe N.

The several operations of this piece of machinery, or mechanism, are as follows: the cylinder of the primary engine No. 1, receives steam from the boiler, by the steam pipes, 8, 9, which steam enters the cylinder by a regular valve situated at D: its piston being at the upper end of its stroke, and the part of the cylinder which is below the piston being exhausted, the elastic power of the steam presses down the piston, until it arrives at the bottom or termination of its stroke; the regulating valve D is then shut and the middle regulating valve at E is opened, which admits steam to enter under the piston, whereby the engine is enabled to rise up the piston to the top of its stroke, where it was at the beginning, the middle regulating valve E is then shut, and the regulating valves F and P are opened; the valve F permits the steam to pass through the eduction pipe N, into the perpendicular steam pipe R, of the secondary engine, and to press upon its piston, under which piston there is a vacuum. The steam, which is or was contained under the piston or primary engine No. 1, being of the same density with the atmosphere, or nearly so, will, while the piston of the secondary engine No. 2, remains stationary, act upon it with the full power belonging to its density or elasticity, and will thereby cause it to commence its motion downwards; but as the piston of No. 2, moves downwards, the density and elastic force of the steam will diminish in proportion as the spaces which it occupies are increased; so that in case the cylinders of the two engines are of an equal capacity, when the piston of No. 2, has arrived at the bottom or lower end of its stroke, the density and elastic force of the steam will be only one half of what they were while the piston remained at the top; therefore if a simple lever, wheel, or working beam, is used for this secondary engine No. 2, the engine ought only to be loaded with a column of water or other work, equal to half the number of pounds on each square inch, which the primary engine No. 1, is able to work with. But if the secondary engine, No. 2, is furnished with any proper contrivance for equalizing the powers of the steam, it may, in case the cylinders of the two engines are of equal capacity, be made to do seven tenths of the work which is done by the primary engine No. 1. When the piston of the secondary engine, No. 2, has come to the bottom of its stroke, the middle regulating valve O is opened, and the steam rushes into the condenser GK, and in its way meets the jet of injection water, which condenses it, and thereby the upper part of the cylinder of the secondary engine, and the lower part of the cylinder of the primary engine are exhausted of steam. The piston of the secondary engine, No. 2, having the vacuum both above it, and below it, is pulled up easily by the working beam of that engine; and there being a vacuum under the piston of the primary engine, No. 1, the steam from the boiler exerts its power upon it, and presses it down; and the other motions are repeated as have been described.

These compound engines may also be wrought by other methods, of which I shall describe one of the best: let the eduction pipe N be supposed to be removed, and a steam pipe S, (which for distinction is dotted in the engraving) be made to communicate between the perpendicular steam pipe C, of the primary engine, and the top regulator box or cross pipe Q of the secondary engine; then the piston of the primary engine No. 1, being pressed to the bottom by steam, shuts its top regulating valve D, and opens the top regulating valve Q;

of the secondary engine: the piston of that engine will immediately begin to descend with a decreasing power, as has been remarked before. When the piston of the secondary engine, No. 2, has come to the bottom of its stroke, its middle regulator O, is opened, whereby the steam rushes out of the cylinder of both the engines into the condenser or condensers; and there being a vacuum both above and below the pistons of both engines, the equilibrium of both is restored, and both the pistons are permitted to be raised by the unbalanced weight of the pump rods, or other weights or machinery applied for that purpose. It is proper in this mode of application to make a small pipe, leading from the lower part of the cylinder of the primary engine to the eduction pipe or condenser of the secondary engine, whereby the vacuum under and above both pistons may be maintained of an equal degree of rareness or perfection.

For the more clear understanding of these improvements and contrivances, I have delineated and adapted them all, except (fig. 12, Plate IV.) to engines whose cylinders are 30 inches in diameter, and the length of the stroke of whose pistons is eight feet: but I make the cylinders larger or lesser, longer or shorter, and vary the proportions and shape of them, and of the other parts according as their uses may require; and as each improvement, method, piece of mechanism or contrivance admits of numberless variations, I have set forth and delineated only such as I esteem to be among the best, and which are the most easy to be executed.

My Fourth New Improvement on steam or fire engines, consists in applying a certain mechanical contrivance, called a toothed rack, and sector of a circle, or toothed racks, and toothed sectors of circles for suspending or connecting the pump rods or pistons with the working beams, levers, or other machinery used in lieu of them, in place or instead of chains, which hitherto have been used for these purposes. This new improvement, or mechanical contrivance, is delineated at OQ, Fig. 1, Plate I, and requires no other explanation than to say, that it is delineated by a scale of $\frac{1}{4}$ of an inch to each foot of the real size, according to its proper dimensions for a cylinder of 30 inches in diameter; and the said rack and sector are supposed to be made of hammered or cast iron; but it may be made of wood or other materials, by giving it dimensions suitable to the strength of the material of which it is made; and in order to accommodate the same to cylinders of other sizes, the strength of its parts must be increased or diminished, in proportion to the powers of the respective cylinders, to which it may be applied. I have described and delineated all my aforesaid new improvements upon, and new mechanical contrivances applicable to steam engines, as applied to or connected with the new steam engine of my own invention, as being the most perfect hitherto made; but I notwithstanding apply the same to the common steam engines, known by the name of Newcomen's steam or fire engines, and they are also applicable to any other species or variety of steam engines, which works with a piston, moving in a cylinder, or steam vessel, and they will in such engines, produce greater or less effects in proportion to the degree of perfection of the engine to which they are applied. Though I have described all the engines as standing erect, and having the piston rods coming through the holes at the top of the cylinder, and the working beams or equalizing machinery to be placed under them, yet I sometimes use such cylinders and working beams, in an inclined or an horizontal position.

My Fifth New Improvement on steam or fire engines, consists in making the steam vessels in form of hollow cylinders, or in the form of other regular, round, hollow vessels, or the form of greater or lesser segments or sectors, of such bodies or vessels; and I place in the centre or axis, of the circular curvature of such vessels, a round shaft or axle, passing through, and extending beyond one or both ends of such steam vessel; and I shut up the ends of the said steam vessel with smooth plates, which have proper apertures for the said axle or shaft to pass through; and within the said steam vessel, I fix to the said axle a piston or plate extending from the said axle to the circular circumference of the steam vessel, and also extending from one end of the steam vessel to the other; and I make the said piston steam tight, by surrounding the parts which fit to the steam vessel, with hemp or other soft substances, soaked in grease, oil, wax; or by means of springs made of steel or other solid and elastic or pliable materials; and to the said steam vessel, I fix one or more plates, or divisions, extending from the axle to the circumference of the steam vessel, and where these plates or divisions join to, or approach the axle, or where the said axle passes through the end plates of the steam vessel, I make such joinings, steam and air tight, by the means above recited. In the steam vessel on each side of the piston I make one or more channels, or apertures, for receiving and discharging the steam; which channels I furnish with proper valves for that purpose. I also apply to the said engine, proper condensers, and air pumps; and the pumps which raise water, or such other machinery as is required to be wrought by the said engine, are put in motion, or worked by a wheel or wheels fixed to or upon the external parts of the said axle, or by any other mechanism which may be suitable: and the engine so constructed is wrought by admitting the steam between the fixed division and the moveable piston, and exhausting or making a vacuum on the other side of the said piston, which, according to the force of the steam, moves into the said vacuum and turns the axle

or greater or lesser portion of the circle according to the structure of the machine. The piston is returned into its former situation by admitting steam on the other side of the said piston, and drawing the piston back by some external power, or by exhausting the part of the steam vessel, which was filled with steam. An engine constructed upon this principle, which I name the new reciprocating semi-rotative engine, is delineated in fig. 15, 16, and 17. Plate IV. according to a scale of one fourth of an inch to each foot of the real size; but I make them greater or lesser, and vary the shape and size of the steam vessel, and other parts according to their use. Fig. 15, is a section of the engine at right angles to the axle of the engine cylinder; AA is the hollow cylinder cut open; B, the axle or axis; C, the piston; D, a box filled with some soft substance to make the joining of the division plates EE with the axle, steam and air tight; FG, pipes which admit and discharge the steam; HKLL, places of valves or regulators; M, the steam pipe from the boiler; NN, the steam regulator box; OO, the eduction or condenser pipe; Q, the injection pipe; PP, condenser pumps. Fig. 16, is a side view of the engine wherein the same letters are placed on the same parts as in fig. 15. RR, are sockets to make the axle air tight; SS, the wheel which acts upon the pump rods; and T, the wheel which works the condenser. Fig. 17, is an outside front view of the engine and pump rods. The condenser and regulator boxes are not drawn in this view; and the upper part of the pump rod UU is supposed to be broken off. T, is the pivot of the axle; and UU, WW, are the pump rods and their racks.

The operation of the engine is as follows: the steam vessel AAA being exhausted of steam and air, and the regulating valves K and I being shut, and L and H open, the steam coming from the boiler through the pipe M enters the steam vessel by L and G, and causes the piston C to turn round into or towards the exhausted part of the steam vessel AX, and thereby turns the axle B, and the machinery attached to it until the piston C comes to X; the regulating valves L and H are then shut, and K and I are opened; the steam which had entered by the pipe G and had acted upon the piston, returns through G and I into the condenser or eduction pipe O, where it is condensed; and the steam from the boiler entering through K and F, forces the piston C to return to its first situation. The pump rods U, W, or other machinery, are wrought by the wheel SS fixed on the axle BB, or otherwise. See fig. 16, and 17. Plate IV. And the condenser pump or pumps is wrought by the wheel Q, fixed to any part of the said axle, or otherwise. The said steam vessel must be firmly fixed, and the gudgeons or pivots of the said axle must be rested upon proper supports, which things could not be delineated without confusion. I also cause engines made according to this fifth improvement to revolve with a continued rotative motion, by making their steam vessels complete cylinders, or other circular figures, and in place of the fixed division or divisions, I place one or more valves in their steam-vessels, which shut or close the area between their axes and their circumferences. and which valves open by turning upon a hinge or joint, or are drawn back by a sliding motion like a drawer, or otherwise are constructed so that they may be removed when the piston comes to them, and thereby suffer it to pass by the place where they were (see fig. 18.) and so begin a new revolution in the same direction: or I make a fixed division or divisions as has been described. And I fix one or more valves to the axle, which valves are capable of folding down and applying themselves to the axle, and of forming a part of its circumference, so that they can thereby pass by the division, and when they have passed it, they are raised up by springs or otherwise so as to perform the office of a piston or pistons. In fig. 18, the steam enters by the pipe G, and acts against the valve E, and the moveable radius or piston C; and the space AA, BB, being exhausted, the piston revolves through it by the action of the steam, and turns the axle BB. When the piston comes to the valve E, the pipe G is shut, and the valve E opens by turning upon the joint D, and so permits the piston C to pass by it. The steam then rushes into the condenser by the pipe H, which exhausts the steam-vessel. When the piston has got to its original place, the valve E is again shut, and the steam admitted through the pipe G into the space between the valve E and the piston C. And to continue the motion during the time that the piston is passing the valve, a heavy fly is fixed on or connected with some part of the axle BB on the outside of the cylinder. The outside of this engine is nearly the same as fig. 16; but the steam vessel may be placed either vertically, as drawn, or inclined or horizontally as its use may require.

Fig. 19, Plate IV. is a section of a part of a regulator box or nozzle, which is delineated at the scale of an inch to each foot A is a cross section of a spindle which comes through the side of the box, and moves the arm or sector B, which acts upon the rack C, and raises the regulating valve D, which is ground to fit the seat EE, and is guided by the socket FF; GG is the pipe that leads to the condenser; K a cover which is opened occasionally to rectify the valve HH; and I I is part of the nozzle.

I have not described the boilers which supply any or all of these engines with steam, because I use such as are commonly applied to other steam-engines, or any kind of boiler which is capable of producing steam in sufficient quantities; neither have I described the machinery which opens and shuts the regulating valves, as it is similar to that which is in common use, and may be varied at pleasure.

That

That the reader may be better acquainted with the powers of steam engines, and with the proper dimensions of the cylinder, &c. as suited to different cases, the following problems are inserted, with rules for their solution. In these solutions it is supposed that the pressure of the atmosphere upon a square inch at the earth's surface is at a mean about 14.8 lb. avoirdupoise, that water may be rarified at least 14,000 times, by being reduced into steam, and that the same may again be condensed, as has been shewn, into its former state; that though the pressure of the atmosphere is about 14.8 lb. upon every square inch, yet through friction and other resistances, the piston of a cylinder does not descend with a force above 8 or 9 lb. but for safety in practice it is taken at 7.64 lb. avoirdupoise, upon every square inch of its surface; and that a cubic foot of water weighs about 62.5 lb. avoirdupoise.

PROB. I. To determine the diameter of the cylinder to work a pump of a given diameter, and from a given depth.—Rule, Multiply the square of the pump's diameter in inches by $\frac{1}{2}$ of the depth of the pit in fathoms, and the square root of the product will be the diameter of the cylinder in inches: thus, let the diameter of the pump be 12 inches, and the depth of the pit 30 fathoms: then the required diameter of the cylinder will be found equal to 38 inches.

PROP. II. To find the diameter of a pump, that a cylinder of a given diameter can work at a given depth.—Rule, Divide thrice the square of the cylinder's diameter in inches, by the depth of the pit in fathoms: the square root of the quotient will be the answer in inches: thus, if the diameter of the cylinder be 38 inches, and the depth 30 fathoms, the diameter of the pump will, by this rule, be found to be 12 inches.

PROP. III. To find the depth from which a pump of a given diameter will work, by means of a cylinder of a given diameter.—Rule, Divide thrice the square of the cylinder's diameter in inches, by the square of the pump's diameter in inches, and the quotient will be the answer. If the diameter of the cylinder be 38 inches, and that of the pump 10 inches, then the depth corresponding will be 39 fathoms.

PROP. IV. To determine the pressure of the atmosphere on a cylinder of a given diameter, which works a pump of a given diameter at a given depth.—Rule, Multiply twice the square of the pump's diameter in inches by the depth of the pit in fathoms; divide the product by the square of the cylinder's diameter in inches, and the quotient will be the pressure in pounds on an inch square. When the diameter of the cylinder is 36 inches, that of the pump 10 inches, and the depth 39 fathoms, it will be found that the pressure upon an inch square will be 6 lb.

PROP. V. To determine the hogheads delivered per hour by a pump of a given diameter, which makes a given number of strokes in a minute.—Rule, Multiply 4 times the square of the pump's diameter in inches, by the number of strokes per minute; divide the product by 21, and the quotient will be the number of hogheads required. Thus, if the diameter of the pump be 16 inches, and the number of strokes made each minute be 12, then it will be found that the hogheads discharged in an hour are 585.

PROP. VI. To determine the number of strokes per minute that an engine must make to raise a given number of hogheads per hour by a pump of a given diameter.—Rule, Multiply the given number of hogheads per hour by 21; divide the product by four times the square of the pump's diameter in inches, and the quotient will be the number of strokes made each minute. If it be required to raise 585 hogheads per hour, by a 16 inch pump, it will be found that the number of strokes per minute must be 12.

PROP. VII. To determine the number of gallons drawn at a six-feet stroke by a pump of given diameters.—Rule, Multiply the square of the pump's diameter in inches, by 2, and the product will be the answer.

PROP. VIII. Having given the number of gallons drawn by a stroke of six feet, and the depth of the pit in fathoms to determine the diameter of the cylinder.—Rule, Multiply five times the number of gallons drawn at a stroke by the depth in fathoms; extract the square of $\frac{1}{2}$ of the product, and you will have the answer in inches.

PROP. IX. Having given the number of gallons drawn by a six-feet stroke, to determine the diameter of the pump.—Rule, The square root of 5 times the given number of gallons will be the answer in inches.

PROP. X. Given the diameter of the cylinder, and the depth of the pit to find the number of gallons drawn at a stroke of six feet.—Rule, Divide the square of the cylinder's diameter in inches by the given number of fathoms; then three-fifths of the quotient will be the answer in gallons.

PROP. XI. Given the diameter of the pump, and the number of hogheads drawn per hour, to find the number of strokes that can be made per minute.—Rule, Multiply the number of hogheads drawn per hour by 21, divide the product by 4 times the square of the pump's diameter in inches, and you will have the answer.

PROP. XII. Given the diameter of the pump, the depth, and the pressure of the atmosphere to find the diameter of the cylinder.—Rule, Multiply twice the square of the pump's diameter in inches, by the depth in fathoms; divide by the number of pounds pressure on a square inch, and the quotient will be the answer in inches.

PROP. XIII. Given the diameter of the cylinder, the depth, and

the pressure of the atmosphere to find the diameter of the pump.—Rule, Multiply half the square of the cylinder's diameter in inches by the number of pounds pressure on a square inch; divide the product by the depth in fathoms, and you will have the answer in inches.

PROP. XIV. Given the cylinder's diameter, the depth, and the pressure, to find the number of gallons drawn by a six-feet stroke.—Rule, Multiply $\frac{1}{2}$ of the square of the cylinder's diameter, by the pounds that press on a square inch; then divide the product by the depth in fathoms, and you will have the answer in gallons.

PROP. XV. Given the hogheads drawn per hour, the depth, and the number of strokes per minute, to find the diameter of the cylinder.—Rule, Multiply 7 times the given number of hogheads by the depth in fathoms; divide the product by the number of strokes, and you will have the answer in inches.

PROP. XVI. Given the hogheads per hour, the number of strokes in a minute to find the diameter of the pump.—Rule, Multiply the given number of hogheads by 21; divide the product by the number of strokes, and the quotient will be the answer in inches.

PROP. XVII. Given the diameter of the cylinder, the depth, the number of strokes per minute, and the pressure of the atmosphere, to determine the hogheads drawn per hour.—Rule, Multiply twice the square of the cylinder's diameter in inches, the number of strokes per minute, and the number of pounds that press upon each square inch into one product; divide that product by 21 times the depth in fathoms, and you will have the hogheads drawn per hour.

PROP. XVIII. Given the cylinder's diameter, the depth, the hogheads draw per hour, and the pressure of the atmosphere to find the number of strokes per minute.—Rule, Multiply 21 times the depth in fathoms, by the number of hogheads drawn per hour, then multiply twice the square of the cylinder's diameter in inches, by the pounds that press on each square inch; divide the former product by the latter, and the quotient will be the answer.

PROP. XIX. Given the number of gallons drawn by a stroke of any given length to determine the diameter of the pump.—Rule, Divide 3 times the given number of gallons by $\frac{1}{2}$ of the length of the stroke in feet, and the quotient will be the answer in inches.

PROP. XX. Having given the diameter of the pump, and the length of the stroke to find the number of gallons drawn at each stroke.—Rule, Multiply the square of the pump's diameter in inches, by the length of the stroke in feet; divide the product by 33, and you will have the gallons required.

More problems of this kind might be given, but it is apprehended that these are of the most general use, and are sufficient to convey a proper knowledge of the different powers of steam engines, according to the different sizes of the cylinders and pumps, &c. any one well versed in the operations of these problems cannot be at a loss in any other.

In the description of this machine, we have exceeded the general economy of our plan; but as the improvement of the Engine is an invention of such a highly important nature, and as there has not been a description of it, or plates given to represent it in any other Dictionary of Arts and Sciences, or in any other work whatever, it is presumed that the readers will not deem the space it occupies misapplied.

STEEL, is an iron reduced or converted by art to a particular state, which occasions some changes in its properties; though these are essentially the same as those of iron. Stahl, Cramer, and all good chymists, justly consider steel as an improved iron, possessing a larger quantity of the inflammable principle, so necessary to all metals, and containing fewer heterogeneous, and more metallic parts than an equal bulk of iron.

Steel may be made by fusion or by cementation. The first method is used to convert iron into steel immediately from the ore. All ores of iron are not used indifferently for this purpose; because some of these, which are therefore called ores of steel, are much fitter than others for affording good steel; and the steel extracted from them is called natural steel. But though steel is made sometimes directly from the ore, it is more frequently produced from crude or cast iron. These methods of making steel are not known in England, but are practised in Sweden and other parts of Europe. There is another kind of steel, besides those which are produced from the ore and cast-iron, or from the forged iron, which is obtained by remelting bar-steel in crucibles, and casting it into ingots. This, which is of modern discovery, is called cast-steel, and being more uniform and similar in all its parts than any other sort of steel, is fitter for being wrought into the finer kinds of utensils for which steel is employed.

By conversion of iron into steel, this metal acquires a darker and browner colour, a closer, more compact, and finer grained texture, greater hardness, elasticity, tenacity, density, sonorousness, and disposition to receive the magnetic property. Besides, steel is much more fusible than iron, on account of the greater quantity of phlogiston united with it; as phlogiston is known to be, in general the cause of the fusibility of metals. Indeed soft forged iron can scarcely, without addition, be brought into perfect fusion by the heat of our furnaces, till the fuel has converted it into steel. If steel, after the tempering, be found too hard, there is a very familiar way

of bringing it back to what state one pleases, between that and iron, which is only the heating it in the fire; for it may be kept in the fire so long as to be reduced wholly to iron again. It is easy to infer from hence, what was before observed, that cast iron is steel of a peculiar kind; its properties plainly evince, that it is steel with an over proportion of all that makes it so, and consequently of all its properties. It is not malleable, is very brittle, and too hard for the file, or any other tool, to cut. These are the qualities of steel which is over tempered, or, as it may be called, too much steel; it owes these qualities to its being overcharged with those sulphurs and salts, which in a due proportion make steel of iron.

Annealing or Nealing of STEEL, is by some used for the softening it, in order to make it work easier; which is usually done by giving it a blood red heat in the fire, and then taking it out, and letting it cool of itself. Steel may indeed be made a little softer than in the common way, by covering it with coarse powder of cow-horn or hoofs; thus enclosing it in a loam, heating the whole in a wood-fire till it be red-hot, and then leaving the fire to go out of itself, and then the steel to cool.

STEEL YARD, in mechanics, a kind of balance, by means whereof the gravities of different bodies are found by the use of one weight. For its construction and uses, see the System, Sect. III. For representation, see Plate III. fig. 1.

STEERING, in navigation, the art of directing a ship's way from one place to another, by means of the helm and rudder, or of applying the efforts of the helm to regulate her course when the advances. He is held the best steersman, who uses the least motion in putting the helm over to and again, and who keeps the ship best from making yaws; that is, from running in and out.

STENOGRAPHY, *Στενογραφία*, formed of *στενός*, secret, and *γραφω*, I write, the art of secret writing, or of writing in ciphers, known only to the persons corresponding. See DE-CIPHERING.

STEM, in botany, that part of a plant arising out of the root, and which sustains the leaves, flowers, and fruits. See the System, Sect. II. and Plate II.

STEM of a ship, is a circular piece of timber, into which her two sides are united at the fore-end; the lower end of it is scarfed to the keel; and the bowsprit rests upon its upper end. See Treatise on *Naval Affairs*, Part II. Sect. IV. and the Plate annexed.

STENOGRAPHY, from *στενός*, angustus, and *γραφω*, writing; the art of quick or short-writing. There have been various kinds of stenography invented: among the Romans, there were certain notes used, each whereof signified a word. In France, &c. the only stenography used is, the retrenching of letters, or even whole syllables of words: as in *sdm* for *secundum*, *aut* for *autem*, *d* for *sed*, *o* for *non*, *participaon* for *participation*, &c. The first printers imitated these abbreviations: but at present they are almost laid aside, except among scriveners, &c. In England we have great variety of methods of stenography, or short-hand; more by far, and those too much better, easier, speedier, and more commodious, than what are known in any other part of the world; witness Shelton's, Wallis's, Rich's, Mason's, Webster's, Weston's, Macaulay's, Annet's, Gurney's, Lyle's, and several other short-hands. The most essential properties of short-hand writing are expedition and legibility. Any scheme which does not possess a sufficient degree of the first, has no title to the name of short-hand, and if the last is wanting, let the method in other respects be what it will, it cannot answer any useful purpose.

STEREOGRAPHIC Projection of the Sphere, is that wherein the eye is supposed to be placed in the surface of the sphere. Stereographic projection is, the projection of the circles of the sphere on the plane of some one great circle, the eye being supposed placed in the pole of that circle.

STEREOGRAPHIC Projection on the Plane of the Meridian. See the System of ASTRONOMY, Sect. IX. Problem I. and Plate IV. Fig. 1.

STEREOGRAPHIC Projection on the Plane of the Equinoctial. See Sect. IX. Problem III. and Plate IV. Fig. 3.

STEREOGRAPHIC Projection on the Plane of the Horizon. See Sect. IX. Problem II. and Plate IV. Fig. 2.

STEREOGRAPHIC Projection on the Plane of the Ecliptic. See Sect. IX. Problem IV. and Plate IV. Fig. 4.

STEREOMETRY, *Στερομετρία*, formed of *ερεος*, solid, and *μετρον*, measure, that part of geometry which teaches how to measure solid bodies, i. e. to find the solidity, or solid contents of bodies; as globes, cylinders, cubes, vessels, ships, &c.

STERILITY, formed from *sterilitas*, of *sterilis*, barren, the quality of a thing that is barren; in opposition to *fecundity*. Sterility was held a grievous affliction by the wives of the ancient patriarchs. Nature has annexed sterility to all monstrous productions, that the creation might not degenerate. Hence the sterility of mules, &c. Sterility in women sometimes happens from a miscarriage, or violent labour, injuring some of the genital parts; but one of the most frequent causes is the suppression of the menstrual flux. There are other causes, arising from various diseases incident to those parts, by which the uterus may be unfit to receive or retain the male seed; from the tubæ fallopianæ being too short, or having lost their erective power; in either of which cases no conception can take place; from universal debility and

relaxation; or a local debility of the genital system; by which means, the parts having lost their tone or contractile power, the semen is thrown off immediately *post coitum*:—from imperforation of the vagina, the uterus, or the tubæ: or from diseased ovaries, &c. Hence medical treatment can only avail in cases arising from topical or universal debility: in correcting irregularities of the menstrual flux, or in removing tumours, cicatrices, or constrictions of the passage, by the art of surgery.

STERN of a Ship, denotes her posterior face; or that part which is presented to the view of a spectator, placed on the continuation of the keel behind. For representation of a stern view, &c. of a ship of the line, see the Treatise on *Naval Affairs*, Sect. IV. and the Plate annexed.

STERN-Post, in a ship, a great timber let into the keel, at the stern of a ship, somewhat sloping, into which are fastened the after-planks; and on this post, by its pintle and gudgeon, hangs the rudder. For a geometrical delineation of the dimensions of the stern-post of a ship of the line, see Sect. IV. the plate annexed.

STERNOHYOIDEUS, in anatomy, is a long, thin, flat muscle, broader at the lower than the upper part, and is situated, together with its fellow, on the fore-side of the throat. For its origin, insertion, and use, see the System, Part II. Table of Muscles, Art. IX.

STERNOTHYROIDEUS, in anatomy, a pair of muscles of the larynx, arising in the sternum, or breast-bone, and terminating in the cartilago thyroides. For its origin, insertion, and use, see the System, Part II. Table of Muscles, Art. IX.

STERNUM, *Στερον*, in anatomy, the breast-bone, a cartilaginous fort of bone, which makes the fore-part of the breast, and into which the ribs are fitted. See the System, Part I. Sect. III. Art. 2. fig. 1. letter a.

STERNUTATIVE, or **STERNUTATORY**, a medicine proper to produce sneezing. Sternutatives, also called Ptarmics, are of two kinds, gentle and violent. Of the first kind are betanay, sage, marjoram, tobacco, and the whole fashionable tribe of snuffs. Of the latter kind are euphorbium, white hellebore, pellitory, &c. Sternutatives operate by their sharp pungent parts vellicating the inner membrane of the nose, which is exceedingly sensible, and occasioning the serous matter contained in the gland of the nose, and in several sinuses situate in the base of the cranium, and the os frontis, to be expelled.

STEWARDS, or **STUES**, were places, anciently permitted in England, to women of professed incontinency, for the proffer of their bodies to all comers. These were under particular rules and laws of discipline, appointed by the lord of the manor. The word is probably borrowed from the French, *eslues*, hot baths, in regard prostitutes are wont to prepare themselves for venereal acts by bathing; and hot baths were, by Homer, reckoned among the effeminate sorts of pleasure. The stewards were suppressed by king Henry VIII. about the year 1546.

STEWARD, or **SENECHAL**, an officer, whereof there are various kinds; thus called from the Saxon *steda*, *stead*, place or room; and *ward*, *keeper*, q. d. a deputy, or person, appointed in the place of another.

Lord High STEWARD of Great Britain, is the first and highest officer of the crown, as having the power of what we call *vice-roy*. Common lawyers call him *magus Angliæ seneschallus*. His office, as expressed in an ancient record, is to supervise and regulate the whole kingdom, both in time of peace and war, immediately under the king, and after him; an authority so very great, that it has not been judged safe to trust it any longer in the hands of a subject. The office was hereditary and permanent in the family of the dukes of Lancaster, till the time of Henry IV. since whom it has only been made *pro hac vice*, occasionally: as, to officiate at a coronation; at the arraignment and trial of some nobleman for treason, or other great crimes. And it hath been the constant practice (and therefore seems now to have become necessary) to grant it to a lord of parliament, else he is not capable of trying such delinquent peer. While he holds his office, he bears a white staff in his hand, and the trial, &c. ended, he breaks his staff, and with it his commission expires. During the session of parliament, the trial of an indicted peer is not properly in the court of the lord-high-steward, but before the court of our lord the king in parliament. In this case, however, a lord-high-steward is always appointed to regulate and add weight to the proceedings: but he is rather in the nature of a speaker, *pro tempore*, or chairman of the court, than the judge of it; for the collective body of the peers are therein the judges both of law and fact, and the high-steward has a vote with the rest, in right of his peerage. But in the court of the lord-high-steward, which is held in the recesses of parliament, he is the sole judge in matters of law, as the lords triers are in matters of fact; and as they may not interfere with him in regulating the proceedings of the court, so he has no right to intermix with them in giving any vote upon the trial. Blackst. Com. book iv. p. 260.

Lord STEWARD of the Household, is an officer to whom the state of the king's house is committed, to be ruled and guided at his discretion.

STIGMA, among botanists, is the summit of the pistil, covered with a moisture for the breaking of the pollen. See the System, Sect. II. and Plate III.

STIGMATA, in the animal economy, the apertures in different

ferent parts of the bodies of insects communicating with the tracheæ, or air-vessels, and serving for the office of respiration. Nature has given to these minute animals a much larger number of tracheæ and bronchia, than to us. We have the ramifications of the trachea reaching no farther than into the breast, whereas, in the bodies of these insects, we find them extended through the whole, and finely and admirably interlaced with one another. We have but one mouth to respire by; and the organization of the parts, conducive to respiration, is very admirable in us; but in the insect class, the mouths or openings to breathe at, are more numerous, and the organization more complex. See the *System of Comparative Anatomy*, Chap. IV.

STIMULATING, a property in angular or sharp bodies, whereby they velicæ, and cause vibrations and inflections of the fibres of the nerves, and a great derivation of nervous fluid into the parts affected. Stimulants produce pain, heat, redness, &c. They may be reduced to violent penetrating depilatories, gentle sinapisms, vesicatories, and caustics.

STING, *aculeus*, an apparatus in the body of certain insects, in form of a little spear, serving them as a weapon of offence. The sting of a bee, or wasp, is a curious piece of mechanism; it consists of a hollow tube, at the root whereof is a bag full of sharp penetrating juice, which, in stinging, is injected into the flesh through the tube. Within the tube, Dr. Derham has observed, there lie two small sharp bearded spears; in the sting of a wasp, he told eight beards on the side of each spear, somewhat like the beards of fish-hooks. By means of these beards it is, that the animal is forced to leave its sting behind it, when disturbed, before it can have time to withdraw the spears into their scabbard.

STOCK, in Gardening, the stem or trunk of a tree. What stock is most proper for each kind of fruit, ought as well to be considered and known, as what soil is most suitable to trees; for on those two things the future vigour of trees, and the goodness of fruit equally depend. For full directions on this subject, see the *System*, Part II. under the head of *Fruit-Garden*, month of February.

STOCK-Jobbing, denotes the practice of trafficking in the public funds, or of buying and selling stock with a view to its rise and fall. This term is commonly applied to the illegal practice of buying and selling stock for time, or of accounting for the differences in the rise or fall of any particular stock for a stipulated time, whether the buyer or seller be possessed of any such real stock or not.

STOICS, a sect of ancient philosophers, the followers of Zeno; thus called from the Greek *στοα*, *portico*, in regard Zeno used to teach under a portico or piazza. One of his chief followers was Cleanthes, who was succeeded by Chrysippus, and he by Diogenes, Babylonius, Antipater, Panætius, and Posidonius, among the Greeks; and by Cato, Varro, Cicero, Seneca, the emperor Antonius, &c. among the Romans: and by Panteus and Clemens Alexandrinus, among the Christians. And the chief restorers of the stoic philosophy among the moderns were, Justus Lipsius, Scioppius, Heinsius, and Gataker. The stoics cultivated logic, physics, metaphysics, &c. but chiefly ethics. As for the morality of the Stoics, it was couched much in paradoxes; as, that a wise man is void of all passion or perturbation of mind; that pain is no real evil; but that a wise man is happy in the midst of the severest torture; that a wise man is always the same, and always joyful; that none but a wise man is free; all others are slaves: that none but a wise man is rich: that none but a wise man ought to be esteemed a king, magistrate, poet, or philosopher: that all wise men are great: that all things are a wise man's, who is contented with himself: that wise men are the only friends, and the only lovers; that nothing ever happens to a wise man beyond expectation: that all virtues are inviolably connected together: that all good things are equal, and equally to be desired, and that goodness admits of no increase or diminution. They owned but one God, whom, however, they called by various names, as Mind, Fate, Jupiter, &c. by which they did not mean various things, but various powers and relations of the same things. Providence they expressed under the name of Fate, which Chrysippus defines to be a natural series or composition of things mutually following each other, by an immutable nexus, or tie, fixed from all eternity; and which some have supposed to be different from what is now called absolute fatality, and not altogether inconsistent with free agency. Lastly, they held that the human soul survived the body. See *PHILOSOPHY*.

STOMACH, *στομαχος* in Anatomy, a hollow membranous, organical part of the human system, destined to receive the food after deglutition, and to convert it into chyle. See *System of Anatomy*, Part III. Sect. III. and Plate V. For description of the peculiar formation of this part, in quadrupeds, birds, and fishes, see *System of Comparative Anatomy*, under their respective heads.

STOMACHIC, a medicine that strengthens the stomach, and promotes digestion. Of this kind are wormwood, rhubarb, mint, mastic, aloes, pepper, cinnamon, and aromatic bitters; good wine is also a stomachic.

STOMACHIC, in Anatomy, is applied to the arteries, veins, &c. of the stomach, called also gastric. The stomachic veins terminate in the trunk of the vena porta, and the splenic vein. The stomachic arteries arise from the celiac. The stomachic nerves come from the eighth pair. See the *System*, Part V. Sect. II. and Part IV. Sect. I. and II. For representation, see Plate XI. fig. 3, 4, 5, and 10. See also Plate XII. and XIII. with the explanation of them under the same article.

STONES, in Natural History, are defined to be essentially compound fossils, not inflammable, nor soluble in water or oil, nor at all ductile; found in continued strata, or beds, of great extent; formed either of a congeries of small particles, in some degree resembling sand, and lodged in a smoother cementitious matter; or else of this cementitious matter, and the grit or sand-like particles running together into one smooth mass; or, finally, of granules cohering by contact, without any cementitious matter among them; or composed of chrysal or spar, usually debased by earth, and often mixed with talc, and other extraneous particles. They are formed by succession of time, in the body of the earth, by earthy particles, which, in approaching to one another, acquire various degrees of connection and union. Bodies of this kind are infinitely various, according to their different consistence, colour, form, and other properties. Stones are of various kinds, with regard to the place they are produced in; the most common are formed under ground; others in the bodies of men, and other animals; others seem to be generated by the sea, as pumice, &c. and others to be the effect of a petrifying virtue in certain waters. Of these, some serve simply for magnificence and ornament: as all those called precious stones, which make the commerce of lapidaries and jewellers. Much the greatest quantity, and those too of the most immediate and common use, are those employed in building; such as *free-stone*, *marble*, *lime-stone*, *fire-stone*, &c.

STONE, in Medicine, is the denomination of a disease, called also *calculus*, *lithiasis*, and *nephritis*. It consists of a stony concretion, formed either in the bladder, in which case it is called *LITHIASIS*; or, in the kidneys, when it is denominated *NEPHRITIS*; (see the *System*, Genus 18 and 79) which prevents the discharge of urine and occasions violent pains. The stone, Etmuller says, is not a disease, but the product of a disease: the disease, properly, is the *lithiasis*, or the disposition of the kidneys and bladder to generate stones. When small stones are lodged in the kidneys or discharged along with the urine, the disorder is called the *GRAVEL*; but if one of these stones happens to make a lodgment in the kidneys, or in the bladder, for some time, so as to accumulate fresh matter, and become too large to pass off with the urine, or if it passes from the kidneys, and obstructs the ureter, or passes with great difficulty, the patient is said to have the stone. By a fit of the gravel or stone, are understood the pain and other symptoms that usually attend stony concretions in the kidneys, &c. especially when nature makes an effort for their discharge. The stone and gravel may be occasioned by high living; the use of strong astringent wines; a sedentary life; lying too hot, too soft, or too much on the back; the constant use of water, impregnated with earthy or stony particles; aliments of an astringent or windy nature, &c. These disorders may likewise sometimes proceed from an hereditary disposition. Persons in the decline of life, and those who have been much afflicted with the gout and rheumatism, are most subject to them. The stone is generated, according to some authors, of the earthy viscid parts of the blood, hardened, in course of time, by the heat of the kidneys; much after the manner as brick is baked in a kiln. Dr. Quincy supposes it generated of the harder parts of the urine, pent up by the straitness of the ducts, and brought into contact and cohesion. Etmuller ascribes the stone, sometimes to the stony and metallic particles of our foods and drinks, which the reins, through weakness and relaxation thereof, cannot eject; but more usually to the unequal strength of the kidneys, whence it is that we see one kidney often breeds stones, the other remaining sound. The matter of the stone in the bladder is first formed in the pelvis of the kidneys; whence falling into the bladder, it becomes augmented by new lamellæ or coats. Dr. Mead seems to think, that the proximate cause of this disease is a tartarous salt, conveyed out of the blood into the small ducts of the kidneys, for it is the nature of these salts to contain a considerable quantity of that subtle matter which Newton has shewn to be the cause of the cohesion of bodies. Thus, the calculus is a substance composed of earth and a very large share of air concentered in the renal ducts; and either remains therein, or drops down into the urinary bladder. Dr. Hales found, by distilling a human calculus in an iron retort, that half of it was raised by the action of the fire into elastic air. These particles of air, which are combined in it, in an unelastic state, are firmly united together by sulphur and salt; the proportion of caput mortuum, or earth, being very small. And Mr. Boyle found in such a calculus, a considerable quantity of volatile salt, with some oil.

The diagnostic signs of the *stone in the kidneys*, are, 1. a fixed obtuse pain in the region of the loins, seeming, like a weight loading the reins, accompanied with costiveness and flatulency, sickness, and sometimes vomiting. As the stone falls out of the pelvis into the ureter, the pain is extremely acute and racking, which continues till either the stone be got into the bladder, or returned again to the pelvis. 2. An inflexibility of the spina dorsa, from the extension and compression of the nerves. 3. A stupor of the thigh and leg of that side, from the consent of parts. 4. A retraction of the testicles. 5. A very small quantity of urine, discharged frequently, and with difficulty, either thin and limpid, or bloody; in this case the sediment of the urine subsides directly. But as soon as the stone is got into the bladder, the urine becomes thick, turbid, blackish, and in great quantity.

S T O

S T R

The diagnostics of the *stone in the bladder*, are, a sense of heaviness in the perinæum, and inguinal region, a perpetual and troublesome desire of making water, which is preceded and followed with a sharp pain, and an itching, principally in the glans of the penis, whence a prolapsus of the anus; and an inclination to go to stool during the discharge of urine; the urine's coming away by drops, or stopping suddenly when it was running in full stream; the patient's passing the urine more easily when lying than in an erect posture; a kind of convulsive motion occasioned by the sharp pain in discharging the last drops of the urine; a white, thick, copious, stinking, mucous sediment in the urine; and a violent pain in the neck of the bladder upon motion, especially on horseback, or on a coach on a rough road.

As to the regimen proper to be observed by persons afflicted with the stone or gravel, they should avoid aliments of a windy or heating nature, as salt meats, four fruits, &c. Their diet should be light and easy of digestion, and consist chiefly of such things as tend to promote the secretion of urine, and to keep the body open. Artichokes, asparagus, spinach, lettuce, parsley, succory, purslane, turneps, potatoes, carrots, and radishes, may be eaten with safety; onions, leeks, and celery, are reckoned medicinal. Dr. Hales observes, that onion juice seems to have considerable efficacy in dissolving the calculus; and where frequently eaten, should, if not waste, at least prevent its increase. Dr. Lobb found leeks more effectual solvents than onions. The most proper drinks are whey, butter-milk, milk and water, barley-water, decoctions, or infusions of the roots of marshmallows, parsley, HEATH, liquorice, or other mild mucilaginous vegetables, as linseed, &c. Pitcairn recommends the use of milk for common drink in the stone, with barley-water and a little sugar. He adds, that he cannot give any better reason why milk is serviceable to nephritics than because the same is always found serviceable to gouty persons. The symptoms of both diseases are the same, excepting what relates to the parts affected. If the patient has been accustomed to generous liquors, he may drink small gin and water without acid. Dr. Mead allows either small wine and water or new soft ale; which, he says, will be rendered better and wholsumer, if ground-ivy leaves be infused in it, while it is working: mead is likewise a proper drink, for honey is an excellent diuretic. A spoonful also of honey in a glass or two of the infusion of marshmallow roots is an admirable cleanser of the kidneys, if constantly used. The wines ought to be the softest and smoothest that can be had, and the lightest, clearest river or running water is preferable to any other, except such as abound with fixed air, and may be taken medicinally. Out of the fit, the patient should use moderate exercise, without fatigue, or any violent motion, which is apt to occasion bloody urine. Indeed persons afflicted with gravel often pass a great number of stones after riding on horse-back, or in a carriage, but those who have a stone in the bladder cannot bear such exercise. Persons who have an hereditary tendency to this disease, should never indulge themselves in a sedentary life. Much depends, in the way of prevention, when the first symptoms of gravel, &c. appear, on a proper regimen of diet, and the use of sufficient exercise. In a fit of the gravel, occasioned by the stone sticking in the ureter, or some part of the urinary passages, the patient should be bled, warm fomentations should likewise be applied to the part affected, emollient clysters administered, and diluting mucilaginous liquors drank: and the treatment of this case is similar to that of an inflammation of the kidneys.

Mr. Pennant mentions two instances of stones found in horses; the one of a horse that voided sixteen calculi, each of an inch and a half diameter: the other of a stone taken out of the bladder of a horse, and deposited in the cabinet of the late Dr. Mead, weighing eleven ounces. These stones are formed of several crusts, each very smooth and glossy; their form triangular, but their edges round, as if by collision against each other. Brit. Zool. vol. i. p. 12.

STONE-BLUE, a preparation used in washing linen. See INDIGO and SMALT.

STONEHENGE, or STONE-HENG, in British antiquity, a famed pile or monument of huge stones on Salisbury plain, nine miles distant from that city. For a copious description of this wonderful fabric, see the article CARNEDDE.

STOP, in Grammar. See the System, Part II. Chap. IV. under the article PUNCTUATION.

STORGE, *Στοργή*, a Greek term, frequently used by naturalists, to signify that parental instinct, or natural affection, which animals bear toward their young. The storgé is an admirable principle implanted by the all-wise Creator throughout the animal world, for the preservation thereof, and is governed by such rules as make it best contribute thereto. By means of this, with what care and alacrity do animals nurse their young; and what dangers will they brave for their security! Even the most timorous creatures, which at other times fly the face of men, dogs, &c. will, for the sake of their young, expose themselves. Thus, hens, instead of flying from, will assault such as meddle with their brood: and partridges, before their young can fly, will frequently drop down before the dogs, first at less, then at greater distances, to dodge, and draw them off, from pursuing their young. With what concern do others lead about their young in places of safety

and some even admit them for shelter into their bodies. Thus the opossum, Dr. Tyson observes, has a curious bag on purpose for the securing and carrying about her young. The same author adds, from Oppian, that the dog-fish, upon any storm or danger, receives her young into her belly, which come out again when the fright is over. And it is said the *squatina* and *glaucus* do the like. With what tenderness do others seek and prepare the food for their young, teach them to suck, cherish, or lull them to rest, &c. like so many nurses, deputed by the Creator to take care of his creatures! and still in proportion, as they grow up, and become fit to look to themselves, this storgé abates; and, at length, when no longer needed, becomes extinct. See INSTINCT.

STORK, *ciconia*, in Ornithology, a species of the genus *Ardea*. For description of the Genus, see ARDEA.

STRAIT, in Geography, a narrow channel or arm of the sea, shut up between lands on either side, and affording a passage out of one great sea into another. There are several kinds of straits, as the straits of Gibraltar, Magellan, Babelmandel, Caffa, &c. but the most celebrated of these, and indeed of the whole world, is that of Gibraltar, which is about one hundred and thirty miles long, and twelve broad, joining the Mediterranean sea with the Atlantic ocean. The Straits of Magellan, discovered in 1520, by F. Magellan, were used some time, as a passage out of the North into the South Sea; but since the year 1616, that the strait of Le Maire has been discovered, the former has been disused: both because of its length, which is full three hundred miles, and because the navigation thereof is very dangerous, from the waves of the North and South Seas meeting herein, and clashing. The strait at the entrance of the Baltic is called the SOUND. Strait is also used in geography, for an isthmus or neck of land between two seas, preventing the communication thereof.

STRANGURY, *σπαργις*, formed from *σπᾶρξ*, gutta, drop, *ουρον*, urine, in medicine, a disease, occasioning a frequent and involuntary emission of urine, in very small quantities, and, as it were drop by drop, with an intense pain. Some authors confound the strangury, which the Latins call *urinae stillicidium* with the *urina incontinentia*. The difference between them consists in this, that in the former, the urine comes away with pain; in the latter, without pain. The former proceeds from the acrimony of the urine; and the latter from a relaxation or palsy of the sphincter of the bladder, which cannot keep the neck thereof close shut. By this word is generally understood the three several complaints called by physicians strangury, dysury, and ischury. See the System, Genus 78 and 79.

STRATA, in Natural History, the several beds or layers of different matters whereof the earth is composed. The strata whereof the earth is composed are so very different in different countries, that it is impossible to say any thing concerning them, that may be generally applicable: and indeed the depths to which we can penetrate are so small, that only a very few can be known to us at any rate: those that lie near the centre, or even a great way from it, being for ever hid. The reason why we cannot penetrate to any great depth is, that as we go down, the air becomes foul, loaded with pernicious vapours, inflammable air, fixed air, &c. which destroy the miners, and there is no possibility of going on. In many places, however, these vapours become pernicious much sooner than others, particularly where sulphureous minerals abound, as in mines of metal, coal, &c. But however great differences there may be among the under-strata, the upper one is in some respects the same all over the globe, at least in this respect, that it is fit for the support of vegetables, which the others are not, without long exposure to the air. Properly speaking, indeed, the upper stratum of the earth all round, is composed of the pure vegetable mould, though in many places it is mixed with large quantities of other strata, as clay, sand, gravel, &c. and hence proceed the differences of soils so well known to those who practise agriculture. It has been supposed, by some naturalists, that the different strata of which the earth is composed were originally formed at the creation, and have continued in a manner immutable ever since: but this cannot possibly have been the case, since we find that many of the strata are strangely intermixed with each other; the bones of animals, both marine and terrestrial are frequently found at great depths in the earth, beds of oyster-shells are found of immense extent in several countries; and concerning these and other shell-fish, it is remarkable, that they are generally found much farther from the surface than the bones or teeth either of marine or terrestrial animals. Neither are the shells or other remains of fish found in those countries adjoining to the seas, where they grow naturally, but in the most distant regions. Mr. Whitehurst, in his inquiry into the original state and formation of the earth, has given a copious account of many different kinds of animals, whose shells and other remains or exuviae are found in England; though at present the living animals are not to be found except in the East and West Indies.

STRATAGEM, a military wile, or a device in war, for surprising or deceiving an enemy. The ancients dealt very much in stratagems; the moderns wage war more openly, and on the square. Frontinus has made a collection of the ancient stratagems of war.

STRAWBERRY, *fragaria*, in Botany, a genus of the icolan-dria polygynia class. For the culture and management of strawberries,

berries, see the Treatise on GARDENING, article *Fruit Garden*, months, *February, March, April, and October*.

STRAITED *Leaf*, among botanists. See the *System*, Sect. I. Plate I.

STIX, the owl; in ornithology, a genus belonging to the order of accipitres. The bill is hooked, but has no cere or wax; the nostrils are covered with setaceous feathers; the head is very large, as are also the ears and eyes; and the tongue is bifid. There are twelve species; the most remarkable are the following. The otus, or long-eared owl, is found, though not frequently, in the north of England, in Cheshire, and in Wales. Mr. Haffelquist has seen it alive in Cairo, and it is not unfrequent all over Egypt. The weight of the female, according to Mr. Willoughby, is ten ounces; the length 14 inches and a half; the breadth 3 feet 4 inches; the irides are of a bright yellow; the bill black; the breast and belly are of a dull yellow, marked with slender brown strokes pointing downward; the thighs and vent-feathers of the same colour, but unspotted. The back and coverts of the wings are varied with deep brown and yellow; the tail is marked with dusky and reddish bars, but beneath appears ash-coloured; the horns or ears are about an inch long, and consist of six feathers variegated with yellow and black; the feet are feathered down to the claws. See Plate I. letter A.

The short-eared owl, is 14 inches; extent three feet; the head is small and hawk-like; the bill is dusky; weight 14 ounces; the circle of feathers that immediately surrounds the eyes is black; the larger circle white, terminated with tawny and black; the feathers on the head, back, and coverts of the wings, are brown, edged with pale dull yellow; the breast and belly are of the same colour, marked with a few long narrow streaks of brown pointing downwards. The horns of this species are very small, and each consists of only a single feather; these it can raise or depress at pleasure; and in a dead bird they are with difficulty discovered. This kind is scarcer than the former; both are solitary birds, avoiding inhabited places. This is a bird of passage, and has been observed to visit Lincolnshire in the beginning of October, and to retire early in the spring; so probably, as it performs its migrations with the woodcock, its summer-retreat is Norway. Farmers are fond of seeing these birds in the fields, as they clear them from mice. It is found frequently on the hill of Hoy in the Orkneys, where it flies about and preys by day like a hawk. It is found also in Lancashire, which is a hilly and woody country; and in New-England and Newfoundland. See Plate I. letter B.

The flammea, or common white owl. The elegant plumage of this bird makes amends for the uncouthness of its form: a circle of soft white feathers surrounds the eyes. The upper part of the body, the coverts, and secondary feathers of the wings, are of a fine pale yellow: on each side the shafts are two grey and two white spots placed alternate. This species is almost domestic; inhabiting, for the greatest part of the year, barns, hay lofts, and other out-houses; and is as useful in clearing those places from mice as the congenial cat: towards twilight it quits its perch, and takes a regular circuit round the fields, skimming along the ground in quest of field-mice, and then returns to its usual residence; in the breeding season it takes to the caves of churches, holes in lofty houses, or hollow of trees. During the time the young are in the nest, the male and female alternately fall out in quest of food, make their circuit, beat the fields with the regularity of a spaniel, and drop instantly on their prey in the grass. They very seldom stay out above five minutes; return with their prey in their claws; but as it is necessary to shift it into their bill, they always alight for that purpose on the roof, before they attempt to enter their nest. This species does not hoot; but snores and hisses in a violent manner; and while it flies along will often scream most tremendously. Its only food is mice. As the young of these birds keep their nest for a great length of time, and are fed even long after they can fly, many hundreds of mice will scarcely suffice to supply them with food. Owls cast up the bones, fur, or feathers of their prey in form of small pellets, after they have devoured it, in the same manner as hawks do. A gentleman, on grubbing up an old pollard-ash that had been the habitation of owls for many generations, found at the bottom many bushels of this rejected stuff. Some owls will, when they are satisfied, like dogs, hide the remainder of their meat.

The ulula, or tawny owl. This is a hardier species than the former; and the young will feed on any dead thing, whereas those of the white owl must have a constant supply of fresh meat. It is the flix of Aldrovandus, and what we call the screech owl; to which the folly of superstition had given the power of presaging death by its cries. The ancients believed that it sucked the blood of young children.

The ulula, or brown owl. Both these species inhabit woods, where they reside the whole day; in the night they are very clamorous; and when they hoot, their throats are inflated to the size of a hen's egg. In the dusk they approach our dwellings; and will frequently enter pigeon-houses, and make great havoc in them. They destroy numbers of little leverets, as appears by the legs frequently found in their nests. They also kill abundance of moles, and skin them with as much dexterity as a cook does a rabbit. These build in hollow trees or ruined edifices; lay four eggs, of an elliptic form, and of a whitish colour.

STRUTHIO, the Ostrich; the bill is somewhat conical; the nostrils are oval; the wings short, and not fit for flying; and the

feet are of the running kind. Latham, in his arrangement, makes the ostrich the 58th Genus, and the Cassowary the 59th Genus, of the 6th Order, called STRUTHIOUS. But according to Linnæus, it is the 56th Genus, and belonging to the 4th Order, by him called GRALLÆ. But he has divided the Genus Struthio into three species; the Camelus, or common ostrich; the Emu, or American ostrich; and the Cassuarus, or Cassowary. The existence of the Emu is much doubted; but of the two other species we shall give the following description.

The camelus, or common ostrich, is the largest of all birds. Travellers affirm that they are seen as tall as a man on horseback; and even some of those that have been brought into England were above seven feet high. The head and bill somewhat resemble those of a duck; and the neck may be likened to that of a swan, but that it is much longer; the legs and thighs bear a resemblance to that of a camel. But though usually seven feet high from the top of the head to the ground, from the back it is only four; so that the head and neck are about three feet long. From the top of the head to the rump, when the neck is stretched out in a right line, it is six feet long, and the tail is about a foot more. One of the wings, without the feathers, is a foot and an half; and being stretched out, with the feathers, is three feet. The plumage is much alike in all; that is, generally black and white; though some of them are said to be gray. There are no feathers on the sides, nor yet on the thighs, nor under the wings. The lower part of the back, about half way, is covered with still smaller feathers than those on the belly and back; and those also are of different colours. All these feathers are of the same kind, and peculiar to the ostrich; for other birds have several sorts, some of which are soft and downy, and others hard and strong. Ostrich feathers are almost all as soft as down, being utterly unfit to serve the animal for flying, and still less adapted to be a proper defence against external injury. The feathers of other birds have the webs broader on one side than the other, but those of the ostrich have their shaft exactly in the middle. The upper part of the head and neck are covered with a very fine clear white hair, that shines like the bristles of a hog; and in some places there are small tufts of it, consisting of about twelve hairs, which grow from a single shaft about the thickness of a pin. At the end of each wing, there is a kind of spur, almost like the quill of a porcupine. It is an inch long, being hollow and of an horny substance. There are two of these on each wing; the largest of which is at the extremity of the bone of the wing, and the other a foot lower. The neck seems to be more slender in proportion to that of other birds, from its not being furnished with feathers. The internal parts of this animal are formed with no less surprising peculiarity. At the top of the breast, under the skin, the fat is two inches thick; and on the fore-part of the belly it is as hard as suet, and about two inches and an half thick in some places. It has two distinct stomachs. The first, which is lowermost, in its natural situation somewhat resembles the crop in other birds; but it is considerably larger than the other stomach, and is furnished with strong muscular fibres, as well circular as longitudinal. The second stomach, or gizzard, has outwardly the shape of the stomach of a man; and upon opening is always found filled with a variety of discordant substances; hay, grass, barley, beans, bones, and stones, some of which exceed in size a pullet's egg. The kidneys are eight inches long and two broad, and differ from those of other birds in not being divided into lobes. The heart and lungs are separated by a midriff, as in quadrupeds; and the parts of generation also bear a very strong resemblance and analogy to them.

The osteology of this bird is no less surprising than the formation of its internal parts, as may be seen in Plate II. of Comparative Anatomy; which shews how different the bones are formed from those of all other birds, nature having furnished them with extraordinary strength, and disposed them in such a manner as to be happily adapted to the purposes of walking or running, and the mode of life peculiar to the bird. The ostrich is a native only of the torrid regions of Africa, and has long been celebrated by those who have had occasion to mention the animals of that region. Its flesh is proscribed in Scripture as unfit to be eaten; and most of the ancient writers describe it as well known in their times. Like the race of the elephant, it is transmitted down without mixture; and has never been known to breed out of that country which first produced it. It seems formed to live among the sandy and burning deserts of the torrid zone; and, as in some measure it owes its birth to their genial influence, so it seldom migrates into tracts more mild or more fertile. The Arabians assert that the ostrich never drinks; and the place of its habitation seems to confirm the assertion. In these formidable regions ostriches are seen in large flocks, which to the distant spectator have an appearance like a regiment of cavalry, and have often alarmed a whole caravan. There is no desert, how barren soever, but what is capable of supplying these animals with provision; they eat almost every thing; and these barren tracts are thus doubly grateful, as they afford both food and security. The ostrich is of all other animals the most voracious. It will devour leather, grass, hair, iron, stones, or any thing that is given. Those substances which the coats of the stomach cannot soften, pass whole; so that glass, stones, or iron, are excluded in the form in which they were devoured. In an ostrich dissected by

Ranby, there appeared such a quantity of heterogeneous substances, that it was wonderful how any animal could digest such an overcharge of nourishment. Valisnieri also found the first stomach filled with a quantity of incongruous substances; grass, nuts, cords, bones, glass, brass, copper, iron, tin, lead, and wood; a piece of stone was found among the rest that weighed more than a pound. He saw one of these animals that was killed by devouring a quantity of quick-lime. It should seem that the ostrich is obliged to fill up the great capacity of its stomach in order to be at ease; but that nutritious substances not occurring, it pours in whatever offers to supply the void.

In their native deserts, however, it is probable, they live chiefly upon vegetables, where they lead an inoffensive and social life, the male, as Thevenot assures us, affording with the female with conjugal fidelity. They are said to be very much inclined to venery; and the make of the parts in both sexes seems to confirm the report. It is probable also they copulate like other birds, by compression; and they lay very large eggs, some of them being above five inches in diameter, and weighing above 15 pounds. These eggs have a very hard shell, somewhat resembling those of the crocodile, except that those of the latter are less and rounder. The season for laying depends on the climate where the animal is bred. In the northern parts of Africa, this season is about the beginning of July; in the south, it is about the latter end of December. These birds are very prolific, and lay generally from 40 to 50 eggs at one clutch. No bird has a stronger affection for her young than the ostrich, nor watches her eggs with greater assiduity. It happens, indeed, in those hot climates, that there is less necessity for the continual incubation of the female; and she more frequently leaves her eggs, which are in no danger of being chilled by the weather; but though she sometimes forsakes them by day, she always carefully broods over them by night.

The beauty of a part of the plumage, particularly the long feathers that compose the wings and tail, is the chief reason that man has been so active in pursuing this harmless bird to its deserts, and hunting it with no small degree of expence and labour. The ancients used some plumes in their helmets; the ladies of the east make them an ornament in their dresses; and among us, our undertakers and our fine gentlemen still make use of them to decorate their hearse and their hats. Those feathers which are plucked from the animal while alive, are much more valued than those taken when dead, the latter being dry, light, and subject to be worm-eaten. Beside the value of their plumage, some of the savage nations of Africa hunt them also for their flesh; which they consider as a dainty: They sometimes also breed these birds tame, to eat the young ones, of which the female is said to be the greatest delicacy. Some nations have obtained the name of Struthophagi, or ostrich-eaters, from their peculiar fondness for this food; and even the Romans themselves were not averse to it. As the spoils of the ostrich are thus valuable, it is not to be wondered at that man has become their most assiduous pursuer. For this purpose, the Arabians train up their best and fleetest horses, and hunt the ostrich still in view. Perhaps, of all other varieties of the chase, this, though the most laborious, is yet the most entertaining. As soon as the hunter comes within sight of his prey, he puts on his horse with a gentle gallop, so as to keep the ostrich still in sight, yet not so as to terrify him from the plain into the mountains. Of all known animals, the ostrich is by far the swiftest in running; upon observing himself, therefore, pursued at a distance, he begins to run at first but gently; either insensible of his danger, or sure of escaping. In this situation, he somewhat resembles a man at full speed; his wings, like two arms, keep working with a motion correspondent to that of his legs; and his speed would very soon snatch him from the view of his pursuers; but, unfortunately for the silly creature, instead of going off in a direct line, he takes his course in circles; while the hunters still make a small course within, relieve each other, meet him at unexpected turns, and keep him thus still employed, still following. At last, spent with fatigue, and finding all power of escape impossible, he endeavours to hide himself from those enemies he cannot avoid, and covers his head in the sand, or the first thicket he meets. Sometimes, however, he attempts to face his pursuers; and though in general the most gentle animal in nature, when driven to desperation, he defends himself with his beak, his wings, and his feet. Such is the force of his motion, that a man would be utterly unable to withstand him in the shock.

When the Arabians have thus taken an ostrich, they cut its throat; and making a ligament below the opening, they shake the bird as one would rattle a barrel: then taking off the ligature, there runs out from the wound in the throat a considerable quantity of blood mixed with the fat of the animal; and this is considered as one of their greatest dainties. They next flay the bird; and of the skin, which is strong and thick, sometimes make a kind of vest, which answers the purposes of a cuirass and a buckler. There are others who, more compassionate or more provident, do not kill their captive, but endeavour to tame it, for the purposes of supplying those feathers which are in so great request. The inhabitants of Dara and Lybia breed up whole flocks of them, and they are tamed with very little trouble. But it is not for their feathers alone that they are prized in this domestic state: they are often ridden upon and used as horses. Moore assures us, that at Joanbe saw a man travel-

ling upon an ostrich; and Adanson asserts, that at the factory of Podore he had two ostriches, which were then young, the strongest of which ran swifter than the best English racer, although he carried two negroes on his back. As soon as the animal perceived that it was thus loaded, it set off running with all its force, and made several circuits round the village; till at length the people were obliged to stop it by barring up the way. How far this strength and swiftness may be useful to mankind, even in a polished state, is a matter that perhaps deserves inquiry. For representation of this bird, see Plate IV. Genus 58.

The *Cassowary* is a bird which was first brought into Europe by the Dutch from Java in the East Indies. Next to the preceding, it is the largest and the heaviest of the feathered species. The cassowary, though not so large as the former, yet appears nearly as bulky to the eye; its body being nearly equal, and its neck and legs much thicker and stronger in proportion to its size; this conformation gives it an air of strength and force, which the fierceness and singularity of its countenance conspire to render formidable. It is five feet and a half long from the point of the bill to the extremity of the claws. The legs are two feet and a half high from the belly to the end of the claws. The head and neck together are a foot and an half; and the largest toe, including the claw, is five inches long. The claw alone of the least toe is three inches and a half in length. The wing is so small that it does not appear, it being hid under the feathers of the back. In other birds, a part of the feathers serve for flight, and are different from those that serve for merely covering; but in the cassowary all the feathers are of the same kind, and outwardly of the same colour. They are generally double, having two long shafts, which grow out of a short one which is fixed in the skin.

The part, however, which most distinguishes this animal is the head; which, though small, like that of an ostrich, does not fail to inspire some degree of terror. It is bare of feathers, and is in a manner armed with an helmet of horny substance, that covers it from the root of the bill to near half the head backwards. This helmet is black before and yellow behind. Its substance is very hard, being formed by the elevation of the bone of the skull; and it consists of several plates, one over another, like the horn of an ox. To the peculiar oddity of this natural armour, may be added the colour of the eye in this animal, which is a bright yellow; and the globe being above an inch and a half in diameter, gives it an air equally fierce and extraordinary. About the middle of the neck before, at the rise of the large feathers, there are two processes formed by the skin, which resemble somewhat the gills of a cock, but that they are blue as well as red.

The internal parts are equally remarkable. The Cassowary unites with the double stomach of animals that live upon vegetables, the short intestines of those that live upon flesh. The intestines of the cassowary are 13 times shorter than those of the ostrich. The heart is very small, being but an inch and an half long, and an inch broad at the base. Upon the whole, it has the head of a warrior, the eye of a lion, the defence of a porcupine, and the swiftness of a courser. Thus formed for a life of hostility, for terrifying others, and for its own defence, it might be expected that the cassowary was one of the most fierce and terrible animals of the creation. But nothing is so opposite to its natural character: it never attacks others; and instead of the bill, when attacked, it rather makes use of its legs, and kicks like a horse, or runs against its pursuer, beats him down, and treads him to the ground. The manner of going of this animal is not less extraordinary than its appearance. Instead of going directly forward, it seems to kick up behind with one leg; and then making a bound onward with the other, it goes with such prodigious velocity, that the swiftest racer would be left far behind. The same degree of voraciousness which we perceived in the ostrich, obtains as strongly here. The cassowary swallows every thing that comes within the capacity of its gullet. It is said, that the passage of the food through its gullet is performed so speedily, that even the very eggs which it has swallowed whole pass through it unbroken in the same form they went down. In fact, the alimentary canal of this animal, as was observed above, is extremely short; and it may happen, that many kinds of food are indigestible in its stomach, as wheat or currants are to man, when swallowed whole. The cassowary's eggs are of a grey-ash colour, inclining to green. They are not so large nor so round as those of the ostrich. They are marked with a number of little tubercles of a deep green, and the shell is not very thick. The largest of these is found to be 15 inches round one way, and about twelve the other. The southern parts of the most eastern Indies seem to be the natural climate of the cassowary. His domain, if we may so call it, begins where that of the ostrich terminates. The latter has never been found beyond the Ganges; while the cassowary is never seen nearer than the islands of Banda, Sumatra, Java, the Mollucca islands, and the corresponding parts of the continent. From late accounts it appears that the cassowary is also found in New Holland, yet this animal seems not to have multiplied in any considerable degree, as we find one of the kings of Java making a present of one of these birds to the captain of a Dutch ship, considering it as a very great rarity. For representation, see Plate IV. Genus 29.

STUC, or STUCCO, in Building, a composition of white marble,

pulverized, and mixed with a plaister of lime; the whole sifted and wrought up with water; to be used like common plaister. Of this are made statues, busts, basso relievos, and other ornaments of architecture.

STUPIDITY. The Greek word *μωρία* corresponds most with our English word *stupidity* or *foolishness*, (in the common acceptance of it), which is, when reason is rendered somewhat defective. The immediate causes are, a deficiency of vital heat, or a defect in the brain. Stupid children sometimes become sprightly youths; but if stupidity continues to the age of puberty, it is hardly ever removed. If stupidity follows upon a violent passion, an injury done to the head, or other evident cause, if it continues long, it becomes incurable. But the stupidity which consists in a loss of memory, and succeeds a lethargy, spontaneously ceases when the lethargy is cured.

STURNUS, the **STARLING**, a genus belonging to the order of passerines. The beak is subulated, depressed, and somewhat blunt; the superior mandible is entire, and somewhat open at the edges; the nostrils are margined above; and the tongue is sharp and emarginated. There are five species, the principal of which is the vulgaris or star. It lays four or five eggs, of a pale-greenish ash-colour; and makes its nest of straw, small fibres of roots, and the like. In winter, starlings assemble in vast flocks: they collect in myriads in the fens of Lincolnshire, and do great damage to the fen-men, by roosting on the reeds, and breaking them down by their weight; for reeds are the thatch of the country, and are harvested with great care. These birds feed on worms and insects; and it is said that they will get into pigeon-houses, for the sake of sucking the eggs. Their flesh is so bitter as to be scarce eatable. They are very docile, and may be taught to speak. For representation, see the Plate II, Genus 30.

STYLE, in Botany, the part rising up in the middle of a flower, and bearing, by its lower part, on the rudiment of the fruit, and serving to elevate the stigma from the germen. This we more usually call the pistil. See the System, Sect. II.

STYLE, in Chronology, denotes a particular manner of accounting time, with regard to the retrenchment of ten days from the calendar, in the reformation made thereof under pope Gregory XIII.

Old STYLE, is the Julian manner of computing, which obtains in some protestant states, who refused to admit of the reformation.

New STYLE, is the Gregorian manner, followed by the catholics, and others, in consequence of that reformation. The Julian, or old style, agrees with the Julian year, which contains three hundred and sixty-five days six hours. The Gregorian, or new style, agrees with the true solar year, which contains only three hundred and sixty-five days, five hours, forty-nine minutes.

STYLE, in Dialling, denotes the gnomon or cock of a dial, raised on the plane thereof, to project a shadow: see the Treatise, Part II. sect. III.

STYLE, in Grammar, is a particular manner of delivering a man's thoughts in writing, agreeably to the rules of syntax: see the System, Part II. Chap. IV.

This definition fixes the notion of style to something determinate, which before was very vague and arbitrary; whence many authors, even of note, confounded it with syntax itself. From the definition it appears, that the style supposes or includes the syntax; and that syntax does not extend so far as style; for the syntax may be very just, where the style is wretched. A very common error in grammarians, is to confound two kinds of styles in one; the grammatical style, or that directed by the rules of grammar; and the personal style, which depends less on the grammar than on the person that writes; whether with regard to his particular taste and genius, or with regard to his matter, or the kind or character of his work. There are a great many differences between the two: the most essential is, that the one may be diversified an infinite number of ways, and the other cannot. In effect, the personal style is naturally variable, according to the different geniuses, humours, and complexions. It is the imagination that acts, that conceives, that proposes, and that expresses things, according to its character, which is different in all men; and which is to be varied, according to the particular kind of the work. Hence arise the gay, the grave, the florid, the jejune, the copious, the concise, the poetical, the epistolary, and the burlesque style. These personal styles are all independent on the grammatical; and we have authors who excel in the one case, yet are miserably defective in the other. The personal style is not under the direction of Grammar, but of the imagination, or rather of rhetoric, that art having to do directly with our thoughts, as Grammar with our words.

STYLE, in Oratory and Poetry, is restrained wholly to what F. Buffier calls the personal style. Language refers principally to the matter of the discourse, viz. the words; elocution to the particular members or parts thereof; and style to the whole composition. The masters of the art of rhetoric reduce the kinds of style to three, viz. the low or plain, the middle, temperate, or equable, and the lofty or sublime style. These several characters are distinguished from one another, both by the thoughts and by the language. See the Treatise on ORATORY, Part III. Sect. II. throughout.

The restoration of king Charles II. seems to be the era of the formation of our present style in Great Britain. Lord Clarendon

began, Sir William Temple polished the language still more, and the author, who formed it more than any one into its present state, is Dryden. Since his time considerable attention has been paid to purity and elegance of style; but it is elegance, rather than strength, that forms the distinguishing quality of most of the good English writers.

STYLOGLOSSI, in Anatomy, a pair of muscles, running off sharp and fleshy from the processus styloides, whence descending obliquely forwards, they are inserted into the root of the tongue, and form two portions of its lateral parts. For their origin, insertion, and use, see the System, Part II. Table of Muscles, Art. 10.

STYLOHYOIDÆUS, in Anatomy, a small fleshy muscle, lying obliquely between the apophysis styloides and os hyoides. See Art. 9.

STYLOPHARYNGÆI, in Anatomy, a pair of muscles arising round and fleshy from the apophysis, or epiphysis styloides, and which in their oblique descent along the lateral part of the pharynx, cover and cross the other muscles. See Art. 10.

STYPTIC, in Medicine, *astringent*, a remedy that has the virtue of stopping blood, or of binding up the aperture of a wounded vessel. The service, nettle, Solomon's seal, &c. are styptics. There are various styptic waters, and powders of great efficacy, in most of which vitriol is the principal ingredient. The usual styptic water is made of colcothar calcined, or vitriol dissolved with burnt alum, sugar-candy, &c.

SUBALTERN, formed from *sub*, under, and *alter*, another; an inferior officer, or one who discharges his post under the command, and subject to the direction of another. Such are lieutenants, sub-lieutenants, cornets, and ensigns, who serve under the captain. See the Treatise on MILITARY AFFAIRS, Sect. IV.

SUBCLAVIAN, **SUBCLAVIUS**, is applied to any thing under the arm-pit, or shoulder, whether artery, nerve, vein, or muscle. See those respective articles in the System of ANATOMY.

SUB-DOMINANTE, in Music, is a name given by M. Rameau to the fourth note of the tone, because the dominant is immediately above it, or rather because it has the same interval of the tonic in descending, as the dominant has in ascending. See the System, Sect. XIII.

SUBJECT, a person under the rule and dominion of a sovereign prince or state. Of subjects, some are so by birth, others become so by acts of naturalization.

SUBJECT is also used for the matter of an art or science, or that which it considers, or whereon it is employed. Thus the human body is a subject of medicine. In this sense, anatomists call the body they are dissecting, and whereon they read lectures, their subject. The subject of logic is thinking, or reasoning; but more particularly in a syllogism, one of the terms of a proposition is called the subject, and the other the attribute. In poetry, the subject is the matter treated of, or the event related, or set to view, and enriched with ornaments.

SUBJUNCTIVE, in Grammar, the fourth mood, or manner of conjugating verbs; thus called, because usually subjoined to some other verb, or at least to some other particle, as, *if I loved: though this were true*, &c. See the System, Part I. Chap. II. Sect. I.

SUBLIMATE, a Chymical preparation, the basis whereof is mercury or quicksilver. In making corrosive sublimate, the quicksilver is extinguished by trituration in calcined vitriol.

SUBLIMATION, in Chymistry, an operation by which volatile and solid substances are collected and obtained, and differs little from distillation, excepting that in distillation only the fluid parts of bodies are raised; but, in sublimation, the solid and dry: and that the matter to be distilled may be either solid or fluid; but sublimation is concerned only about solid substances, and restored to them in its operations.

SUBLIME, in Discourse, something extraordinary and surprising, which strikes the soul, and makes a sentiment or composition ravish and transport. By the definition, it may appear, that the sublime is a very different thing from what the orators call the sublime style. See GRANDEUR.

SUBLINGUAL Glands, in Anatomy, two glands under the tongue, placed one on each side thereof. They are of the same kind with the maxillary glands, one smaller, somewhat oblong, and flattened like a blanched almond.

SUBSCAPULARIS, in Anatomy, a muscle arising from the basis and side of the scapula; and spreading itself under the whole convex or under side of it, being of the same breadth and length with it. For its origin, insertion, and use, see the System, Part II. Table of Muscles, Art. 20.

SUBSCRIPTION, in the English commerce, is used for the share or interest which particular persons take in a public stock, or a trading company, by writing their names and the shares they require, in the books or registers thereof.

SUBSCRIPTION, in the commerce of books, signifies an engagement to take a certain number of copies of a book going to be printed; and a reciprocal obligation of the bookseller or publisher, to deliver the said copies on certain terms. The usual conditions of these subscriptions are, on the part of the bookseller, to afford the books cheaper to a subscriber than to another, by one third or one fourth of the price; and on the part of the latter, to advance half the money in hand, and to pay the rest on the delivery of the

the copies; an agreement equally advantageous to the one and the other, as the bookseller is hereby furnished with money to carry on works which would otherwise be above his stock; and the subscriber receives, as it were, interest for his money, by the moderate price the book stands him in: *Subscriptions* had their rise in England, and it is but very lately that they are got into other countries. They were first set on foot in the middle of the last century, for the printing of Walton's Polyglot Bibles, which is the first book ever printed by way of subscription. From England they passed a few years ago into Holland, and they have been since introduced into France. In England they are become exceedingly frequent; and their frequency has rendered them liable to some abuses, which begin to discredit them.

SUBSIDY, *subsidium*, in Law, any aid, tax, or tribute, granted, by authority of parliament to the king, on pressing occasions of the state, levied on the subjects, according to their several abilities, or the yearly produce of their lands, goods, &c.

SUBSTANTIVE, in Grammar, is a quality ascribed to a noun or name, when the object it denotes is considered simply, and in itself, without reference to any other subject or idea. When the object is considered, as clothed with certain qualities, the noun is said to be adjective. For a more palpable criterion, all nouns, to which one cannot add the word *thing*, are substantives; and all those to which *thing* may be added are adjectives. Substantives, according to Mr. Harris, are all those principal words which are significant of substances, considered as substances. See the SYSTEM, Part I. Chap. I.

SUBTRACTION, or **SUBTRACTION**, in Arithmetic, the second rule, or rather operation; in arithmetic, whereby we deduct a less number from a greater, to learn the precise difference: or, more justly, *subtraction* is the finding a certain number from two homogeneous ones given, which, with one of the given numbers, is equal to the other. See the SYSTEM, Chap. II. Sect. II. Chap. III. Sect. II. Chap. IV. Sect. II.

SUBTRACTION, in Algebra, is performed by connecting the quantities with all the signs of the subtrahend changed; and at the same time uniting such as may be united: see the SYSTEM, Art. II.

SUTERRANEAN, or **SUTERRANEAN**, something underground. Naturalists talk much of *subterranean* fires, as the cause of volcanos; and *subterranean* winds, as the cause of earthquakes. Among the many places where *subterranean* fires are found, England is not wholly without them; though with us they appear only in the coal countries, and plainly feed on nothing but the upper stratum of the coal, called by the miners *day-coal*, unless where they have by accidents been kindled by actual fires at great depths, or fired downward, by being pent in for room. See VOLCANO. We have an account, in the Philosophical Transactions, of a *subterranean* town found at Portici, near Naples, in which many antique statues, paintings, and other curiosities have been found. This *subterranean* town is probably the ancient city of Herculaneum, which was swallowed up by an earthquake. See Phil. Trans. No 458. sect. 4, 5, and 6. It is remarkable, that some of the antique paintings found there are fresh and perfect, as if lately painted. Ibid. sect. 6.

SUBTILE, in Physics, intimates a thing exceedingly small, fine, and delicate; such as the animal spirits, the effluvia of odorous bodies, &c. are supposed to be. One kind of matter is only more *subtile* than another, in that, being divided into smaller parts, and those too more agitated; on the one hand, it makes less resistance to other bodies; and, on the other, insinuates itself more easily into their pores.

SUBTILIZATION, *subtilizatio*, the act of subtilizing, or rendering any thing smaller and subtler; particularly, the dissolving or changing a mixt body into a pure liquor, or a fine powder, by separating the grosser parts therefrom.

SUCCESSION to the Crown. See HEREDITARY Right.—From the days of Egbert, the first sole monarch of England, even to the present, the four cardinal maxims mentioned in that article have ever been held constitutional canons of succession. The title to the crown is at present hereditary, though not quite so absolutely hereditary as formerly: and the common stock, or ancestor, from whom the descent must be derived, is also different. Formerly, the common stock was king Egbert; then William the conqueror; afterwards, in James I.'s time, the two common stocks united; and so continued till the vacancy of the throne in 1688; now it is the princess Sophia, in whom the inheritance was vested by the new king and parliament. Formerly, the descent was absolute, and the crown went to the next heir without any restriction: but now, upon the new settlement, the inheritance is conditional; being limited to such heirs only, of the body of the princess Sophia, as are Protestant members of the church of England, and are married to none but Protestants. And in this due medium consists the true constitutional notion of the right of succession to the imperial crown of these kingdoms. The extremes between which it steers are each of them equally destructive of those ends for which societies were formed and are kept on foot. Where the magistrate, upon every succession, is elected by the people, and may by the express provision of the laws be deposed (if not punished) by his subjects, this may sound like the perfection of liberty, and look well enough when delineated on paper; but in

practice will be ever productive of tumult, contention, and anarchy. And, on the other hand, divine indefeasible hereditary right, when coupled with the doctrine of unlimited passive obedience, is surely of all constitutions the most thoroughly slavish and dreadful. But when such an hereditary right as our laws have created and vested in the royal stock, is closely interwoven with those liberties which are equally the inheritance of the subject; this union will form a constitution, in theory the most beautiful of any, in practice the most approved, and, we trust, in duration the most permanent.

SUCKERS, *off-fets* in Agriculture and Gardening, young shoots proceeding from the root of a tree; being of the same kind with the tree from which they spring; because such as grow from trees raised by grafting or inoculation, follow the nature of the stock. See Treatise on GARDENING, article *Fruit Garden*, month February.

SUCTION, **SUCTIO**, the act of sucking, or of drawing up a fluid, as air; water, or the like, by the mouth and lungs, or in a singular manner by artificial means: see the SYSTEMS of HYDROSTATICS and PNEUMATICS.

SUDORIFIC, in Medicine; a remedy that causes, or promotes sweat. Sudorifics only differ from diaphoretics in the degree of their action; the one promoting sensible perspiration, the other insensible. To the class of sudorifics belong 1^o, all things that moving violently through the body; attenuate the humours, and accelerate their motion. 2^o, such things; as at the same time diminish the resistance in the sudatory vessels about the cutis. To which some add a third kind; such as absorb the acidities of the blood, and thus set at liberty the matter of the sweat. Sudorifics, if taken in time, are the best medicines for preventing inflammatory and feverish disorders of all kinds. Sir John Pringle condemns the use of treacle, given with this intention, on account of its heating quality. However, he observes, that it is rendered more sudorific and less narcotic, by adding ten grains of salt of hartshorn to a common dose, and promoting the sweat by a large draught of vinegar-whey. Instead of this composition, two scruples of salt of hartshorn, saturated with about three spoonfuls of common vinegar, may be given at bed time. Pringle's Obs. on the Diseases of the Army. p. 131. A safe, easy, and effectual sudorific, may be prepared in the following manner. Take an ounce of refined camphor, beat it in a marble mortar with two ounces of blanched almonds, till it be reduced to a smooth and even paste. This may be formed into pills, boluses, and given according to the strength of the patient, and other considerations, from three grains to forty.

SUFFOCATION, in Medicine, a privation or obstruction of respiration or breathing. *Suffocation* sometimes arises from a too great abundance of blood thrown on the lungs, or the muscles of the larynx, and preventing the ingress of the air; as is the case in quinzies, suffocating catarrhs, peripneumonies, &c. The fumes of wines, or strong beers, when boiling, cause *suffocation*, by interrupting the circulation of the blood. And the same may be observed of the fumes of lime, wherewith walls are whitened; and those of charcoal, antimony, sulphur, vitriol, and spirit of nitre. The *suffocation* under water is owing partly to the passage of air being stopped up, and partly to the irruption of the water into the breast. See DROWNING, HANGING, &c.

SUFFUSION, in medicine, an overflowing of some humour, shewing itself in the skin; particularly that of the blood or bile. That redness ordinarily arising from shame, is only a *suffusion* of blood appearing in the cheeks. The *jaundice* is a *suffusion* of bile over the whole body.

SUGAR, **SACCHARUM**, a very sweet, agreeable, saline juice, expressed from a kind of canes, or reeds, growing in great plenty, in the East and West Indies. See SUGAR-cane. It is a question not yet decided among botanists, &c. whether the ancients were acquainted with this cane, and whether they knew how to express the juice from the same? What we can gather from the arguments advanced on either side is, that if they knew the cane, and juice, they did not know the art of condensing, hardening, and whitening it; and of consequence they knew nothing of our *sugar*. Dr. William Douglas, in his Summary, &c. of the first planting of our American settlements, printed at Boston in 1751, and reprinted at London in 1755, affirms, that *sugar* was not known among the ancient Greeks and Romans, who used only honey for sweetening. Paulus Aegineta, he says, a noted compiler of medical history, and one of the last Greek writers on that subject, about anno 1625, is the first who expressly mentions *sugar*: it was at first called *mel arundinaceum*, i. e. *reed* or *cane honey*. He adds, that it came originally from China, by way of the East Indies and Arabia into Europe, and was formerly used only in syrups, conserves, and such Arabian medicinal compositions. Another question among the naturalists is, whether the *sugar-canes* be originally of the West-Indies; or whether they have been translated rather from the East. The learned of these last ages have been much divided on the point; but F. Labat, a Dominican missionary, in a Dissertation published in 1722, asserts that the *sugar-cane* is as natural to America as India; and the Spaniards and Portuguese first learned from the Orientals the art of expressing its juice, boiling it, and reducing it into *sugar*. The boiling and baking of *sugars*, says Dr. Heylin in his Cosmography, the first edition of which was printed in 1624,

SUG

as it is now used, is not above two hundred years old; and the refining of it more new than that, first found out by a Venetian in the days of our forefathers, who got one hundred thousand crowns by the invention. Before which art of boiling and refining it, our ancestors made use of it rough as it came from the canes, but they most commonly used honey instead of it. The first account we have of sugar-refiners in England is in the year 1659. Anderson's Hist. of Com. vol. i. p. 82. 246, 331, 334. vol. ii. p. 72—105.

Preparation of SUGAR. The juice coming out of the canes, when pressed and broken between the rollers, runs through a little canal in the sugar-house, which is near the mill; where it falls into a vessel, whence it is conveyed into the first copper or caldron, to receive its first preparation, only heated by a flow fire to make it simmer. With the liquor is here mixed a quantity of ashes and quick-lime, called temper; the effect of which mixture, assisted by the action of the fire, is, that the unctuous parts are separated from the rest, and raised to the top, in form of a thick scum, which is kept constantly scumming off, and serves to feed the poultry, &c. The juice, in the next place, is purified, in a second copper; where a brisker fire makes it boil; and all the time the casting up of its scum is promoted by the means of a strong ley, composed of lime-water, and other ingredients. This done, it is purified and scummed, in a third boiler, wherein is cast a kind of ley, that assists in purging it, collects together its impurities, and makes them rise to the surface, whence they are taken with a skimmer. From the third it is removed to a fourth boiler, where the juice is farther purified by a more violent fire; and hence to a fifth, where it is brought to the consistence of a syrup. In a sixth boiler, the syrup receives its full coction; and here all the impurities left from the former leys are taken away by a new ley, and a water of lime and alum cast into it. In this last copper there is scarce found one-third of what was in the first; the rest being wasted into scum. By thus passing, successively, a number of coppers, the sugar juice is purified, thickened, and rendered fit to be converted into any of the kinds of sugar. The size of the several coppers always diminishes from the first to the last; each being furnished with a furnace, to give an heat proportionable to the degree of coction the juice has received. In some large sugar-works there are also particular coppers for the boiling and preparing of scums.

Crude, or Muscovado SUGAR, is that first drawn from the juice of the cane; and whereof all the rest are composed. The method of making it is that already described as for sugar in the general. We need only add, that when taken out of the sixth copper, it is put into a cooler, where, stirring it briskly together, it is let stand to settle, till a crust of the thickness of a crown piece be formed thereon. The crust being formed, they stir it up again, then put it into vessels, where it stands to settle till it be fit to barrel.

Refining of SUGAR, is the art of purifying sugar, and of giving it a superior degree of whiteness and solidity. The excellence of Muscovado sugars, or such as have not been refined by the planter, but are sent home in the most crude state, consists in their whiteness, dryness or freeness, cleanness and sharpness, or strength. The judicious refiner decides upon these several qualities by the eye, the touch, and the taste. Sugar is refined from the coarse state in which it generally comes from abroad, to various degrees of purity by new solutions, and is sold at different prices, and under different names, according to the purity it is brought to. Our sugar-refiners first dissolve it in water, then clarify the solution by boiling with whites of eggs and despumation; and after due evaporation pour it into moulds; where the fluid part being drained off, and the sugar concreted, its surface is covered with moist clay as before. The sugar thus once refined, by repetition of the process, becomes the double-refined sugar of the shops.

SUGAR-candy, saccharum candidum, or crystallinum, is sugar depurated and crystallized. The sugar to be used herein is first dissolved in a weak lime-water, then clarified, scummed, strained through a cloth, and boiled, and put in forms or moulds, that are traversed with little rods, to retain the sugar as it crystallizes. These forms are suspended in an hot stove, with a pot underneath, to receive the syrup that drops out at the hole in the bottom, which is half-stopped, that the filtration may be the gentler. When the forms are full, the stove is shut up, and the fire made very vehement. Upon this the sugar fastens to the sticks that cross the forms, and there hangs in little splinters of crystal. When the sugar is quite dry, the forms are broken and the sugar is taken out candied. Red sugar-candy they make, by casting into the vessel, where the sugar is boiling, a little juice of the Indian fig; and, if it is desired to have it perfumed, they cast a drop of some essence in, when the sugar is putting into the forms.

Barley SUGAR, saccharum hordeatum, is a sugar boiled till it be brittle, and then cast on a stone anointed with oil of sweet almonds, and formed into twisted sticks, about the length of the hand, and the thickness of a finger. It should be boiled up with a decoction of barley, whence it takes its name; but in lieu thereof, they now generally use common water, to make the sugar the finer. To give it the brighter amber colour, they sometimes cast saffron into it. It is found very good for the cure of colds and rheums.

SUGAR, in Chymistry and Medicine, denotes a chrysalizable essential salt, of a sweet agreeable taste, contained more or less plentifully in many kinds of vegetables, as well as in the sugar-cane, which

SUL

furnishes the greatest quantity of it. Mr. Margraaf has obtained sugar from the roots of several plants, as from carrots, parsnips, white and red beets. Considering that sugar is soluble in spirit of wine, and that the mucilaginous parts of plants are not soluble in that fluid, he easily obtained a pure sugar by digesting the dried roots in that spirit, and by evaporating the liquor. It is also presumed, that much sugar may be obtained from other vegetables, as from green peas, cabbage, green farinaceous grains, and from several trees, as the sycamore and birch trees. Green Maze contains a liquor from which the American savages are said to extract sugar. It may also be extracted from the *asclepias caule erecto simpliciter annuo*, and from any flowers collected while the morning is upon them. But the vegetable which yields the largest quantity of sugar, next to the sugar cane, is the sugar-maple. The methods employed for extracting sugar from this tree in Canada are related by M. Gautier, in the Mem. des Scav. Estrang. tom. ii. and by Mr. Kalm in the Swedish Mem. for 1757. By discovering a menstruum, that would dissolve the sugar and not the slimy substance, the saccharine and mucilaginous parts of plants might be separated from one another with advantage.

Sugar preserves both animal and vegetable substances from putrefaction; and Dr. Lewis says, that it possesses this power in a higher degree than the common alimentary salt. On account of this property, it has been sometimes applied externally as a balsamic and antiseptic. The impure brown sugars, by virtue of their oily or treacly matter, prove emollient and gently laxative. The crystals or candy are most difficult of solution, and hence are most proper where this soft lubricating sweet is wanted to dissolve slowly in the mouth, as in tickling coughs and hoarseness. Dict. Chem. Art. Sugar. Lewis's Mat. Med. Coarse sugar, in which there is more oil than in refined sugar, is recommended as a good medicine in collyria for discharging ulcers of the cornea, in which allringents are hurtful.

SUGAR-spirit, a name given by our distillers to a spirit made in England, Holland, and other places, from the washings, scummings, dross and waste of a sugar-baker's refining house. The manner of preparing it is the same with that used for the malt and melasses-spirits. The refuse of the sugar is fermented with water in the usual manner, then distilled into what is called low wines, and afterwards rectified, without any addition, into proof spirit.

When the operation is well performed, and no foul, fetid, or foreign matter has got in among the wash, that is a tolerably clean spirit. We usually make it such, but in Holland it is usually made very nauseous and disagreeable: though capable, by an easy rectification, familiar with us, though not much known abroad, of being brought to a fine and clean spirit. With us this sugar spirit is used to mix with, and adulterate brandy, rum, and arrack, which will receive a large dose of it without its being at all discoverable; but the Dutch, who have it very coarse, can only adulterate rum with it, and even that will bear but a small proportion, without being betrayed by its nauseousness. The sugar spirit, reduced to alcohol, makes one of the purest spirits we are acquainted with, much superior to that of melasses, and much more to that of malt. Shaw's Essay on Distillery.

SUICIDE, or SELF-MURDER, the pretended heroism, but real cowardice of the Stoic philosophers, who destroyed themselves to avoid those ills which they had not the fortitude to endure, though the attempting it seems to be countenanced by the civil law, yet was punished by the Athenian law with cutting off the hand which committed the desperate deed. And also the law of England wisely and religiously considers, that no man hath a power to destroy life but by commission from God the author of it: and as the suicide is guilty of a double offence; one spiritual, in invading the prerogative of the Almighty, and rushing into his immediate presence uncalled for; the other temporal, against the king, who hath an interest in the preservation of all his subjects; the law has therefore ranked this among the highest crimes, making it a peculiar species of felony, a felony committed on one's self. And this admits of accessories before the fact, as well as other felonies; for if one persuades another to kill himself, and he does so, the adviser is guilty of murder. A *felo de se*, therefore, is he that deliberately puts an end to his own existence, or commits any unlawful malicious act, the consequence of which is his own death: as if, attempting to kill another, he runs upon his antagonist's sword; or, shooting at another, the gun bursts and kills himself. The party must be of years of discretion, and in his senses, else it is no crime. A *felo de se* is to be interred without Christian burial, with a stake driven through his corpse, and is to forfeit his goods and chattles, real and personal; but he may make a devise of his lands, because they are not subject to forfeiture. However, these forfeitures are generally saved by the verdict of the coroner's jury, who find *lunacy*.

SUIT, in Law, is used in divers senses. As **SUIT in Law**, which is of two kinds, *real* and *personal*; the same with what we call *real* and *personal actions*; from which also proceed *mixed actions*. **SUIT in Equity or Chancery**; for the proceedings in this court, see **CHANCERY**.

SULPHUR, in a general sense, is a term that has been used by the ancient chymists to denote all inflammable substances, of whatever nature they might be. Sulphur, according to them, is one of the

the principles of bodies, and they call the inflammable principle itself the principal sulphur. Accordingly, they speak continually of the sulphurs of metals, of the sulphurs of plants; and of the sulphurs of animals: and oils, ardent spirit, resins and bitumens were, in this extensive application of the term; all sulphurs. But by the more accurate distinction, suggested by Beecher, and more fully illustrated and established by Stahl and modern chymists, between the pure and simple inflammable principle, called *phlogiston*, and the more compounded bodies which contain it, and owe their inflammability to it, we acquire a knowledge of the true theory of sulphur and all inflammable substances. Hence we learn, that the inflammable principle is always alike; and the same in every body, and that this principle, by its combination with different substances, produces all the inflammable matters with which we are acquainted. Oils, fats, resins, bitumens, ardent spirits, coals, metals, sulphur, properly so called, or common sulphur, are so many compounds, all which have the common property of burning, because they all contain the principle of inflammability; but which differ in other respects, because this principle is united to different substances, and in different proportions. See the *System of CHYMISTRY*, under the article *INFLAMMABLE SUBSTANCES*.

The uses of sulphur are very extensive in chymistry, in medicine, and in the arts. The *Liver of Sulphur* is employed in Chymistry for several solutions: Sulphur is also used for several fusions, precipitations, and separations of metals, and minerals. And as sulphur contains a very large quantity of vitriolic acid, a method is now practised for extracting from it this acid, by burning sulphur in close vessels with the addition of nitre. Sulphur is employed in medicine, both internally and externally: the internal preparations are flowers of sulphur, washed sulphur, magistery of sulphur, tablets, balsams, &c. in some of which this substance is not altered, but only purified and divided, and in others, it is combined with other substances. The native sulphurs should never be used internally, without purification, because they almost always participate of arsenic, which is discoverable in some by their having naturally more or less of a red colour, and in others by their exhibiting this colour, after a part of the pure sulphur has been separated by sublimation. Pure sulphur, taken in doses of ten grains to a dram or more, gently loosens the belly, and promotes perspiration. Some physicians and chymists, indeed, considering that sulphur is unsoluble in water, and capable of resisting the action of most menstrua, have advanced, that it can produce no effect when taken internally, single and unaltered; but this notion seems to be groundless; and sulphur, which is attached by all oily and saponaceous substances, and consequently by almost all animal liquors, is much more soluble than is generally believed. It seems to pass through the whole habit, and manifestly transpires through the skin, as appears from the sulphureous smell of persons who have taken it, and from silver being stained in their pockets to a blackish hue, as by the vapour of sulphureous solutions.

Sulphur is principally recommended against the piles, in disorders of the breast, and in cutaneous eruptions; in the itch it is a certain remedy, whether internally or externally used, in which case its efficacy probably depends, not so much on its purifying the blood, as on its fumes being destructive to the cuticular animalcules to which the present theory ascribes that distemper. It remarkably corrects or restrains the power of certain mineral substances of the more active kind: by the admixture of sulphur mercury becomes inert, the virulent antimonial regulus mild, and arsenic itself almost innocent. Several mineral waters, which are drunk or used as baths for some diseases of the breast or of the skin, owe their good qualities to the sulphur contained in them. And sulphur combined with other substances may contribute to their medicinal powers. Sulphur is also used in several arts. By means of its fine impressions of engraved stones are taken.

The utility of this substance as an ingredient in the preparation of gunpowder and fire-works is well known; and it is also used for whitening wool, silk, and many other matters exposed to its vapour during its combustion, the colours and redness of which could not be destroyed by any other substance, but are quickly effaced by this acid vapour. In this case it must be burnt, as Stahl has observed, very slowly. The vapours of sulphur also whiten red roses. They have the same effect on gold, which is to be restored to its colour by boiling it in water with tartar: see on the subject of this article, *Dict. Chym. art. Sulphur*. *Watson's Chym. Ess. vol. i. p. 167.* &c. *Lewis's Mat. Med. art. Sulphur*. There is a preparation of common sulphur, strongly recommended by Mortimer for preserving timber from being worm-eaten, as it is very subject to be when felled before the sap is wholly at rest. A quantity of common yellow brimstone is to be put into a common retort of glass, and covered three fingers deep with aqua fortis; this is to be distilled off to a dryness, and the same repeated three times. The sulphur then is to be taken out, and laid on a marble, or put into an open flat glass vessel, where it will soon run into an oil by deliquium. This oil is to be rubbed on any curious piece of wood that is in danger of worms; it will destroy them if they have begun to breed in it, and wholly prevent them if not yet begun. It also gives the wood an agreeable tinge or colour, which no art can ever rob it of afterwards. It is also a great preservative of wood that is to be set in the earth, or under water; and may be used with success

No. 141.

to rub over the cables in shipping, or any other ropes that are endangered by lying much in the water. *Mortimer's Husbandry*, vol. ii. p. 104.

SULTAN, a title of application given to the emperor of the Turks. It had its rise under Mahmoud, son of Sebedeghin, the first emperor of the dynasty of the Gaznevites, toward the close of the fourth century of the era of the hegra; when that prince going to Segastan to reduce Kalaf, governor of that province, who affected the sovereignty, Kalaf was no sooner advertised of his coming, than he went out to meet him, delivered the keys of his fortress, and owned him his sultan; that is, his lord or commander. The title pleased Mahmoud so well, that he assumed it ever afterwards; and from him it passed to his descendants, and to other Mahometan princes.

SULTANA, the wife of a sultan. The favourite sultana is called *hasaki-sultana*, i. e. private sultana. The sultana queen is the emperor's chief wife. The old sultana, mother of the emperor reigning, is called *sultana valide*. If any of the virgins of the seraglio, whom the grand signior makes choice of for his bed-fellow, by walking between two ranks of them, and throwing a handkerchief into her hand, conceives by him, and brings forth his first begotten child, she is called by the name of *sultana-queen*: and if this child be a son, she is confirmed and established by great feasts and solemnities, and hath a separate dwelling assigned unto her of many stately rooms well furnished, and many servants to attend upon her. She is likewise allowed a large revenue, and acknowledged in the seraglio as queen, by every expression of duty and respect. The other women (though they may have issue) are not called queens; but they are called *sultanas*, because they have had carnal commerce with the king; but she only is honoured with the title of queen, who is the mother of the first begotten son, heir to the empire. If this son should die, and another of the *sultanas* should have a second son, then her son being to succeed the deceased heir, she is immediately made queen, and the former shall remain a *sultana* only, and be deprived of her revenue and royalty; and thus the title of queen is transferred from one sultana to another, by virtue of the son's succession. *Greave's Works*, vol. ii. p. 638, &c.

SUMMARY, an abridgement, containing the sum and substance of a thing in a few words. The summary, placed at the head of a book, a chapter, a law, or the like, is very useful to the reader, to facilitate the understanding thereof. A recapitulation is to contain a summary of the whole preceding discourse.

SUMMER, one of the seasons of the year, commencing, in these northern regions; on the day the sun enters Cancer; and ending when he quits Virgo. Or, more strictly and universally, the summer begins on the day when the sun's meridian distance from the zenith is the least. It ends on the day when his distance is a mean betwixt the greatest and smallest. The end of summer coincides with the beginning of winter. It is said, that a frosty winter produces a dry summer, and a mild winter a wet summer. It often happens so, in fact, but why it should be so, is perhaps a question difficult to determine. The curious may, on this subject, consult the *Philosophical Transactions*, No. 458, sect. X.

SUMMER Solstice. See **SOLSTICE**.

SUMMIT, the vertex or point of any body or figure; as of a triangle; a pyramid, a pediment, &c.

SUMPTUARY Laws, *Leges SUMPTUARIÆ*, are laws made to restrain excess in apparel, costly furniture, eating, &c. Most ages and nations have had their sumptuary laws, and some retain them still, as the Venetians, French, &c. But it is observed, that no laws are worse executed than sumptuary laws. Political writers have been much divided in opinion with respect to the utility of these laws to a state. Baron Montequieu observes, that luxury is necessary to monarchies, as in France; but ruinous to democracies, as in Holland. With regard to England, whose government is compounded of both species, it may still be a dubious question, says judge Blackstone, how far private luxury is a public evil; and as such cognizable by public laws. The sumptuary laws of that ancient Locrian legislator Zaleucus, are famous: by these it was ordained, that no woman should go attended with more than one maid in the street, except she were drunk: that she should not go out of the city in the night, unless she went to commit fornication: that she should not wear any gold or embroidered apparel, unless she proposed to be a common strumpet; and that men should not wear rings, or tissues, except when they went a whoring, &c. The English have had their share of sumptuary laws, chiefly made in the reigns of Edw. III. Edw. IV. and Hen. VIII. against piked shoes, short doublets, and long coats; though all repealed by statute 1 Jac. I. c. 25. Under king Henry IV. Camden tells us, pride was got so much into the foot, that it was proclaimed, that no man should wear shoes above six inches broad at the toes. And their other garments were so short, that it was enacted, 25 Edw. IV. no person, under the condition of a lord, should, from that time, wear any mantle or gown, unless of such a length, that, standing upright, it might cover his privy members and buttocks.

SUN, **SOL**, in Astronomy, the great luminary which enlightens the world, and by his presence constitutes day. The sun, which, in the infancy of astronomy, was reckoned among the planets, should rather be numbered among the fixed STARS. It appears bright

*

4 P

an

and large in comparison with them, because we keep constantly near the sun, whereas we are at an immense distance from the stars. For a spectator, placed as near to any star as we are to the sun, would see that star a body as large and bright as the sun appears to us; and a spectator, as far distant from the sun as we are from the stars, would see the sun as small as we see a star, divested of all its circumvolving planets; and would reckon it one of the stars, in numbering them. According to the Copernican hypothesis, which is now generally received, and which has even demonstration on its side, the sun is the centre of all the planetary and cometary system: round which all the planets and comets, and our earth among the rest, revolve, in different periods, according to their different distances from the sun. For a particular description of the SOLAR SYSTEM, see the SYSTEM, Sect. II. and Plate III. Fig. 1.

SUNDAY, the first day of the week, thus called by our idolatrous ancestors, because set apart for the worship of the sun. It is now more properly called the Lord's day, *dies Dominicus*, because kept as a feast in memory of our Lord's resurrection on this day. See **SABBATH**.

It was Constantine the Great who first made a law for the proper observation of Sunday; and who, according to Eusebius, appointed it should be regularly celebrated throughout the Roman empire. Before him, and even in his time, they observed the Jewish sabbath, as well as Sunday; both to satisfy the law of Moses, and to imitate the apostles, who used to meet together on the first day. It is well observed by Judge Blackstone, (book iv. p. 63.) that besides the notorious indecency and scandal of permitting any secular business to be publicly transacted on this day, in a country professing Christianity, and the corruption of morals which usually follows the profanation of it; the keeping one day in seven holy, as a time of relaxation and refreshment as well as for public worship, is of admirable service to a state, considered merely as a civil institution. It humanizes, by the help of conversation and society, the manners of the lower classes, which would otherwise degenerate into a feroic ferocity and savage selfishness of spirit: it enables the industrious workman to pursue his occupation in the ensuing week with health and cheerfulness; it imprints on the minds of the people that sense of their duty to God, so necessary to make them good citizens; but which would be worn out and defaced by an unremitted continuance of labour, without any stated times of recalling them to the worship of their Maker. No arrest can be made nor process served upon a Sunday, except for treason, felony, or breach of the peace; nor can any proceedings be had nor judgment given, nor supposed to be given, on a Sunday.

SUPERCILIIUM, in Anatomy, the eye-brow. See the SYSTEM, Part VII. Sect. V.

SUPEREROGATION, in Theology, what a man does beyond his duty, or more than he was commanded to do. The Romanists stand up strenuously for works of supererogation; and maintain, that the observance of evangelical counsels is such. By means thereof, a stock of merit is laid up, which the church has the disposal of, and which she distributes in indulgences to such as need. This monstrous and absurd doctrine was first invented towards the close of the twelfth century, and modified and embellished by St. Thomas in the thirteenth; according to which it was pretended, that there actually existed an immense treasure of merit, composed of the pious deeds and virtuous actions, which the saints had performed beyond what was necessary for their own salvation, and which were, therefore, applicable to the benefit of others: that the guardian and dispenser of this precious treasure was the Roman pontiff; and that, of consequence, he was empowered to assign to such as he thought proper a portion of this inexhaustible source of merit, suitable to their respective guilt, and sufficient to deliver them from the punishment due to their crimes. The reformed churches do not allow of any work of supererogation; but hold with the apostles, that when we have done our best, we are but unprofitable servants.

SUPERFETATION, **SUPERFOETATIO**, formed from *super*, over, and *fatus*, embryo, in Medicine, an after or second conception; happening when the mother, already pregnant, conceives a later coition; so that she bears at once two fetuses of unequal age and bulk, and is delivered of them at different times. We also meet with something like a superfetation in plants; there being a kind of lemon found to grow enclosed in the body of another.

SUPERFICIES, or **SURFACE**, in Geometry, a magnitude, considered as having two dimensions; or extended in length and breadth, but without thickness or depth. In bodies, the superficies is all that presents itself to the eye. A superficies is chiefly considered as the external part of a solid: when we speak of a surface simply, and without any regard to body, we usually call it figure: see the SYSTEM of GEOMETRY and SURVEYING.

SUPERLATIVE, in Grammar, an inflexion of nouns adjective, serving to augment and heighten their signification, and shew the quality of the thing denoted to be in the highest degree: see SYSTEM, Part II. Chap. III. Art. IV.

SUPERSTITION, extravagant devotion, or religion wrongly directed or conducted. Superstition consists in false and abject notions of the deity, in the gloomy and groundless fear of invisible beings, and in the absurd rites which these notions and fears naturally produce: and, generally speaking, it is the effect of ignorance, and of a judgement perverted by a sour and splenetic tem-

per. The author of the article fanaticism in the Dict. Encyclop. Paris, defines fanaticism as a blind and passionate zeal, which ariseth from superstitious opinions, and leads its votaries to commit ridiculous, unjust, and cruel actions, not only without shame, but even with certain internal feelings of joy and comfort: from which he concludes that fanaticism is really nothing more than superstition set in motion. The difference between true religion and superstition seems to be this: that the former is the exercise of the understanding and affections, and the regulation of the conduct, founded on just notions of God, and of the method of averting his displeasure and securing his favour; and the latter is the result of fancy and passion undirected and ungoverned, and originating either in the delusive hope of pleasing God by some opinion or practice entirely distinct from, and contrary to, those notions, or the distressing fear that he will not be pleased without the addition of something which such notions neither require nor justify.

SUPINATOR, in Anatomy, a denomination given to two muscles of the arm; the one called *supinator longus*, the other *supinator brevis*; both serving to turn the palm of the hand upwards: see the SYSTEM, Part II. Table of Muscles, Art. 22.

SUPINE, in the Latin Grammar, a part of the conjugation of a verb, of like effect with the infinitive mood. There are two kinds of supines; the one is *um*, whose signification is active, and marks a motion, as *dare nuptum*; the other in *u*, having a passive signification, as *horrendum auditu*, &c. The supines have neither number nor person.

SUPPER, the evening repast; suppers that are heavy should be avoided, because the stomach is more oppressed with the same quantity of food in an horizontal posture than in an erect one, and because digestion goes on more slowly when we sleep than when we are awake. They should be eaten long enough before bed-time, that they may be nearly digested before going to sleep; and then a draught of pure water will dilute that which remains in the stomach.

SUPPLIES, called also **AIDS** and **SUBSIDIES**, are extraordinary grants made by the commons of Great Britain, in parliament assembled: who, when they have voted a supply to his majesty, and settled the quantum of that supply, usually resolve themselves into what is called a committee of ways and means, to consider of the ways and means of raising the supply so voted. And in this committee every member (though it is looked upon as the peculiar province of the chancellor of the exchequer) may propose such schemes of taxation as he thinks will be least detrimental to the public. The resolutions of this committee (when approved by a vote of the house) are in general esteemed to be, as it were, final and conclusive. But though the supply cannot be actually raised upon the subject till directed by an act of the whole parliament, yet no man will scruple to advance to the government any quantity of ready cash, on the credit of a bare vote of the house of commons, though no law be yet passed to establish it; and which requires the assent of the two other branches of the legislature. The general reason given for this exclusive privilege of the house of commons, is that the supplies are raised upon the body of the people, and, therefore, it is proper that they alone should have the right of taxing themselves. This reason, says Judge Blackstone, would be unanswerable, if the commons taxed none but themselves; but it is notorious, that a very large share of property is in the house of lords, which is equally taxed with the property of the commons; and, therefore, he says, the commons not being the sole persons taxed, this cannot be the reason of their having the sole right of raising and modelling the supply. The true reason, arising from the spirit of our constitution, he apprehends to be this. The lords being a permanent hereditary body, created at pleasure by the king, are supposed more liable to be influenced by the crown, and when once influenced to continue so, more than the commons, who are a temporary elective body, freely nominated by the people. It would, therefore, be extremely dangerous to give the lords any power of framing new taxes for the subject. It is sufficient that they have a power of rejecting, if they think the commons too lavish or improvident in their grants. See **PARLIAMENT** and **MONEY-BILLS**.

SUPPORTERS, in Heraldry, figures, standing on the scroll, and placed by the side of the escutcheon, and seeming to support or hold up the same. See the SYSTEM, Sect. VII. Art. X.

SUPPRESSION, in Medicine, is applied to the humours that are retained in the body by some obstruction or stoppage of the usual outlet. We say, a suppression of urine, of the menses, &c. See the SYSTEM, Genus 78, 79, and 80.

SUPPURATION, formed from *sub*, under, and *pus*, pus, in Medicine, the action whereby extravasated blood, or other humours, in the body, are ripened, or changed into pus. See **ABSCESS**.

SUPRASPINATUS, in Anatomy, a thick, narrow muscle, thus called from its fleshy origination at the upper end of the basis of the scapula above the spine: see the SYSTEM, Part II. Table of Muscles, Art. 20.

SUPREMACY, in the English policy, the superiority or sovereignty of the king over the church, as well as state, of England, whereof he is established head. See **KING**.

The king's supremacy was first established, or, as others say, recovered, by king Henry VIII. in 1534, after breaking with the pope

pope. Stat. 25 Hen. VIII. cap. 12. 20. 1 Eliz. cap. 1. It is since confirmed by several canons, as well as by the articles of the church of England: and is passed into an oath, which is required as a necessary qualification for all offices and employments both in church and state, from persons to be ordained, from the members of both houses of parliament, &c. This oath, as finally established by 1 W. cap. 8. is as follows: "I A.B. do swear, that I do from my heart abhor, detest, and abjure, as impious and heretical, that damnable doctrine and position, that princes excommunicated or deprived by the pope, or any authority of the see of Rome, may be deposed or murdered by their subjects, or any other whatsoever. And I do declare, that no foreign prince, person, prelate, state or potentate, hath or ought to have any jurisdiction, power, superiority, pre-eminence, or authority, ecclesiastical or spiritual, within this realm. So help me God." By stat. 5 Eliz. cap. 1. to refuse the oath of supremacy will incur the pains of PRÆMUNIRE.

This right of supremacy consists chiefly in the following articles, 1^o, That the archbishops of either province cannot summon the bishops and clergy to convocation, or enact any canons, without the king's express consent, by 25 Henry VIII. cap. 19. whereas, before that act, the convocation was often called, and laws made by it for governing the church, without any authority from the crown. 2^o, In that there lies now an appeal, from the archbishop to the king in chancery; and, on such an appeal, a commission, under the seal, is to be directed to certain persons, whereof commonly half are laymen and half clergymen, which is called the COURT of delegates, and which finally determined all ecclesiastical causes, by 25 Hen. VIII. cap. 19. though sometimes a review is granted. Before this statute, the appeal from the archbishop's court lay to the pope only. 3^o, The king can grant commissions for visiting such places as are exempt from the jurisdiction of bishops, or arch-bishops: and appeals lie from thence to the king in chancery: whereas before 25 Henry VIII. the pope only could visit them and receive appeals from those courts. 4^o, Persons in holy orders are not, as formerly, exempt from the king's temporal laws, any more than laymen. 5^o, The bishops and clergy do not swear, or pay any obedience to the pope; but must take the oaths of allegiance and supremacy to the king.

SURD, in Algebra, denotes a number or quantity that is incommensurate to unity; or that is inexpressible by any known way of notation, otherwise than by its radical sign or index. For explanation of the rules, &c. relative to this branch of the science, with examples for reducing those practices, see the System throughout.

SURGEON, or CHIRURGEON, one that professes the art of SURGERY. In England there are two distinct companies of surgeons now occupying the science or faculty of surgery; the one company called *barbers*, the other *surgeons*, which latter are not incorporated. The two are united to sue, and be sued, by the name of masters or governors and commonalty of the mystery of barbers and surgeons of London. 32 H. VIII. c. 42.

SURGERY, a branch of medicine, including the knowledge of all those diseases wherein the application of the hand is necessary, whether such diseases are occasioned by external injuries, or take their rise from internal causes, with the method of performing all manual operations which may be necessary in such cases.

That surgery was coeval with the other branches of medicine, or perhaps antecedent to any of them, will not admit of doubt. The wars and contentions which have taken place among mankind almost ever since their creation, necessarily imply that there would be occasion for surgeons at a very early period; and probably these external injuries would for some time be the only diseases for which a cure would be attempted, or perhaps thought practicable. In the sacred writings we find much mention of balsams, particularly the balm of Gilead, as excellent in the cure of wounds, though at the same time we are informed that there were some wounds which this balsam could not heal; as indeed we know, at this day, there are many wounds which, though curable by internal medicines, will resist the most powerful external applications. Concerning the surgery practised among the Egyptians, Jews, and Asiatic nations, we know little or nothing. The Greeks were those from whom the art descended to us, though they confessedly received it from the eastern nations. The first Greek surgeons on record are Æsculapius, and his sons Podalirius and Machaon. Æsculapius flourished about 50 years before the Trojan war; and his two sons distinguished themselves in that war both by their valour and skill in curing wounds. This indeed is the whole of the medical skill attributed to them by Homer; for in the plague which broke out in the Grecian camp, he does not mention their being at all consulted. Nay, what is still more strange, though he sometimes mentions his heroes having their bones broke, he never takes notice of their being reduced or cured by any other than supernatural means; as in the case of Æneas, whose thigh bone was broken by a stone cast at him by Diomed. The methods which these two famous surgeons used in curing the wounds of their fellow soldiers seems to have been the extracting or cutting out the dart which inflicted it, and applying emollient fomentations or styptics, when necessary, to the wound: and to these they undoubtedly attributed much more virtue than they could possibly possess; as appears from the following lines, where Homer de-

scribes Eurypylos as wounded and under the hands of Patroclus, who would certainly practise according to the directions of the surgeons.

Patroclus cut the forky steel away;
Then in his hands a bitter root he bruised,
The wound he wash'd, the styptic juice infused.
The *closing flesh* that instant ceas'd to glow:
The wound to torture, and the blood to flow.

Till the days of Hippocrates we know very little of what was the practice of the Greek surgeons. From him, however, we learn, that the practice of blood-letting, cupping, and scarification, was known to them; also the use of warm and emollient fomentations, issues made with hot irons, pessaries, injections, fumigations, &c. Hippocrates also gives directions with regard to fractures, luxations, ulcers, fistulas. He directs the extension, reduction, bandages, and splints, proper to be used in fractures and luxations of different bones, with several machines to increase the extension when necessary. He directs the laxity and tightness of the bandages; the intervals for loosing and binding them on again; the position and repose of the fractured member, the regimen and diet; and he mentions the time when a callus is usually formed. He treats also of fractures of the skull, and the method of applying the trepan. In his treatment of ulcers, he speaks of reducing fungous flesh by means of escharotics, some of which are alum, nitre, verdigrease, quick-lime, &c.

In the time of Ptolemy Philopater of Egypt, medicine, all the branches of which had hitherto been practised by the same person, was now divided into three, viz. the dietetic, pharmacutic, and surgical; from which time to the present, surgery has continued to be reckoned a distinct profession from medicine, though very improperly, in the opinion of the best authors.

Surgery appears not to have existed in Rome, notwithstanding the warlike genius of the people, for more than 500 years. Archagathus, a Greek, was the first professor of that art in the city; and so frequently employed the knife, hot irons, and other cruel methods of cure, that he was branded with the opprobrious title of *hangman*, and expelled the city, where no physician or surgeon of eminence again made his appearance for 180 years. At this time Asclepiades undertook the profession of medicine; but seems to have dealt little in surgery. Neither have we any thing of importance on that subject till the year of Celsus, who flourished during the reigns of Augustus and Tiberius. In his surgery, all the improvements from Hippocrates to his own days are collected; the most minute and trifling diseases are not omitted. An eminent surgeon, of the moderns, emphatically exhorts every person in that profession "to keep Celsus in his hands by day and by night." He describes the signs of a fractured skull, the method of examining for the fracture, of laying the skull bare by an incision in the form of the letter X, and afterwards of cutting away the angles, and of applying the trepan, with the signs of danger and of recovery. The cure of fractures, in the upper and lower extremities, he said were nearly alike; that fractures differ in degree of violence and danger, in being simple or compound, that is, with or without a wound of the flesh, and in being near to the joint. He directs the extension of the member by assistants; the reduction, by the surgeon's hands, of the fractured bones into their natural situation; and to bind the fractured part with bandages of different lengths, previously dipped in wine and oil. Splints, if necessary, are to be applied, to retain the bones in a fixed position. The fractured arm is to be suspended in a broad sling hung round the neck. He describes the method of treating compound fractures, and of removing small fragments of splinters of bones, and the manner of extracting darts. In luxations of the shoulder, he mentions several methods of giving force to the extension, and of replacing the dislocated bone.

In external gangrene, Celsus cut into the sound flesh; and when the disease, in spite of every effort, spread, he advised extirpation of the member. After cutting to the bone, the flesh was separated from it, and drawn back, in order to save as much flesh as possible to cover the extremity of the bone. Celsus, though extremely diffuse in the description of surgical diseases, and of various remedies and external applications, yet is nearly silent on the method and process of extirpating members; from which, comparing his treatise with the modern systems, we might infer, that the operation was then seldom practised than at present. He describes the symptoms of that dangerous inflammation the carbuncle, and directed immediately to burn or corrode the gangrened part. To promote the suppuration of abscesses, he ordered poultices of barleymeal, or of marshmallows, or the seeds of linseed and fennugreek. He also mentions the compositions of several repellent cataplasms. In that superficial inflammation called the *erysipelas*, he applied cerus, mixed with the juice of solanum or nightshade. Sal ammoniac was sometimes mixed with his plasters.

He is very minute in describing diseases of the eyes, ears, and teeth, and in prescribing a multitude of remedies and applications. In inflammation of the eyes, he enjoined abstinence and low diet, rest, and a dark room: if the inflammation was violent, with great pain, he ordered venesection and a purgative; a small poultice of fine flour, saffron, and the white of an egg, to be laid to the forehead to suppress the flow of pituita; the soft inside of warm

white

white bread dipped in wine, to be laid on the eye; poppy and roses were also added to his collyriums, and various ingredients, too tedious to enumerate. In chronic watery defluxions of the eyes, he applied astringents, cupped the temples, and burnt the veins over the temple and forehead. He touched cataracts by depressing the crystalline lens to the bottom of the orbit. He describes not only the inflammation, but likewise the elongation, of the uvula; he also describes the polypus, and some other diseases affecting the nose.

He describes several species of hernia or ruptures, and also the hydrocele or dropsy of the scrotum, and the manual assistance required in those complaints. After the return of the intestines into the abdomen, a firm compress was applied to that part of the groin through which they protruded, and was secured by a bandage round the loins. He describes various diseases of the genital parts, a difficulty of urine, and the manner of drawing off the water by a catheter; the signs of stone in the bladder, and the method of sounding or feeling for that stone. Lithotomy was at that time performed by introducing two fingers into the anus; the stone was then pressed forward to the perineum, and a cut made into the bladder; and by a crooked instrument, made in a particular form, the stone was extracted. He describes the manner of performing this operation on both the sexes, of treating the patient, and the signs of recovery and of danger. Hippocrates had even ventured to cut into the kidney, either to give a discharge to abscesses, or to extract stones. Celsus directed various corrosive applications and injections to fistulas; and, in the last extremity, opened them to the bottom with a knife, cutting upon a grooved instrument or conductor. In old callous ulcers, he made a new wound, by either cutting away the hard edges, or corroding them with verdigrise, quick-lime, alum, nitre, and with some vegetable escharotics. He mentions the symptoms of caries in the bone; directs the bone to be laid bare, and to be pierced with several holes, or with the trepan, or to be burnt or rasped, in order to promote an exfoliation of the corrupted part: afterwards to apply nitre and several other ingredients. One of his applications to a cancer was auripigmentum or arsenic. He directs the manner of tapping the abdomen in the ascites, and drawing blood by the lancet and cupping-glasses. His cupping-glasses seem not to have been so convenient as the modern; they were made either of brass or horn, and were unprovided with a pump. He cured varicose veins by usion, or by incision. He gives directions for extracting the dead fœtus from the womb, in whatever position it should present.

The last writer of consequence who flourished at Rome, was Galen, physician to the emperor Marcus Aurelius. His works are for the most part purely medicinal; however, he wrote also on surgery, and made Commentaries on the Surgery of Hippocrates. He opened the jugular veins, and performed arteriotomy at the temples; directed leeches, scarification, and cupping-glasses, to draw blood. He also describes with accuracy the different species of hernia or ruptures. In the year 500 flourished Aëtius, in whose works we meet with many observations omitted by Celsus and Galen, particularly on the surgical operations, the diseases of women, the causes of difficult labour, and modes of delivery. He also takes notice of the dracuncululus, or worm under the skin, a disease at present common in Africa. Aëtius, however, is greatly excelled by Paulus Egineta, who flourished in 646; and whose treatise on surgery is superior to that of Celsus or all the other ancients. He directs how to extract darts; to perform the operation sometimes required in dangerous ruptures or hernia, where the intestines cannot by any other means be returned back; he directs also to tie up punctured arteries in the operation for the aneurism. Galen, Paulus, and all the ancients, speak only of one species of aneurism, and define it to be "a tumour arising from arterial blood, extravasated from a ruptured artery." The aneurism from a dilation of the artery is a discovery of the moderns. In violent inflammations of the throat, where immediate danger of suffocation was threatened, Paulus performed the operation of bronchotomy. In obstinate defluxions upon the eyes, he opened the jugular veins. He describes the manner of opening the arteries behind the ears in chronic pains of the head. He wrote also upon obstetrics, on difficult labours, and other female diseases. Fabricius ab Aquapendente, a celebrated surgeon of the 16th century, has followed Celsus and Paulus as text-books.

From the time of Paulus Egineta to the year 900, no writer of any consequence, either on medicine or surgery, appeared. At this time the Arabian physicians Rhazes and Avicenna revived in the East medicinal art, which as well as others was almost all entirely extinguished in the West. Avicenna's Canon Medicinæ, or General System of Medicine and Surgery, was for many ages celebrated through all the schools of physic. It was principally compiled from the writings of Galen and Rhazes. The latter had correctly described the spina ventosa, accompanied with an enlargement of the bone, caries, and acute pain. In difficult labours he recommends the fillet to assist in the extraction of the fœtus: and for the same purpose Avicenna recommends the forceps. He describes the composition of several cosmetics to polish the skin and make the hair grow or fall off.

Notwithstanding this, however, it was not till the time of Albucasis, that surgery came into repute among the Arabians. Rhazes

complains of their gross ignorance, and that the manual operations were performed by the physicians servants. Albucasis enumerates a tremendous list of operations, sufficient to fill us with horror. The hot iron and cauteries were favourite remedies of the Arabians; and, in inveterate pains, they resorted, like the Egyptians and eastern Asiatics, great confidence in burning the part. He describes accurately the manner of tapping in the ascites; mentions several kinds of instruments for drawing blood; and has left a more ample and correct delineation of surgical instruments than any of the ancients. He gives various obstetrical directions for extracting the fœtus in cases of difficult labours. He mentions the bronchocele, or prominent tumour on the neck, which he tells us was most frequent among the female sex. We are also informed by this writer, that the delicacy of the Arabian women did not permit male surgeons to perform lithotomy on females; but, when necessary, it was executed by one of their own sex.

From the 11th century to the middle of the 14th, the history of surgery affords nothing remarkable except the importation of that noxious disease the leprosy into Europe. St. Lewis king of France had caught the leprosy in the Crusades; and in order to a cure was prescribed the blood of young children, as a potion, by the Jewish physicians. It does not appear that either external or internal remedies were of any avail in curing it, or indeed thought to be so; but, by taking proper precautions to separate the infected from the sound, it gradually disappeared. The discovery of America introduced a new and more terrible disease than the leprosy, namely, the venereal; which at its origin appeared in loathsome ulcers affecting the genitals, and by degrees the palate and uvula. Swellings and buboes arose in the groin; in its more advanced stages, excruciating pains were felt in the bones, especially at nights; scabs and small running sores covered the skin; nodes or protuberances appeared in the forehead; the bones became at length carious, enlarged, and rotten; many, after lingering for months under such wretched calamities, others, for a year or more, lost their palate, nose, eyes, lips, teeth, genitals, and, before death, presented a cadaverous spectacle of deformity and corruption. Even at this day, when the disease has become much milder, venereal ulcers will sometimes appear with such inveteracy, as to give no small trouble to the surgeon who attempts to remove them. Soon after this, the scurvy, with all its train of direful, and for a long time incurable, ulcers, rigid muscles, and rotten gums, made its appearance. The state of medical knowledge did not, in those ages, admit of a certain and easy cure, either for the venereal disease or scurvy, nor was the true cure of the latter known, till within these few years.

At the beginning of the 16th century, surgery was held in contempt in this island, and was practised indiscriminately by barbers, farriers, and fow-gelders: the barbers and surgeons company continued for 200 years after to be incorporated both in London and Paris. In Holland and some parts of Germany, even at this day, barbers exercise the razor and lancet alternately. The surgeons company in London, however, have now disengaged themselves from that dishonourable connection; they are now likewise authorized to examine and to grant certificates to young surgeons, which qualify them to purchase or to be appointed to a medical commission in the army or navy. Even yet, however, the distinction between physicians and surgeons is by far too great, and their reciprocal ignorance of these different branches of the same science, frequently embarrasses both physician and surgeon, often to the great danger of the patient, as will appear in the sequel of this article.

Surgery, in the strict limitation of the word, is principally confined to wounds, fractures, luxations, tumours, ulcers, and to the different manual operations, instruments, and bandages. These are the themes of general systems of surgery. On this science and art, amongst the ancient surviving writers, Hippocrates, Celsus, Galen, P. Egineta, and Albucasis, alone possess any intrinsic excellence.

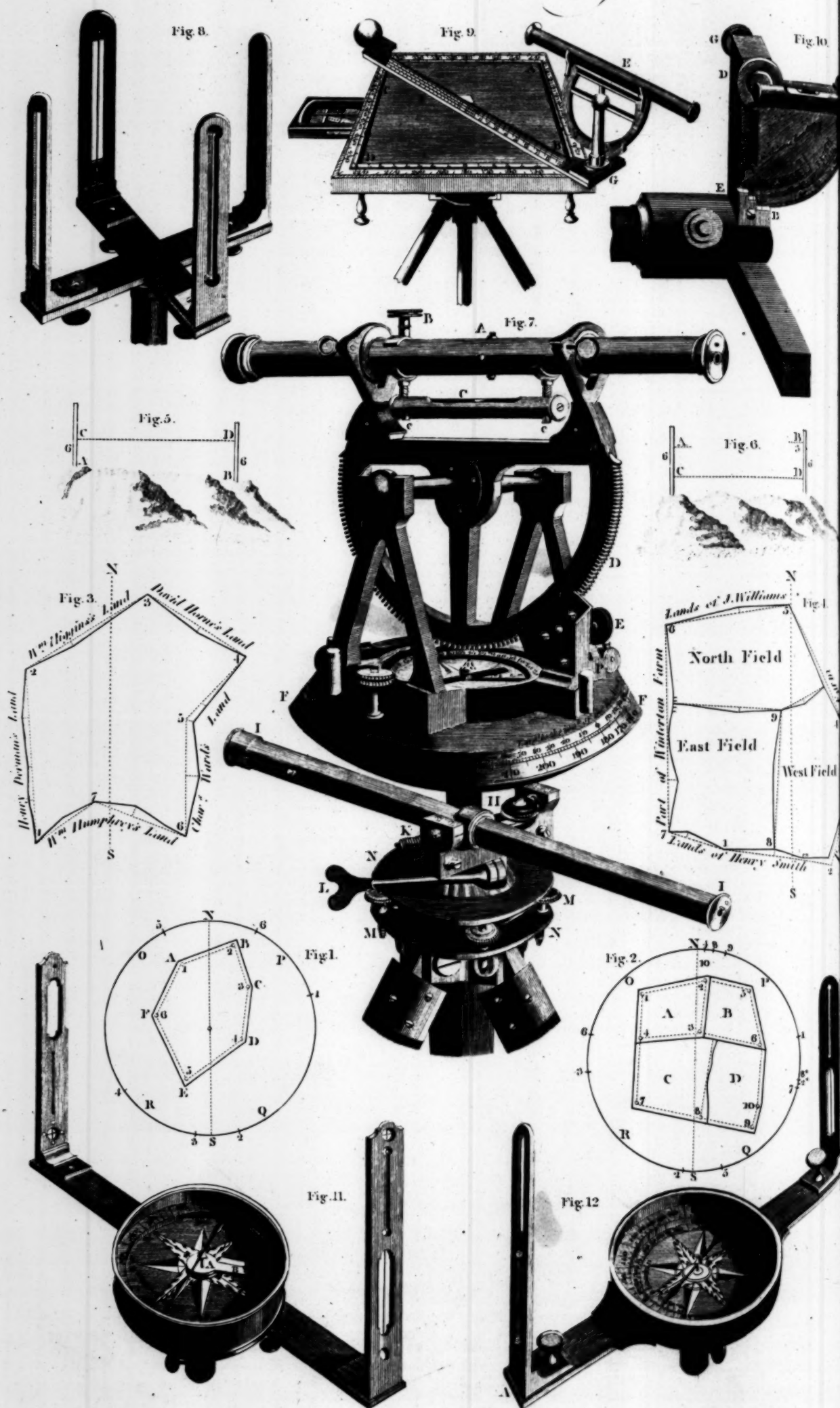
It is within the last three centuries that we have any original improvement in surgery, from the æra of the Arabians; nor do we know of any eminent British surgical writers until within the last 130 years. "In Germany," says Heister, "all the different surgical operations, at the beginning even of the 11th century, were left to empirics; the rest were contented to cure a wound, open a vein or an abscess, return a fractured or luxated bone; but they seldom or ever ventured to perform any of the difficult operations: he also speaks of their gross ignorance of the Latin language." The first surgical work of the 16th century, entitled to any pre-eminence or criticism, is that of J. Carpus; but in the effulgence of later writers, his light is scarce perceptible. F. ab Aquapendente, an Italian, published a system of surgery, containing a description of the various diseases, accidents, and operations. Boerhaave pays this author the following compliment: *Ille superavit omnes, et nemo illi hanc disputat gloriam; omnibus potius quam hocce carere possumus.* About the same period, A. Parey, a Frenchman, made several important additions to surgery, particularly in his collection of cases of wounds, fractures, and other accidents which occur during war. The ancients, who were ignorant of powder and fire-arms, are defective in this part of military surgery. Parey pretends to have first invented the method of tying, with a needle, and strong silk-thread waxed, the extremities of large arteries, after the amputation of a member. The ligature of the blood-vessels is, however, merely

f
t
e
s
h
n
l
y
s
d
r
d
ed
s
us
he
es
r
y
rs
ate
in
vas

on-
rs,
on-
nd
ay,
ons
ves
ho-
ich
nil-
be-
oro-
fre-
reat
le.
con-
the
hefe
and
lfus,
infic

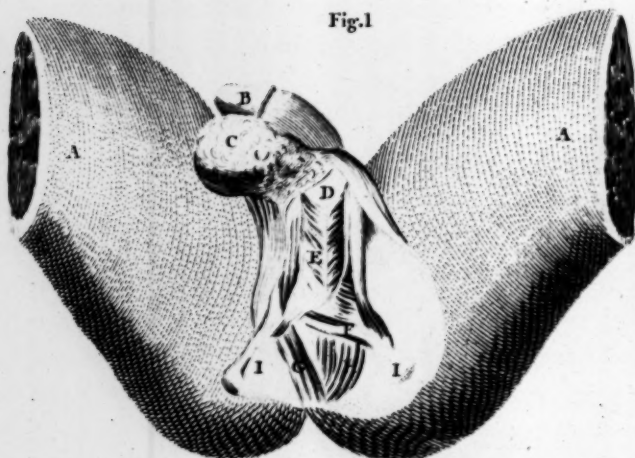
ginal
to we
e last
erent
were
pen a
t they
tions:
age."
pre-
gence
dente,
iption
re pays
t nemo
possu-
several
of cases
ing war.
are de-
to have
ing fitk-
utation
merely
a

*Practical Surveying, illustrated by the Plain-table, theodolite
(and other) Instruments. See the System.*



Views of the Human Pelvis from Male & Female Adults, See the Article Surgery

Fig.1 The subject in the attitude of being cut for the Stone with a view of the posterior Muscles of the Penis, Anus and Rectum.



MALE PELVIS.

Fig.2 Side view of the contents of the Pelvis with the introduction of the Catheter into the Bladder.

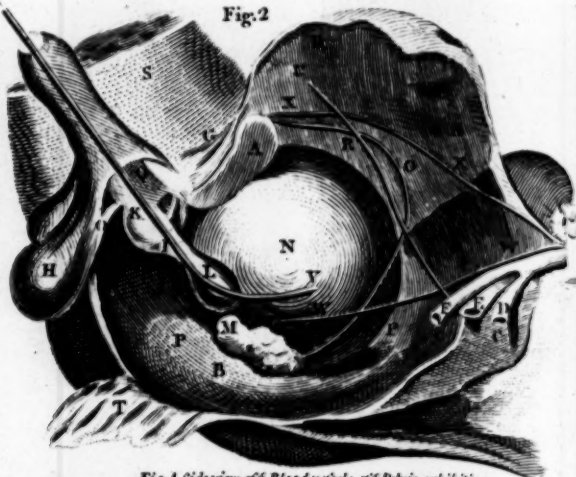


Fig.3 Side view of the Schirous prostate and tube passage with the Bladder preternaturally enlarged.

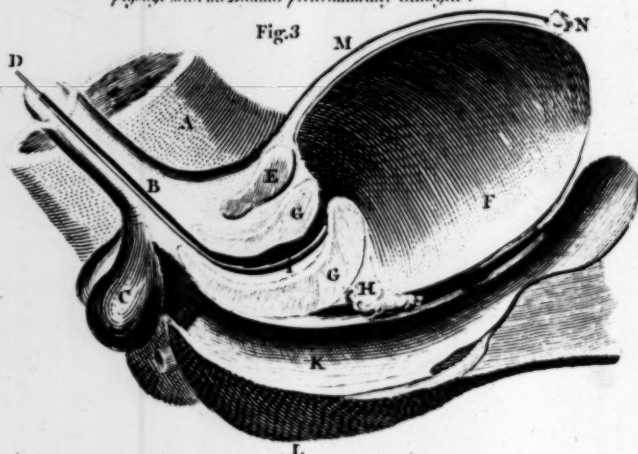


Fig.4 Side view of Blood vessels of Pelvis exhibiting both Arteries and Veins from the recent Subject.

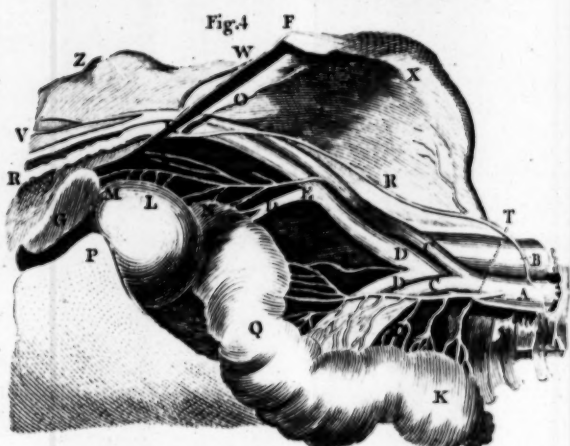
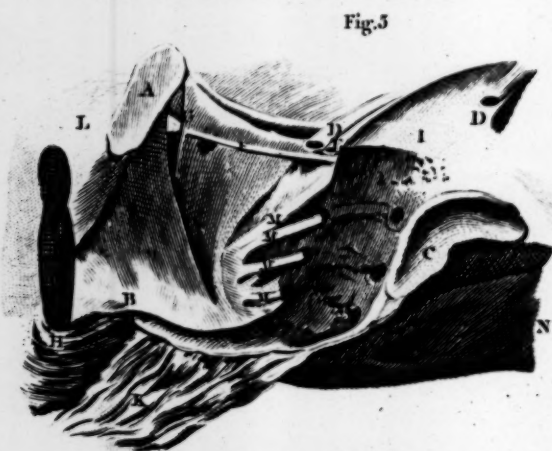


Fig.5 Side view of the three fixed bony points and Cavity of the Pelvis, with the Nerve of the Sacrum.



FEMALE PELVIS.

Fig.6 Side view of the contents of the Pelvis with the Muscles of the Vulva & Anus in Situ.

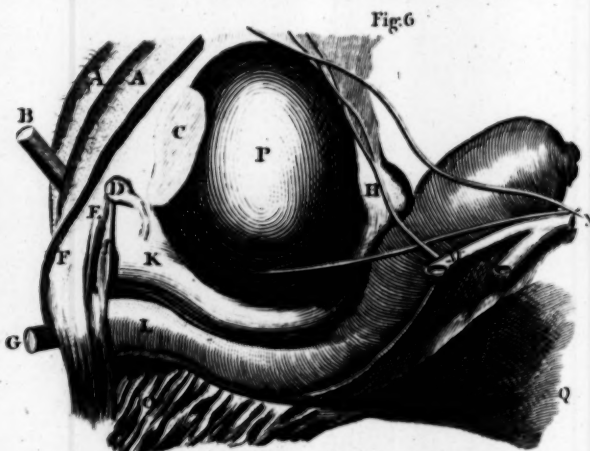


Fig.7 Side view of the Blood vessels of the Pelvis, with the Muscles of those parts, taken from Iconis of Baron Haller.

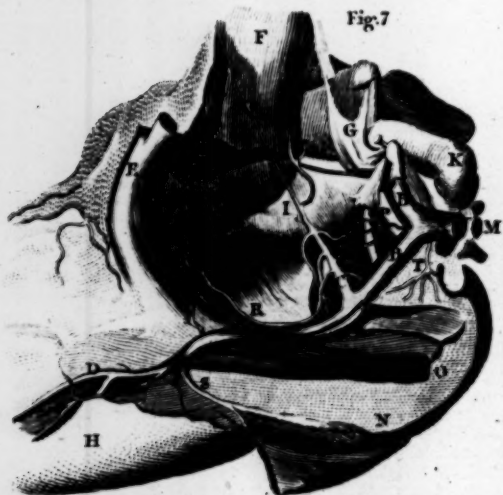
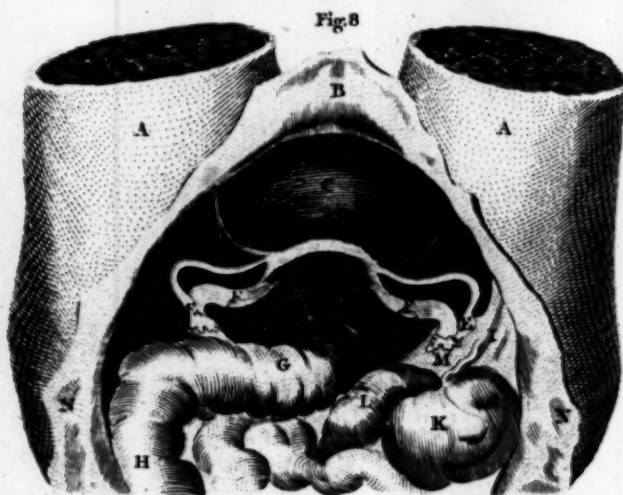


Fig.8 Front view of the contents of the Pelvis as it appears to the Operator, when his back is towards the head of the subject



p[®]

*Carious Skulls infected with the Venereal Disease,
See the Article Surgery.*

Plate 1.

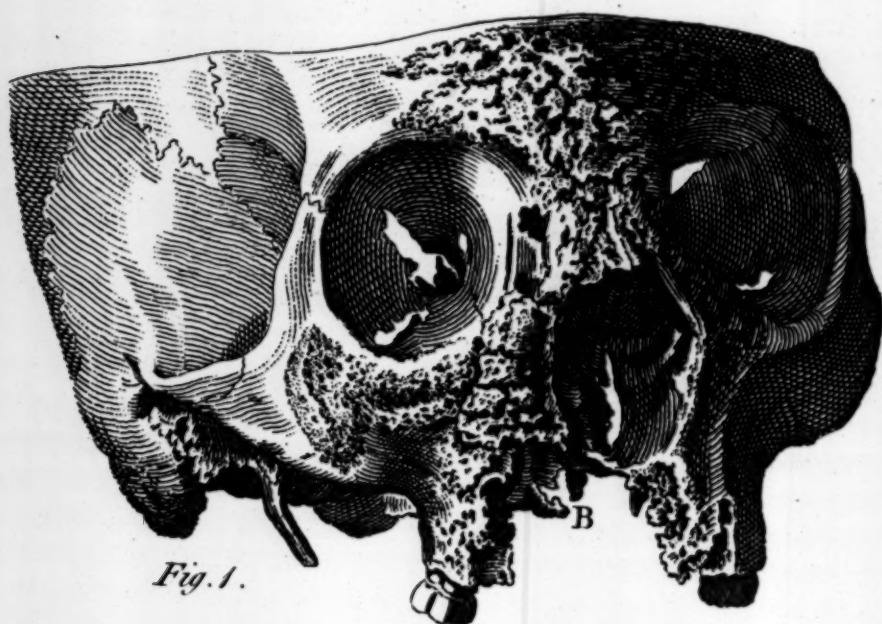


Fig. 1.



Fig. 2.

Engraved for Hall's Encyclopedia & Printed for C. & G. B. Row.

C. & G. B. Row.

a
th
af
ta
a
an
su
J.
T.
ver
of
oft
po
ven
and
blac
thr
tur
wh
mu
wit
thro
Th
app
A
pro
or
and
oper
still
was
for
inco
The
groo
knif
impr
one
after
prov
and
J.
catio
paren
be br
treme
morr
the 17
Th
ligatu
the ar
them,
mende
growi
in haer
A c
eases,
beginn
and pl
celebr
De la
Sharp.
prefac
dium
Inquir
added,
Institu
On
field n
fractur
inven
rious i
machin
cidents
inven
There
tured n
alterna
on exti
Nun
died in
fistulas
remedy
and m
more c
sent c
preffy
tions
No

a revival of the ancient practice, which had fallen into disuse; throughout the dark ages, the hot iron, cauteries, and strong astringents, were substituted in its place. B. Maggus and L. Botalus wrote on the cure of gun-shot wounds. J. A. Cruce wrote a system of surgery.

In the 17th century, surgery was enriched with several systems, and with detached or miscellaneous observations. The principal authors are, M. A. Severinus, V. Vidius, R. Wiseman, Le Clerc, J. Scultetus, J. Mangetus, C. Magatus, Spigellius, F. Hildanus, T. Bartholin, P. de Marchette. The 18th century opens with several eminent surgical writers and improvements. In the operation of lithotomy, as described by Celsus, the rectum or lower gut, and often the femoral ducts, were wounded, fistulas ensued, or the power of generation was annihilated. The moderns therefore invented three methods different from that of Celsus. One method, and the earliest, was to introduce a catheter into the urethra and bladder, and upon that to make a direct incision through the urethra into the bladder. J. de Romanis, an Italian, in the 16th century was the original inventor of this operation, a description of which was published by his pupil Marianus. Another method much later invented, was to distend the bladder as large as possible with urine, and when thus enlarged and elevated, to open into it through the abdominal muscles, immediately above the os pubis. These are called the *high and low operations*; that of Celsus, the *apparatus minor*.

A French priest called *Frere Jacques* introduced another improvement, somewhat different from the modern low operation, or apparatus major. Jacques's incision was directed obliquely and to one side of the urethra, avoiding as much as possible to open any considerable extent of the urinary canal. Inconveniences still attended these various experiments in lithotomy. Jacques was a bold rash man, and ignorant of anatomy; of 60, cut by him for the stone, 25 died soon after; others survived, but under an incontinence of urine and fistulas, and only 13 were perfectly cured. The priest's operation and success is described by J. Mercey. A grooved catheter was afterwards invented to conduct the incision-knife: other surgeons added the cutting gorget; and with these improvements, Jacques's lateral operation is now considered as one of the most safe and successful. Douglas, Chefelden, and afterwards Le Dran, took uncommon pains to explain and to improve this operation. J. Denys also wrote well on the stone and lithotomy.

J. Petit of Paris wrote on diseases of the bones, fractures, dislocations, and caries. Boerhaave says, *Tractatus hic nunquam sibi parem habuit*. Petit invented the screwed tourniquet, which can be braced or relaxed at pleasure, and in the hurry of battles, is extremely useful, to compress the large arteries, and to stop the hæmorrhage. Tourniquets were not used until towards the end of the 17th century.

The ancients, previous to amputation, only made a tight ligature round the member, or attempted to grasp and compress the arteries with the hand and fingers; from these defects amongst them, the amputation of any large member was thought tremendous, and was too frequently fatal. Of late years, the agaric, growing upon oak-trees, has been extolled as a powerful styptic, in hæmorrhages from large vessels.

A complete description of the different surgical accidents and diseases, and of the principal surgical operations, as executed from the beginning of the 18th century to the present time, with descriptions and plates of the instruments and bandages; will be seen in those celebrated writers, French, German, and English; P. Dionis and De la Faye, J. Garengeot, H. F. le Dran, L. Heister, and S. Sharp. Heister's System consists of two quarto volumes, and is prefaced with a large catalogue of writers. To Sharp's Compendium of surgical operations, is added a volume called *A Critical Inquiry into the Modern Practice of Surgery*. To these may be added, Saviard's Surgical Observations, J. Z. Platner's Surgical Institutions.

On gunshot wounds, and on fractures, Ranby and Bromfield merit perusal. Splints of a new construction, to retain fractured bones in a steady position until a callous is formed, were invented by Sharp, and improved by Pott. Gough, with meritorious ingenuity, has invented and published a description of several machines to secure fractured bones in a fixed station. As such accidents occur so frequently in life, and above all during war, every invention of this sort, and the author, is intitled to public thanks. There is infinitely more skill and address required to save a fractured member, than to cut it off. Knives and saws are dreadful alternatives; and we have already an exuberant stock of treatises on extirpation.

Numbers had dragged through a great part of life, and many had died in excruciating agony, from obstructions of the urethra and fistulas, the consequence of venereal gleet, and other causes. To remedy such complaints, we find bougies, of different constructions and materials recommended by the moderns, and described with more or less accuracy in most of the surgical systems. In the present century, Daran and Goulard have written dissertations expressly upon this subject. Goulard's Treatise on the Preparations of Lead, and its utility in external inflammations, sprains,

contusions, and a variety of complaints, is also well entitled to perusal.

In preventing the protrusion of inguinal ruptures, the modern steel-bandages called *trusses* are more effectual than the ancient. The nature of the hernia congenita, or inguinal rupture of infants, was obscure before the publications of Haller, Hunter, and Pott. The last author has written excellent treatises on ruptures and on the hydrocele.

On diseases of the eyes, and surgical operations of those organs, the most celebrated treatises are written by Maitre Jean, C. St. Yves, D. Mauchard, and Taylor; to which may be added, those of Wathen and Ware, modern practitioners of great eminence. David, a modern French surgeon, rejected the operation of depressing the crystalline lens with a needle to the bottom of the orbit, in couching of cataracts; he made an incision through the external coat of the eye, and extracted this humour entire. In the former mode the lens frequently ascended, and again interrupted the rays of light.

On the teeth, their diseases, the dentist operations, and the dentition of infants, we have two excellent treatises, one in French, the other in English; written by P. Fauchard and by J. Hunter. We do not meet among the ancients with any mention of artificial teeth. Hippocrates and Celsus only direct the immediate reinserting into their sockets found teeth suddenly loosened from the jaw. With us, artificial teeth are commonly made from the hard tusk of a sea-horse.

Another modern invention, in which, unfortunately, the advantages and disadvantages are balanced, is that of transplanting sound teeth of similar shape and size from one head, and fixing them instantaneously into the fresh sockets of another person's jaws; there they are tied to the neighbouring teeth by a waxed silk thread, and in a few weeks are firmly grasped and secured by the gums.

Through the writings of almost all the eminent anatomists, there are a variety of miscellaneous surgical operations. To recapitulate their names in detail would be superfluous.

The great superiority of the moderns above the ancients, in the knowledge of anatomy, and the superiority likewise in the construction and workmanship of their instruments, necessarily render all their operations more safe and prosperous.

In England there are two distinct companies now occupying the science of surgery; the one commonly called *barbers*, the other *surgeons*, which latter were not incorporated till lately. The two were united to sue and be sued, by the name of masters or governors, and commonly of the mystery of Barbers and Surgeons of London. 32 Hen. VIII. cap. 42.

No person using any barbery, or shaving in London, was to occupy any surgery, letting of blood, or other matter, drawing of teeth only excepted. And no person using the mystery or craft of surgery, was to occupy or exercise the seal or craft of barbery, or shaving, neither by himself, nor any other for his use. 32 Hen. VIII. cap. 42. By the same statute, surgeons were obliged to have signs at their doors.

EXPLANATION OF PLATE I.

FIGURE I.

Represents the skull of a Woman, who died of the Venereal Disease.

A, the carious part of the skull; B, great part of the upper jaw rotted away.

FIGURE II.

Represents the skull of a Man who died of the Venereal Disease.

A, the bones of the nose. B, the upper jaw. CC, the orbits of the eyes. DD, processus jugales. EE, carious parts of the skull; the places which appear in shadow being exfoliated through both figures.

The bones are subject to diseases from all the same causes that other parts are; but either from their hardness, insensibility, or other causes, they are neither so frequently diseased, nor do their diseases appear so various; and it is generally of more consequence, what texture the diseased bone or part of the bone is of, than from what cause the disease proceeded; for when diseases happen upon the surface of the hard bones, they usually admit a cure by exfoliation. But when matter is formed in the spongy ends of the cylindrical bones, or in the bodies of other spongy bones; the matter, whatever was the first cause, insinuates itself through those spongy cells, swelling the bone, and making generally an incurable caries. But if the matter is corrosive, it often ulcerates these parts, and usually makes so large a discharge as to destroy the patient where the part diseased cannot be extirpated, which is often the case when matter is formed in the bones in scrophulous habits.

The venereal disease rarely attacks any but the hardest parts of the bones; very soon raising large tumours, and caries or mortification, but these carious parts of bones, from this or other causes, are but partially mortified; for were they perfectly so, the sound and unbound parts would separate, though the integuments were not taken off; whence it happens, that where there is a good habit of body, carious bones are often endured many years without much

inconvenience, and we find from experience, that such separations are not to be made till the diseased part is laid bare, and perfectly mortified by being exposed to the air; and then the second part underneath separating from the unsound, there first grandulates a fungous flesh-like appearance, which ought never to be treated with corrosive medicines, it constantly shrinking and hardening of itself, being the same substance, which shoots from the ends of broken bones, where also it soon shrinks and connects into a callous to reunite them.

The diseases of the joints either happen from ulcers in the lubricating glands, which pouring out matter that cannot be discharged, foul the ends of the bones, or else form swellings in the ends of the respective bones; either of these in time create excessive pain, which appears to be chiefly in the ligaments of the joints, notwithstanding what has been said of the insensibility of these parts by authors. When a joint is much swelled, in these cases it is vulgarly called a white swelling, and whatever may be done, when once the limb wastes, and the fingers or toes of the limbs grow thinner at the joints, lose their shape, and are what a painter would call out of drawing, the case then is absolutely irrecoverable. Sometimes in these cases the ends of the bones corrode, then join together and form an ankylosis, which though a bad disease of itself, yet is often a remedy for this disease, which is much worse. In like manner the bones of the hands and feet, when they are ulcerated, sometimes unite, and are thus preserved from total ruin. But there is one case of a white swelling that is amazing, where the pain is so great that there is a necessity of taking off the limb, and yet neither perceive the ligament or glands diseased, nor matter in the joints, nor the bones carious, or any diseased appearance, except that the ends of the bones are a little larger and softer.

Chefelden, in his Osteographia, or Treatise on the Bones, observes that not only these parts, but even the large medullary cavities of the cylindrical bones, have sometimes matter formed in them, which constantly increasing and wanting vent, will, partly by corroding and rendering the bone carious, and partly by pressure, tear asunder the strongest bone in the human body, of which, this author says, he has known several instances. In one case, where the matter had sufficient discharge by an external caries, formed together with the internal one, all the internal hard part of the bone which contains the medulla was separated from the rest, and being drawn out through the place where the external caries made a vent, the patient received a perfect cure. Another case of this kind where the internal part which contains the medulla was also separated from the rest, and there being holes through which the matter was discharged, but none sufficient to take out the unfoliated bone, the matter continued to flow in a great quantity till it destroyed the patient: and possibly if this case had been rightly known, the internal foliated part might have been taken out, and the patient cured. In both these cases it seems as if only so much of the internal part of the bone was become carious, as receives nourishment from the artery which enters the middle of the bone, and as a caries is a mortification of a bone, might not this disease arise from a hurt in the vessels which nourishes that particular part? These are the most common diseases of the bones.

EXPLANATION OF PLATE II. EXHIBITING VIEWS OF THE HUMAN PELVIS.

MALE PELVIS.

FIGURE I.

A front view of the posterior muscles of the pelvis, the subject being put in the attitude as when cut for the stone.

We have begun the Plates with this view, because it is following the order of dissection: these muscles always being shown before the contents of the pelvis are explained, and because these muscles are generally cut in the operation of Lithotomy.

aa, the right and left thighs, *b*, penis, *c*, scrotum, turned back, *dd*, the corpora cavernosa penis: in this view the erector muscles, or as Winslow terms them, the Ischia Cavernosa, are hid in the internal labium of the ramus of the Os Ischium; *e*, the accelerator urinæ, by the assistance of this muscle the last drops of urine are squeezed out; *f*, the transversalis muscle; *g*, levatores ani; *h*, sphincter ani; *i*, the two tuberosities of the os ischium.

FIGURE II.

A side view of the contents of the Pelvis.

A, symphysis pubis, *b*, this letter is placed over the point of the os coccygis above the rectum, the rectum *c*, symphysis sacri or junction between the os ilium and sacrum; *d*, external iliac artery; *e*, iliac vein, *f*, internal iliac artery, *gg*, vesiculæ seminales; *h*, the scrotum; *i*, cowpers glands; *k*, prostate glands; *l*, bulb of the urethra; *m*, vesiculæ seminales, *n*, bladder; *o*, spermatic plexus; *pp*, rectum; *q*, corpus cavernosum penis; *rrr*, the peritoneal coat dissected off from the left thigh; *s*, the right thigh; *t*, the levatores ani; *u*, the umbilical ligament; *vv*, a staff in the urethra, shewing its course into the bladder; *ww*, the left ureter; *xx*, spermatic plexus, coming down from the aorta.

FIGURE III.

A side view of a schirrous, prostate gland, and as a consequence of it the bladder preternaturally enlarged.

a, right thigh; *b*, penis; *c*, scrotum; *d*, the catheter introduced to

shew the situation of the urethra; *e*, symphysis pubis; *f*, bladder; *gg*, the superior and inferior portions of the prostate gland; *i*, bulb of the urethra preternaturally enlarged; *k*, cavity of the rectum; *l*, integuments; *m*, the cut surface of the skin upon the belly; *n*, the navel.

FIGURE IV.

A side view of the blood vessels of the pelvis.

a, the aorta; *b*, vena cava; *cc*, the two iliac arteries; *dd*, the two iliac veins; *e*, internal iliac artery; *f*, Poupart's ligament; *g*, symphysis pubis; *h*, the sciatic artery; *i*, obturator artery; *k*, hæmorrhoidales arteriæ internæ; *l*, arteria vesicalis; *m*, arteria pudica; *n*, arteriæ hæmorrhoidales externæ; *o*, arteria circumflexa, iliac artery; *p*, the left thigh; *q*, rectum; *rr*, the spermatic artery; *s*, vertebrae of the loins; *t*, inferior mesenteric artery; *u*, arteria sacra; *v*, the external iliac artery; *w*, the epigastric artery; *x*, the os ilium; *y*, arteries of the loins; *z*, great trochanter of the right thigh bone.

FEMALE PELVIS.

FIGURE V.

A side view of the cavity of the pelvis.

a, the symphysis pubis; *b*, point of the os coccygis; *c*, the os sacrum; *dd*, the iliac vein and artery cut off; *e*, the external iliac artery; *f*, the obturator nerve; *g*, a portion of the obturator artery; *h*, a knife in the anus; *i*, the lumbar vertebrae; *k*, musculi levatores ani; *l*, the right thigh; *m*, sacral nerves, going to form the great sciatic nerve, or nerve of the thigh; *n*, integuments and fat, &c.

FIGURE VI.

A side view of the contents of the pelvis, with the muscles of the vulva and anus.

aa, the vulva; *b*, a bougie introduced into the vagina; *c*, symphysis pubis; *d*, the clitoris; *e*, sphincter vaginae; *f*, fat and integuments; *g*, a bougie in the rectum; *h*, the uterus; *i*, plexus retiformis; *k*, the vagina; *l*, the rectum; *m*, the internal iliac artery; *n*, the ureter; *o*, levatores ani muscles; *q*, muscles and integuments of the loin; *r*, the os sacrum.

FIGURE VII.

A side view of the blood vessels of the pelvis from Baron Haller.

a, the aorta; *bb*, the two iliac arteries; *c*, the internal iliac artery given off the umbilical ligament and arteries of the bladder, and rectum, &c. *d*, the femoral artery; *e*, the os pubis; *f*, the bladder turned up; *g*, the uterus; *i*, the vagina; *k*, the rectum; *l*, the last lumbar vertebra; *m*, a portion of the vena cava; *n*, the os ilium; *o*, psoas muscle; *p*, the arteria sacra; *q*, the umbilical ligament; *r*, obturator artery; *s*, epigastric artery; *t*, arteria lumbalis.

FIGURE VIII.

A front view of the contents of the pelvis.

a, the thighs; *b*, the recti, muscles and skin, turned over the pubes; *c*, the bladder; *d*, the uterus; *ee*, the fallopian tubes; *f*, the ovaries; *g*, the rectum; *h*, the sigmoid flexor of the colon; *i*, appendiculæ vermiformes; *k*, the cæcum; *l*, the ilium at its insertion into the cæcum; *m*, the psoas muscles; *n*, muscles of the abdomen and integuments.

For description of the bones of the pelvis, see the System of ANATOMY. Part I. Sect. III. Art. 3. and Plate I. Fig. 1. For the muscles of the Pelvis, see the System, Part II. Sect. II. Table Art. 24. For views of the Human Pelvis, male and female, in a variety of situations, see Plate II. annexed to this article.—For a further description of the bones and contents of the Female Pelvis, see the System of MIDWIFERY, Plate I. and its Explanation.

Surgery, as it relates to theory and practice, being so comprehensive in its nature, that to give it in an abstracted point of view would be attended with little utility or entertainment to the readers, and if we were to introduce a regular and complete System, it would occupy the whole space allotted for the completion of the work. We have therefore waved the consideration of it in a systematic point of view, esteeming it a subject of too great importance to admit of abridgment, or to be presented by way of epitome. But we have given a copious account of its rise and progress, and have described the two plates which refer to this article, the latter of which (the human pelvis) we thought could by no means be omitted, though we have not treated the subject at large.

Notwithstanding so many authors have written on this subject, and treated it so copiously, not one of them has illustrated the description by plates; we therefore presume those we have presented will be acceptable to readers in general, and the faculty in particular, as they minutely explain parts so inaccessible to the inspection of the practitioner, so frequently the seat of disease, and consequently of surgical treatment; and further, as they afford more correct information with respect to the relative situation and figures of the parts, than can be derived from the perusal of the best writers. Indeed, in this instance, descriptions without figures to illustrate them, may be considered as a body without animation.

SYSTEM OF SURVEYING.

THE practice of surveying consists of four parts. 1. Measuring straight lines. 2. Taking angles, or finding the position of straight lines with respect to each other. 3. Laying down or planning these positions and measures upon paper. 4. Obtaining the area or superficial measure of the land to be surveyed. Land surveying is therefore an art which teaches us according to the rules of geometry, trigonometry, and mensuration, to find how many times any customary measure is contained in a given piece of ground, and to exhibit the true boundaries thereof, in a plan or map. In this business the curvature of the earth's surface, within the limits of an ordinary survey, is so inconsiderable, that it may be safely considered as a plane. Though in an exceeding large extent, as a province, or a kingdom, such curvature becomes considerable, and due allowance should be made for it.

SECT. I.

OF THE DIFFERENT INSTRUMENTS USED IN SURVEYING, AND THE METHOD OF EXAMINING THEIR ADJUSTMENTS.

A surveyor should be provided, 1. with a measuring chain, and arrows, stations, a cross staff, and offset staff, in order to the taking of distances, or distances may be measured by a measuring wheel, also with a surveying quadrant to correct distances measured by the chain. 2. with a theodolite, plain table, circumferenter, Hadley's sextant, or some other convenient and practical instrument for the taking of angles, or determining the positions of lines; and 3. with a case of pocket instruments, a set of plotting scales, and with parallel rules, proportional compasses, and such other pocket instruments as may be found useful in planning, or laying down the measurements upon paper.

Description of the Chain. The measure now universally adopted in this kingdom for the purposes of land-surveying, is the Gunter's chain. It is 66 feet, or 4 poles in length, and is divided into 100 links, each link, with the rings between them is 7.92 inches long, every tenth link is pointed out by pieces of brass of different shapes for the more ready counting of the old links. *N.B.* Ten chains or 40 poles or perches in length, and one chain, or 4 poles or perches in breadth, make an acre: consequently an acre contains 160 square poles.

Directions for using the chain. Marks are first to be set up at the places whose distance is to be obtained; the place where you begin, may be called your first station; and the station to which you first measure, the second station; two persons are to hold the chain, one at each end; the foremost, or chain leader, must be provided with nine arrows, one of which is to be put down (perpendicularly) at the end of the chain when stretched out, and to be afterwards taken up by the follower, by way of keeping an account of the number of chains. When the arrows have all been put down, the leader must wait till the follower brings him the arrows, then proceeding onwards as before, but without leaving an arrow at the tenth extension of the chain. In order to keep an account of the number of times which the arrows are thus exchanged, they should each tie a knot on a string carried for that purpose (and which may be fastened to the button or button-hole of the coat): they should also call out the number of those exchanges, that the surveyor may have a check on them. And as it is necessary that the chain-bearer should proceed in a straight line, it is a very good method to set up a staff at every ten chains, for the purpose of a guide to preserve the rectilinear direction. All distances of offsets from the chain line to any boundary which are less than a chain, are most conveniently measured by the offset staff: the measure must always be obtained in a direction perpendicular to the station line, which in small offsets may be accurately enough determined by the eye. In large offsets, the cross staff, or some convenient instrument, should be used.

Description of the SURVEYING QUADRANT, invented by Mr. R. KING, Surveyor.

There are two circumstances to be considered in the measuring of lines in an inclined situation: the first regards the plotting, or laying down the measures on paper; the second, the area or superficial content of the land. With respect to the first, it is evident that the oblique lines will be longer than the horizontal ones, or base; if therefore the plan be laid down according to such measures, all the other parts thereof, would be thereby pushed out of their true situations; hence it becomes necessary to reduce the hypothenusal lines to horizontal, which is easily effected by Mr. King's quadrant. With respect to the area, there is a difference among surveyors; some contending that it should be made according to the hypothenusal, others according to the horizontal lines: but as all are agreed to the necessity of the reduction for the first purpose, we need not enter minutely into their reasons here; for even if we admit, that in some cases more may be grown on the hypothenusal plane than the horizontal, yet even then the area should be given according to both suppositions, as the hilly and uneven ground requires more labour in the working. The quadrant, *AB*, fig. 10, Plate of Surveying, is fitted to a wooden square which slides upon an offset staff, and may be fixed at any height, by means of the screw *C*, which draws in the diagonal of the staff, thus embracing the four sides, and keeping the limb of the square perpendicular to the staff; and the staff should be pointed with iron to prevent wear:

when the staff is fixed in the ground on the station line, the square answers the purpose of a cross staff, and may, if desired, have sights fitted to it. The quadrant is furnished with a spirit level, and is fastened to the limb *DE* of the square, by the screw *G*. When the several lines on the limb of the quadrant, have their first division, coincident with their respective index divisions, the axis of the level is parallel to the staff. The first line next the edge of the quadrant is numbered from right to left, and is divided into 100 parts, which shews the number of links in the horizontal line, which are completed in 100 links on the hypothenusal line; and in proportion for any lesser number. The second, or middlemost line, shews the number of links the chain is to be drawn forward, to render the hypothenusal measure the same as the horizontal. The third or uppermost line, gives the perpendicular height, when the horizontal line is equal to 100.

To use the quadrant. Lay the staff along the chain line, on the ground, so that the place of the quadrant may be upright, then move the quadrant till the bubble stands in the middle, and on the several lines you will have, 1. The horizontal length gone forward in that chain. 2. The links to be drawn forward to complete the horizontal chain. 3. The perpendicular height or descent made in going forward on the horizontal chain. The two first lines are of the utmost importance in surveying land, which cannot possibly be planned with any degree of accuracy without having the horizontal line, and this is not to be obtained by any instrument in use, without much loss of time to the surveyor. For with this, he has only to lay his staff on the ground, and set the quadrant till the bubble is in the middle of the space, which is very soon performed, and he saves by it more time in plotting his survey, than he can lose in the field; for as he completes the horizontal chain as he goes forwards, the offsets are always in their right places, and the field-book being kept by horizontal measure, his lines are always sure to close. If the superficial content by the hypothenusal measure be required for any particular purpose, he has that likewise by entering in the margin of his field-book the links drawn forward in each chain, having thus the hypothenusal and horizontal length of every line. Also the third line, which is the perpendicular height, may be used with success in finding the heights of timber.

Of the IMPROVED MEASURING WHEEL, as constructed by Mr. GEORGE ADAMS.

A measuring wheel consists of a wheel of wood, shod or lined with iron, to prevent the wear; a short axis fixed to the wheel, which communicates motion to the wheel-work, included in the body of the instrument. In this instrument, the circumference of the wheel is 8 feet 3 inches, or half a pole; one revolution of this wheel turns a single-threaded worm once round; the worm takes into a wheel of 80 teeth, and turns it once round in 80 revolutions; on the socket of this wheel is fixed an index, which makes one revolution in 40 poles, or one furlong; on the axis of this worm is fixed another worm with a single thread, that takes into a wheel of 40 teeth; on the axis of this wheel is another worm with a single thread, turning about a wheel of 160 teeth, whose socket carries an index that makes one revolution in 80 furlongs, or ten miles. On the dial-plate there are three graduated circles, the outermost is divided in 220 parts, or the yards in a furlong; the next into 40 parts, the number of poles in a furlong; the third into 80 parts, the number of furlongs in ten miles; every mile being distinguished by its proper Roman figure. This is a useful instrument for measuring roads and commons, &c. where expedition is required.

Of the SURVEYING CROSS, or CROSS STAFF.

The cross consists of two pair of sights, placed at right angles to each other; these sights are sometimes pierced out in the circumference of a thick tube of brass about 2 inches diameter. Sometimes it consists of four sights strongly fixed upon a brass cross; this is, when in use, screwed on a staff having a sharp point at the bottom to stick in the ground; one of this kind is represented at fig. 8, surveying. The surveying cross is a very useful instrument for placing of offsets, or even for measuring small pieces of ground; its accuracy entirely depends on the placing the sights, which are to be exactly at right angles to each other. It may be proved by looking at one object through two of the sights, and observing at the same time, without moving the instrument, another object through the other two sights; then turning the cross upon the staff, look at the same objects through the opposite sights; if they are accurately in the direction of the sights, the instrument is just.

The Common PLANE TABLE.

This is an instrument so well known that it is unnecessary to delineate it. The tabular part of it is usually made of two well seasoned boards forming a parallelogram of about 15 inches long, and 12 inches broad: the size is occasionally varied to suit the intentions of the operator. The aforesaid parallelogram is framed with a ledge on each side to support a box frame, which frame confines the paper on the table, and keeps it close thereto; the frame is therefore so contrived, that it may be taken off and put on at pleasure, either side upwards; each side of the frame is graduated; one side is usually divided into scales of equal parts, for drawing lines parallel or perpendicular to the edges of the table, and also for more conveniently shifting the paper: the other face or side of the frame is divided

vided into 360°, from a brass center in the middle of the table, in order that angles may be measured as with a theodolite; on the same face of the frame, and on two of the edges, are graduated 180°, the center of these degrees is exactly in the middle between the two ends, and about $\frac{1}{4}$ part of the breadth from one of the sides. A magnetic needle and compass box, covered with glass and spring ring, slides in a dovetail on the under side of the table, and is fixed there by a finger screw; it serves to point out the direction, and be a check upon the sights. There is also a brass index somewhat larger than the diagonal of the table, at each end of which a sight is fixed; the vertical hair, and the middle of the edge of the index, are in the same plane; this edge is chamfered, and is usually called the fiducial edge of the index. Scales, of different kinds, are usually laid down on the edge of the index. Under the table is a spring to fix on the pin of the ball and socket, by which it is placed upon a three-legged staff.

To place the Paper on the Table, take a sheet of paper that will cover it, and wet it to make it expand, then spread it flat upon the table, pressing down the frame upon the edges to stretch it, and keep it in a fixed situation: when the paper is dry it will by contracting become smooth and flat.

Of Shifting the Paper on the PLANE TABLE.

When the paper on the table is full, and there is occasion for more, draw a line in any manner through the farthest point of the last station line, to which the work can be conveniently laid down; then take the sheet of paper off, and fix another on the table; draw a line upon it in a part most convenient for the rest of the work; then fold or cut the old sheet of paper by the line drawn on it, apply the edge to the line on the new sheet, and, as they lie in that position, continue the last station line upon the new paper, placing upon it the rest of the measures, beginning where the old sheet left off, and so on from sheet to sheet. To fasten all the sheets of paper together, and thus form one rough plan, join the aforesaid lines accurately together, in the same manner as when the lines were transferred from the old sheets to the new one. But if the joining lines upon the old and new sheet have not the same inclination to the side of the table, the needle will not point to the original degree when the table is rectified. If the needle therefore should respect the same degree of the compass, the easiest way of drawing the line in the same position, is to draw them both parallel to the same sides of the table, by means of the scales of equal parts on the two sides.

To use the Plane Table. Fix it at a convenient part of the ground, and make a point on the paper to represent that part of the ground. Run a fine steel pin or needle through this point into the table, against which you must apply the fiducial edge of the index, moving it round till you perceive some remarkable object, or mark set up for that purpose. Then draw a line from the station point, along the fiducial edge of the index. Now set the sights to another mark, or object, and draw its line, and so proceed till you have obtained as many angular lines as are necessary from this station. The next requisite is the measure or distance from the station to as many objects, as may be necessary, taking at the same time the offsets to the required corners or crooked parts of the hedges; setting off all the measures upon their respective lines upon the table. Now remove the station to some other station, whose distance from the foregoing was previously measured; then lay down the objects which appear from thence, and continue these operations till your work is finished, measuring such lines as are necessary, and determining as many as you can by intersecting lines of direction, drawn from different stations. In uneven ground, the table cannot in all stations be set horizontal, or uniformly in any one place. Also the contraction and expansion of the paper according to different degrees of moisture and temperature of the air, is a source of many errors in the use of this instrument, if not carefully attended to.

Of the IMPROVED PLANE TABLE, Fig. 9.

To remedy some of the inconveniences and errors, to which the common plane table is liable, the following improved one usually called Beighton's plane table, though differing in many respects from that described by him in the Philosophical Transactions, is constructed and sold by Mr. George Adams of Fleet Street. It is a plain board, 16 inches square, with a frame of box or brass round the edge, for the purpose of being graduated. On the sides AB, CD, are two grooves and holdfasts for confining firmly, or easily removing the paper; they are disengaged by turning the screws under the table from the right towards the left, and drawn down and made to press on the paper by turning the screws the contrary way. When the holdfasts are screwed down, their surface is even with that of the table. There are two pincers to hold that part of the paper, which in some cases lies beyond the table, and prevent its flapping about with the wind. The compass box is made to fit either side of the table, and is fixed, by two screws, and does not when fixed, project above one inch and a half from the side of the table. There is an index with telescopic sights, EFGH; it is sometimes so constructed, as to answer the purpose of a parallel rule. The papers or charts for this table, are to be either a fine thin pasteboard, fine paper pasted on cartridge paper, or two papers pasted together, cut as exactly square as possible, and of such a length that they may slide in easily, between the upright parts, and under the flat part of the holders. Any one of these charts may be put into the table any of the four ways, be

fixed, taken out, and changed at pleasure; any two of them may be joined together on the table, by making each of them meet exactly at the middle, whilst near one half of each will hang over the sides of the table; or by doubling them both ways through the middle, four of them may be put on at one time, meeting in the centre of the table. For this purpose, each chart is always to be crossed quite through the middle; by these means the great trouble and inaccuracy in shifting the paper is removed. The charts thus used, are readily laid together by corresponding numbers on their edges, and thus make up the whole map, in one view; and being in squares are portable, easily copied, enlarged or contracted. Underneath the table is a spring to fit on the socket of a staff with parallel plates and adjusting screws.

Of the CIRCUMFERENTER.

This instrument consists of a compass box, a magnetic needle, and two plain sights, perpendicular to the meridian line in the box, by which the bearings of objects are taken from one station to another. It is not much used in England where land is valuable; but in America, where land is not so dear, and where it is necessary to survey large tracts of ground (overstocked with wood,) in a little time, and where the surveyor must take a multitude of angles, in which the sight of the two lines forming the angle may be hindered by underwood, the circumferenter is chiefly used. The circumferenter, see fig. 12, consists of a brass arm about 14 or 15 inches long, with sights at each end, and in the middle thereof a circular box (with a glass cover) of about $5\frac{1}{2}$ inches diameter; within the box is a brass graduated circle, the upper surface divided into 360 degrees, and numbered 10. 20. 30. to 360; every tenth degree is cut down on the inner edge of the circle. The bottom of the box is divided into four parts or quadrants, each of which is subdivided into 90 degrees numbered from the meridian, or north and south points, each way to the east and west points; in the middle of the box is placed a steel pin finely pointed, called the center pin, on which is placed a magnetic needle, the quality of which is such, that (allowing for the difference between the astronomic and magnetic meridians) however the instrument may be moved about, the bearing or angle which any line makes with the magnetic meridian, is at once shewed by the needle. At each end of the brass rule, and perpendicular thereto, sights are fixed; in each sight there is a large and small aperture, or slit, one over the other, these are alternate; that is, if the aperture be uppermost in one sight, it will be lowest in the other, and so of the small ones; a fine piece of sewing silk, or a horse hair, runs through the middle of the large slit. Under the compass box is a socket to fit on the pin of the staff; the instrument may be turned round on this pin, or fixed in any situation by the milled nut; it may also be readily fixed in an horizontal direction by the ball and socket of the staff, moving for this purpose the box, till the ends of the needle are equidistant from the bottom, and traverse or play with freedom.

To use the circumferenter. Let FED, (fig. 1.) be the angle to be measured. 1. The instrument being fixed on the staff, place its centre over the point E. 2. Set it horizontal, by moving the ball in its socket till the needle is parallel to the bottom of the compass box, on which the flower de lys is engraved, next the eye. 4. Look along EF, and observe at what degree the needle stands, suppose 30. 5. Turn the instrument round upon the pin of the ball and socket, till you can see the object D, and suppose the needle now to stand at 125. 6. Take the former number of observed degrees from the latter, and the remainder is the required angle. When in the use of the circumferenter, you look through the upper sights from the ending of the station to the beginning, it is called a *back-sight*; but when you look through the lower slit from the beginning of the station towards the end, it is termed the *fore-sight*.

Of the NEW IMPROVED CIRCUMFERENTER, as constructed by Mr. ADAMS.

The excellency and defects of the preceding instrument both originated in the needle; from the regular direction thereof, arise all its advantages; the unsteadiness of the needle, the difficulty of ascertaining with exactness the point at which it settles, are some of its principal defects. In this improved construction, these are obviated, as will be evident from the following description. One of these instruments is represented at fig. 11. A pin of about three quarters of an inch diameter goes through the middle of the box, and forms as it were a vertical axis, on which the instrument may be turned round horizontally; on this axis an index AB is fastened, moving in the inside of the box, having a nonius on the outer end to cut, and subdivide the degrees on the graduated circle. By the help of this index, angles may be taken with much greater accuracy than by the needle alone; and as an angle may be ascertained by the index with or without the needle, it of course removes the difficulties which would otherwise arise if the needle should at any time happen to be acted upon, or drawn out of its ordinary position by extraneous matter; there is a pin beneath, whereby the index may be fastened temporarily to the bottom of the box, and a screw as usual, to fix the whole occasionally to the pin of the ball and socket, so that the body of the instrument, and the index, may be either turned round together, or the one turned round, and the other remain fixed, as occasion shall require. A further improvement is that of preventing all horizontal motion of the ball in the socket; the ball has a motion in the socket every possible way, and every one

SURVEYING.

of these possible motions is necessary except the horizontal one, which is here totally destroyed, and every other possible motion left perfectly free.

Of the COMMON THEODOLITE.

The common theodolite consists of a brass graduated circle, and a moveable index; on the top of the index is a compass with a magnetic needle, the compass box is covered with a glass, two sights are fixed to the index, one at each end, perpendicular to the plane of the instrument; there are two more sights which are fitted to the graduated circle at the point of 360° and 180° ; they all take on and off for the convenience of packing. In each sight, there is, as in the circumference, a large and a small aperture placed alternately, the large aperture in one sight being always opposed to the narrow aperture in the other; underneath the brass circle, and in the center thereof, is a spring to fit on the pin of the ball and socket which fixes on a three-legged staff. The circle is divided into degrees, which are all numbered one way to 360° , usually from the left to the right, supposing yourself at the center of the instrument; on the end of the index is a nonius division, by which the degrees on the limb are subdivided to five minutes; the divisions on the ring of the compass box are numbered in a contrary direction to those of the limb. The index should move regularly when in use; the theodolite should always be placed truly horizontal, otherwise the angles measured by it will not be true; of this position you may judge with sufficient accuracy by the needle, for if this be originally well balanced, it will not be parallel to the compass-plate unless the instrument be horizontal.

THEODOLITES with TELESCOPIC SIGHTS.

Theodolites with telescopic sights are without doubt the most accurate, commodious, and universal instruments for the purpose of surveying, and have been recommended as such, by the most expert practitioners, and best writers on the subject, as Gardiner, Hammond, Cunn, Stone, Wild, Emmerfon, Waddington, &c. The leading requisites in a good theodolite are; 1. That the parts be firmly connected, so that they may always preserve the same figure. 2. The circles must be truly centred and accurately graduated. 3. The extremity of the line of sight should form a true circle; various sorts of theodolites have been invented by different Artists; but that which we shall here describe, claims the preference above all others; except perhaps one that Mr. Adams was about the construction of, but the description of which has not been made public.

Of the THEODOLITE, as improved by RAMSDEN, fig. 7.

Among the improvements the instruments of science have received from Mr. Ramsden, we are to rank those of the theodolite; in the present instance, he has happily combined elegance and neatness of form with accuracy of construction; and the surveyor will contemplate with pleasure this instrument, and the various methods by which the parts concur to give the most accurate results. The principal parts of this instrument are similar to those of a common theodolite. FF represents the horizontal limb, so called, because when in use it ought always to be placed parallel to the horizon. It consists of two plates, the edges of these two are chamfered, so that the division, and the nonius are in the same plane, which is oblique to the plane of the instrument. The limb is divided into half degrees, and subdivided by the nonius to every minute; it is numbered to 300 from the north towards the east: besides these, the tangents to 100 of the radius are laid down thereon. The upper plate is moved by turning the pinion; on this plate are placed, at right angles to each other, two spirit levels for adjusting more accurately the horizontal limb. NOP is a solid piece fitted on the upper horizontal plate, by means of three capstan headed screws passing through three similar screws. By the action of these, the vertical arch may be set perpendicular to the horizontal limb, or be made to move in a vertical plane. On this solid piece are fixed two stout supports to carry the axis of the vertical arch which arch is moveable by the pinion E. On the upper part of the vertical arch are the Y's and loops to support and confine the telescope: the Y's are tangents to the cylindric rings of the telescope, which rings are turned and then ground as true as possible, and are prevented from moving backwards or forwards, by means of two shoulders. The telescope is acromatic, and may be adjusted to the eye of the observer, or the distance of the object, by turning the milled nut B. The hairs are adjusted by the screws in the eye tube. Under the telescope is fixed a spirit level C, the distance of whose ends from the telescope may be regulated by the screws cc. Beneath the horizontal limb there is a second telescope, which has both an horizontal and vertical motion; it is moved horizontally by the milled screw H, and when directed to any object, is fixed in its situation by another middle screw; it moves vertically on the axis; there is an adjustment to this axis, to make the line of collimation move in a vertical plane. By the horizontal motion, this telescope is easily set to what is called the backset stations; the under telescope keeping in view the back object, while the upper one is directed to the fore object. Underneath the lower telescope is a clip to fasten occasionally the main axis: this clip is tightened by the finger screw L, and when tightened, a small motion of the adjusting screw K, will move the telescope a few degrees, in order to set it with great accuracy. Beneath these is the staff, the nature of which will be sufficiently evident from what was said thereon in the description of the last theodolite, or by inspection of the figure.

To adjust the Levels of the Horizontal Plate.

1. Place the instrument on its staff, with the legs thereof at such a distance from each other, as will give the instrument a firm footing on the ground. 2. Set the nonius to 360, and move the instrument round, till one of the levels is either in a right line with two of the screws of the parallel plates, or else parallel to such a line. 3. By means of the two last mentioned screws, cause the bubble in the level to become stationary in the middle of the glass. 4. Turn the horizontal limb by the milled nut half round, or till the nonius is at 180, and if the bubble remains in the middle as before, the level is adjusted; if it does not, correct the position of the level, by turning one or both of the screws which pass through its ends, till the bubble has moved half the distance it ought to come to reach the middle, and cause it to move the other half, by turning the screw of the parallel plates. 5. Return the horizontal limb to its former position, and if the adjustments have been well made, the bubble will remain in the middle; if otherwise, the process of altering must be repeated till it bears this proof of accuracy. 6. Now regulate the screws of the staff-head, so that the bubble remain in the middle while the limb is turned quite round. 7. Adjust the other level by its own screws to agree with that already adjusted.

To adjust the LEVEL under the TELESCOPE.

1. The horizontal plate being levelled, set the index of the nonius of the vertical arch to 0, pull out the two pins, and open the loops which confine the telescope. 2. Adjust the bubble by its own screws. 3. Reverse the level so that its right-hand end may now be placed to the left: if the bubble continues to occupy the middle of the glass it is in its right position; if not, correct one half of the error by the capstan screws under the plate, and the other half by the screws under the level. 4. Reverse the level, and correct if there is any occasion, continuing the operations till the error vanishes, and the bubble stands in the middle in both positions.

To adjust the LINE of COLLIMATION.

1. Direct the telescope, so that the horizontal wire may coincide with some well defined parts of a remote object. 2. Turn the telescope so that the bubble may be uppermost: if the wire does not coincide with the same part of the object as before, correct half the difference by moving the vertical circle, and the other half by moving the wire, which is effected by the screws in the eye tube of the telescope, and so on repeatedly, till the difference wholly disappears. Lastly, adjust the vertical wire in the same manner; when the two wires are properly adjusted, their intersection will coincide exactly with the same point of an object, while the telescope is turned quite round. The description of Hadley's Sextant, which is also a very useful instrument in surveying, the reader will find in the Treatise on Navigation.

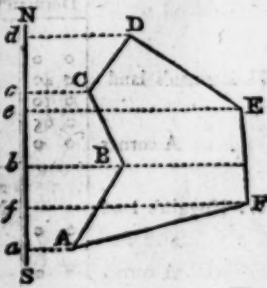
General Directions for Surveying.

The surveyor being provided with a surveying chain, and proper instruments, he must proceed to take the dimensions, &c. of the ground to be surveyed; and that must be done by dividing it into some convenient polygon, regular, or irregular, as the case may happen. And to effect this, he must fix as many marks at the several corners, and out-parts of the field, as are necessary for that purpose. And beginning his survey at some convenient place, he must direct the chain in a straight line, from one station to another, and with instruments must take as many angles as he can; by means of those angles and sides, he will be able from geometrical and trigonometrical principles, to make a plot of the ground or estate which he is about to survey; and he will find it constituted of a number of triangles, from the dimensions of which he must find the area, according to the rules delivered in our system of Mensuration; observing, however, that the operation will be performed in chains and decimal parts, or links, each link being the 100th part of a chain, and that ten square chains is an acre. But there is one general method for finding the area which I prefer to any other, where the surveyor is furnished with instruments for taking the bearings of the different stations. This is by means of such a table as is used in navigation, for finding the eastings, and westings, and northings, and southings; commonly called a table of difference of latitude, and departure; the rule adapted to this method is derived from the following theorem.

UNIVERSAL THEOREM.

If the sum of the distances, (on an east and west line,) of the two ends of each line of the survey, from any assumed meridian laying entirely out of the survey, be multiplied by the respective northing or southing, made on each respective line; the difference between the sum of the north products, and the sum of the south products, will be double the area of the survey.

* Demonstration. Let ABCDEF be any survey, and let the east and west lines Aa, Bb, Cc, Dd, Ee, and Ff, be drawn from the ends of each of the lines of the survey to any assumed meridian, as N. S. laying entirely out of the survey.



SURVEYING.

Then, say, the difference between the sum of the products $Aa+Bb \times a b$, $Bb+Cc \times b c$, $Cc+Dd \times c d$, and the sum of the products $Dd+Ee \times d e$, $Ee+Ff \times e f$, $Ff+Aa \times f a$; will be double the area of ABCDEFA. For, the former products will be, respectively, double the areas of the spaces ABba, Bccb, and Cddc, and their sum will of course be double the area of the space Aad DCBA. In like manner the latter products will be, respectively, double the areas of the spaces DEed, EFfe, and FAaf; and their sum will of course be double the area of the space AadDEFA, but it is evident that the difference between the areas of the spaces AadDEFA, and AadDCBA must be the area of the space ABCDEFA; consequently the difference between their double, must be double the area of ABCDEFA.

To take the plot of a field, ABCDEF with a plain table, by going round the same, *fig. 1*. Set up your plain table at the first station in the field; move the fiducial edge of the index on the centre $\odot$, and take an observation at the mark placed at the 2d station, then will the same fiducial edge cut the circle $OPQR$ in the point 1; then remove your instrument to the 2d station, and placing the edge of the index on $\odot$ and the point 1, take a back sight to the 1st, or last, station; then directing the index on the centre $\odot$ to the 3d or next station the edge thereof will cross the circle in the point 2. In like manner the instrument being planted at every station, a backsight taken to the last preceding one, and the index directed forward to the next succeeding station, will give the protracted points, 3, 4, 5, 6. The field book is ruled into five columns, the middle column contains the courses or bearings and distances, the adjoining columns on the right and left contain the measure of the offsets to the right and left respectively; and the outside column contains remarks made on the right or left hand respectively.

To draw the Plan.

Chuse any point $\odot 1$, to denote the first station, lay the edge of a parallel ruler on the centre $\odot$ and the point 1, and extend the other edge till it touch $\odot 1$, and draw by the side thereof the line 1 2 in length equal to the proper measured distance; then apply the ruler to $\odot$ and the mark 2, and extend the other edge to $\odot 2$, and draw thereby the line 2 3 equal to its proper length; again, lay the edge of the ruler to $\odot$ and the point 3, and the other edge being extended to $\odot 3$, draw the line 3 4 according to its length; after the same method lay down the remaining stations, and the traverse is delineated.

To take the plot of several fields A, B, C, D, by circulation, *fig. 2*. From the projecting point $\odot$, by the last example, project the stations in A into the points 1, 2, 3, 4; then the instrument being planted at the 2d station, from the same projecting point $\odot$, project that station, the 2d in A, into the point 2², 2² denoting the instrument being planted a second time at that station, which is done thus: lay the index to $\odot$ and the point 2, and take a back-sight to the first station, that being the station immediately preceeding that you are at in the field-book; then on the center $\odot$ take a fore-observation at the next succeeding station, and the index will cut the circle in the point 2². Thus project every other remaining station. The bearings being protracted, the plan will be drawn by setting off the respective distances, &c.

Practice of Surveying, fig. 3, represents a field to be surveyed whose boundaries are crooked. Having a circumferenter, theodolite, or other proper instrument, set it up at or near any convenient corner as at 1, and take the course and bearing, which suppose to be north 7° west, note this down in the middle column of the field-book, and measure with the chain as before directed, till you come opposite to the first bend, so that the bend be at right angles to the station line: note the distance thus measured, 3 chains, 60 links, in the middle column, and measure the offset from thence to the bend, 40 links, noting the same in the adjoining left-hand column, (because the boundary is on the left-hand of the station line) and note in the outside column, the name or owner of the adjoining field, proceeding in the same manner all round the field, noting the courses, distances, offsets, and remarks, as in the following.

FIELD-BOOK.

Remarks.	Off-sets.	Station lines.	Off-sets.	Remarks.
		1st. at the corner, against Wm. Humphreys, and H. Derman's land.		
		N. 7° W.		
H. Derman's land	0 0	3 60	0 0	
	0 10	8 45	0 0	
	0 65	15 60	0 0	
A corner	0 0	21 00	0 0	
		2d.		
W. Huggin's land	0 0	N. 55° 15 E.	0 0	
	0 0	6 10	0 60	
A corner	0 0	18 20	0 0	To the boundary of the field.

FIELD-BOOK.

Remarks.	Off-sets.	Station lines.	Off-sets.	Remarks.
		3d.		
D. Horne's land	0 0	S. 62° 30 E.	0 0	
	0 0	7 40	0 90	
A corner	0 0	14 40	0 0	To the boundary of the field.
		4th.		
C. Ward's land	0 0	S. 40° W.	0 0	
	0 40	8 00	0 0	
To a corner	0 95	11 00	0 0	
		5th.		
To the above cor.	0 98	S. 4° 15 E.	0 66	
C. Ward's land	1 25	7 50	0 0	
A corner	0 0	14 00	0 0	
		6th.		
W. Humphrey's land.	0 0	N. 73° 45 N.	0 0	
	0 0	3 20	0 3	
		7 50	1 25	
		12 40	0 0	To the boundary of the field.
		7th.		
W. Humphrey's land.	0 0	S. 52° W.	0 0	
	0 0	4 10	0 60	
		9 17	0 0	To the boundary of the field.

Here at setting out, the line from the first to the second station bears N. 7° W. and at the distance of three chains and sixty links, there is an offset to the left of forty links; at 8 chains forty-five links, there is an offset of ten links; at fifteen chains and sixty links, there is an offset of sixty-five links; at the second station there is no offset; then the third station bears N. 55° 15 E. and at six chains ten links distance, there is an offset of sixty links to the right-hand, and so for the rest.

The northings and southings, eastings and westings, in the following table are obtained thus: first find the course 7 degrees in the traverse table, and over against 21 chains in the column marked dist. you have 20.84, that is 20 chains, 84 links, for the quantity of northing; and 2.56, that is 2 chains, and 56 links for the westing made on that course and distance. 2. Find the next course 55.15 in the table, and over against 18 chains in the column dist. you have 10 chains 26 links for the northing, and 14 chains 79 links for the easting; and over against 20 links in the column dist. you have 11 links, and 16 links for northing and easting respectively, which put together make 10 chains 37 links, for the northing, and 14 chains 95 links, for the easting made on the second course; and so of the rest. The north and south distances made from the place of beginning to the end of each line, contained in the next column, are determined thus. On the first course, 20 chains and 84 links of northing was made; on the second course, 10 chains 37 links of northing, which added to the preceding, makes 31 chains 21 links of northing; on the third course was made, 6 chains 65 links of southing, which subtracted from the preceding, 31 chains 21 links of northing, makes 24 chains 56 links of northing; and so of the rest. The east and west distances made from the place of beginning to the end of each line contained in the next right-hand column, are determined in the same manner; thus, on the first course was made, 2 chains 56 links of easting; on the second course, 14 chains 25 links of easting; from which, subtracting the preceding 2 chains 56 links of westing, there remains 12 chains 39 links of easting; on the third course was made, 12 chains 77 links of easting, which added to the preceding 12 chains 39 links, makes 25 chains 16 links of easting; and so of the rest. The distances of the end of each line from the assumed meridian, contained in the next right-hand column, are thus determined. The first assumed number may be taken at pleasure, provided only, that it exceeds the greatest quantity of westing contained in the preceding column, whereby the assumed meridian shall be entirely out of the survey. In the foregoing example, the greatest quantity of westing contained in the preceding column, is 2 chains 56 links; the nearest whole number greater than this, is 3 chains, which is accordingly taken and placed at the top, to represent the distance between the assumed meridian and the place of beginning of the survey; from this 3 chains, subtract 2 chains 56 links of westing, there remains 44 links for the distance between the terminations of the first line and the assumed meridian. The 12 chains 39 links of easting, in the next step, is added to the assumed 3 chains which make 85 chains 39 links, for the distance of the termination, by the second line from the assumed meridian. The 25 chains 16 links of easting, in the next step, being added in like manner to the assumed 3 chains, makes 28 chains 16 links, for the distance of the termination of the third line from the assumed meridian, and so on, always adding the eastings, and subtracting the westings from the first assumed number.

The three last columns, relating to the area, are the only ones that remain to be explained. The first of these three columns contains the sums of the distances of the two ends of each line of the survey

SURVEYING.

survey from the assumed meridian; which (according to the above universal theorem) are multipliers for determining the area. These are formed by adding each two of the successive numbers in the preceding left-hand column together. Thus 3.00 is the distance of the place of beginning from the assumed meridian; and 0.44 is the distance of the end of the first line from the assumed meridian; and their sum is 3.44 for the first multiplier. Again, 0.44 added to 15.39 makes 15.83 for the second multiplier. And 15.39 added to 28.16 makes 43.55 for the third multiplier; and so of the rest.

For a Proof of the Field Work.				For the Plotting.				For the Area.			
Field Notes.				North and South Distances made on each line.				Sum of the distances of the ends of each line from an assumed meridian, laying out to the end of each line.			
Courses and distances as taken in the field.				N.	S.	E.	W.	N.	E.	W.	E.
1. N. 7° 15' E. 21.00				20.4		14.95	2.56	N. 20.84	W. 2.56		
2. N. 55° 15' E. 18.20				10.37		12.77		N. 31.21	E. 12.39		
3. S. 62° 30' E. 14.40					6.65			N. 24.56	E. 25.16		
4. S. 40° 00' E. 11.00					8.43			N. 16.13	E. 18.09		
5. S. 4° 15' E. 14.00					13.96	1.04		N. 2.17	E. 19.13		
6. N. 73° 45' W. 12.40				3.47			11.90	N. 5.64	E. 7.83		
7. S. 32° 00' W. 9.17					5.64		7.23				
Total				34.68	34.68	28.76	28.76				
				The agreement between the sum of the northings, and the sum of the southings, and between the sum of the eastings, and the sum of the westings, shews that the survey has been truly taken.							
								The first and third of these columns only are used in plotting;—the middle column is only a preparatory step, for the distances contained in the third column.			
								Sum of the distances of the ends of each line from an assumed meridian, laying out to the end of each line.			
								North prod. 138 47 534			
								Subtract 34 84 359			
								2) 103 46 175			
								Area. Acres 51 73 087			
								Roods 2 95 948			
								Perches 36 93 920			
								North prod. 138 47 534			
								Subtract 34 84 359			
								2) 103 46 175			
								Area. Acres 51 73 087			
								Roods 2 95 948			
								Perches 36 93 920			

line and the boundary of the field, we have first, a base line 3.60, and a perpendicular offset 0.40; which contains an area, of 0.07200. Secondly, a base line 4.85 (being the difference between 3.60 and 8.45; on the station line, at which points the offsets were taken,) and an offset or breadth at the one end 0.40, and at the other end 0.10, which contains an area of 0.12125. Thirdly, a base line 7.15 (being the difference between 8.45 and 15.60 on the station line,) and an offset or breadth at the one end 0.10, and at the other end 0.65; which contains an area of 0.26812. Fourthly, a base line 5.40 (being the difference between 15.60 and 21.00 on the station line,) and a perpendicular offset 0.65; which contains an area of 0.17550. These added together, make 0.63687 for the area of the offset on the first station line: and, as this station line is within the survey, this area must of course be added to the area comprehended within the station lines. Next, for the area comprehended between the second station line and the boundary of the field, we have a base line 18.20, and a perpendicular or offset 0.60; which contains an area of 0.54600. And, as this station line is without the survey, this area must of course be subtracted from the above mentioned area.

The areas of all the other offsets are determined in the same manner, and are respectively as follows: viz.

Areas of the offsets.		
To be added	To be subtracted.	
On the first station line - - - -	A. 0.63687	
On the second - - - - -		0.54600
On the third - - - - -		0.64800
On the fourth - - - - -	0.36250	
On the fifth - - - - -	1.08875	
On the sixth - - - - -		0.68750
On the seventh - - - - -		0.27510
Totals - - - - -	2.08812	2.15660

The area comprehended within the station lines, as above, is 51.73087 acres. The offsets to be added are 2.08812. The sum is 53.81899. The offsets to be subtracted are 2.15660. The area of the survey is therefore 51.66239 acres, = 51 acres, 2 roods, and 26 perches. When the survey consists of a number of fields lying together, it is best to determine the area of the whole, first; and afterwards, the area of each of the fields separately; the sum of which if the work be true, will of course agree with the area of the whole; which forms a check on the truth of the computations. But here it must be observed, that the boundaries of each field must be so arranged for the computation, as to proceed regularly one after another, all the way round the field, because without such arrangement, the northing or fouthing made on each line, and the distances from the assumed meridian, would not correspond with one another. For example. Suppose it were required to ascertain the area of the fields denoted by fig. 4. of which this is the

FIELD-BOOK.

Remarks.	Off-sets.	Station lines.	Off-sets.	Remarks.
1st. At a corner against Winterton farm, and H. Smith's land.				
Land of H. Smith	0 00	S. 87° W.	0 00	East field.
		0 00	1 10	To the corner of east and west fields.
		5 50	0 00	corner of west field.
		11 30	0 60	
Hunterdon farm		2d N. 18° 30' W.		The above corner.
		0 58	0 16	
		9 60	0 00	
		3d N. 12° 15' E.		West fields.
Lands of Jacob Williams		0 00	0 00	
		4 10	0 60	
		8 90	0 00	
		4th N. 37° E.		To the corner of the west field, and north field.
Winterton farm	0 00	5 40	0 40	
		17 00	0 00	
		5th S. 76° 45' E.		North field.
	0 70	6 50		
Winterton farm	0 00	16 00	0 00	
		6th S. 5° 15' W.		To the corner of north and east field.
		9 60	0 56	N. B. A gate into each field 20 links from the corner.
		14 30	0 10	
Winterton farm		19 00	0 70	
		25 00	0 00	
		7th S. 74° 30' W.		East field.
		2 30	0 86	
Winterton farm		7 65	0 00	

the north products contained in the next column, are the products of the multiplication of the several northings contained in the columns marked N, by their corresponding multipliers in the last mentioned column. Thus 7.16896 is the product of the multiplication of 20.84 by 3.44; an additional place of decimals being cut off, to give the product in acres. The fourth products contained in the next right-hand column are, in like manner, the products of the multiplication of the several fouthings in the column marked S, by their corresponding multipliers. Thus 28.96075, is the product of the multiplication of 6.65 by 43.55; an additional place of decimals being cut off, as before, to give the product in acres: and so of the rest. The north products being then added together into one sum, and the fourth products into another sum, and the lesser of these sums being subtracted from the greater; the remainder (by the above universal theorem) is double the area of the survey; which being divided by 2, gives the area required: viz. 51.73087, equal (when reduced) to 51 acres, 2 roods, and 36 perches 9-10. Nothing can be more simple or easy in the operation, or more accurate in answering the desired ends, both with respect to the proof of the work, the plotting and the computation of the area, than this process. The northings, fouthings, eastings, and westings, which give the most decisive proof of the accuracy, or inaccuracy of the field work, are shewn by inspection. From these the numbers or distances for the plotting, are formed by a simple addition or subtraction. And the multipliers, for determining the area, are formed from thence, by a simple addition, with much less labour, than by the common method of dividing the plot into trapezia, and taking the multipliers by the scale of equal parts. If the boundary lines of the survey should have crooks and bends in them, which is generally the case in old settled countries, those crooks and bends are taken by making offsets from the station lines. In these cases the area comprehended within the station lines is determined as above; and the areas comprehended between the station lines and the boundaries, are determined separately, from the offsets and base lines, noted in the field book; and are added or subtracted respectively, according as the station lines shall happen to be within or without the field surveyed; which, of course, gives the area required. In the present case the area comprehended between the first station

SURVEYING.

FIELD-BOOK.

Remarks.	Off-sets.	Station lines.	Off-sets.	Remarks.
West field		8th North 8 30 16 61	0 75 0 00	East field.
		9th East 0 5 40 13 77	0 00 0 60 0 00	East field. To the corner of north and east fields against Winterton farm.
North field	0 00	10th Back to the last Station. N. 62° 03' W.		
West field				North field.
Corner of west and north fields against Huntendon farm.	0 00 0 70 0 00	0 3 40 7 92	0 00 0 00 0 00	

The bearings and lengths of the station lines on the outside boundaries are as follow; viz.

1st. S. 87° W. 15.00; 2d. N. 18° 30' W. 9.60; 3d. N. 12° 15' E. 8.90; 4th. N. 37° E. 17.00; 5th. S. 76° 45' E. 16.00; 6th. S. 5° 15' W. 25.00; 7th. S. 74° 30' W. 7.65.

The area comprehended within these station lines, computed according to the abovementioned universal theorem, is A. 66.90493; the area of the offsets to be added, is 0.56715; the sum is 67.47208; and the area of the offsets to be subtracted, is 2.56715; therefore the area of the whole survey is 64.90493 acres = 64 acres, 3 roods, and 24 perches.

Then for determining the area of the east field, we have the following. 1st. Part of the first station line in the field book, viz. S. 87° W. 5.50; 2d. The offset of the corner of the field, N. 3° W. 1.10; 3d. The eighth station line in the field book, N. 16° 61; 4th. The ninth station line in the field book, E. 13.77; 5th. The offset from the corner of the field to the sixth station line in the field book, S. 84° 45' E. 0.56; 6th. Part of the 6th station line in the field book, S. 5° 15' W. 15.40; 7th. The seventh station line in the field book, S. 74° 30' W. 7.65. The area comprehended within these lines, (computed according to the foregoing universal theorem,) is 22.91936 acres. There are no offsets to be added in this field, the areas of the offsets to be subtracted, are 2.22052 acres. The remainder is the area of the east field, 20.69884 acres, = 20 acres, 2 roods, 31.8 perches.

For ascertaining the area of the west field, we have the following lines. 1st. The offset from the fourth-easterly corner to the first station line in the field book, S. 3° E. 1.10; 2d. Part of the first station line in the field book, S. 87° W. 9.50; 3d. The second station line in the field book, N. 18° 30' W. 9.60; 4th. The third station line in the field book, N. 12° 15' E. 8.90; 5th. Part of the fourth station line in the field book, N. 37° E. 5.40; 6th. The offset to the corner, S. 53° E. 0.40; 7th. The tenth station line in the field book, reversed, S. 62° 30' E. 7.92; 8th. The eighth station line in the field book, reversed, S. 16.61. The area comprehended within these lines, (computed according to the above universal theorem,) is A. 22.18048. The areas of the offsets to be added 0.62287. Their sums is 22.80335 acres. The areas of the offsets to be subtracted, are 1.15900 acres. Consequently the area of the west field, is 21.64435 acres, = 21 acres, 2 roods, and 23 perches.

From the above, the reader cannot be at a loss how to find the area of the North field, which is 22 acres, 2 roods, and 10 perches.

Of Levelling.

Levelling is the art which instructs us in finding how much higher or lower any given point on the surface of the earth is than another given point on the same surface: or in other words, the difference in their distance from the centre of the earth. Those points are said to be level, which are equidistant from the centre of the earth. The art of levelling consists therefore: 1st, In finding and marking two, or more level points that shall be in the circumference of a circle, whose centre is that of the earth. 2dly, In comparing the points thus found, with other points, in order to ascertain the difference in their distance from the earth's centre.

Of Simple Levelling. We term that simple levelling, when the level points are determined from one station, whether the level be fixed at one of the points or between them. Thus let A. B. fig. 5. be the station point of the level, C, D. the two points ascertained, and let the height from A to C be six feet, from B to D be nine feet, their difference is three feet, shewing that B is three feet lower than A. In this example, the station points of the level are below the line of sight and level points, as is generally the case; but if they were above, as in fig. 6, and the distance of A to C. be six feet, and from B to D nine feet, the difference will be still three feet, which B is higher than A. As to compound levelling it is nothing more than a collection of many single or simple operations compared together.

MARITIME SURVEYING, or DIRECTIONS for SURVEYING COASTS and HARBOURS.

1. Make a rough sketch of the coast or harbour, and mark every point of land, or particular variation of the coast, with some letter of the alphabet; either walk or sail round the coast, and fix a staff with

a white rag at the top, at each of the places, marked with the letters of the alphabet. If there be a tree, house, white cliff, or other remarkable object at any of these places, it may serve instead of a station staff. 2. Chuse some level spot of ground upon which a right line called a fundamental base, may be measured either by a chain, a measure pole, or a piece of log line marked into feet; generally speaking the longer this line is, the better: its situation must be such, that the whole, or most part of the station-staves may be seen from both ends thereof; and its length and direction must, if possible be such, that the bearing of any station-staff, taken from one of its ends, may differ at least ten degrees from the bearing of the same staff taken from the other end; station-staves must be set at each end of the fundamental base. If a convenient right line cannot be had, two lines and the interjacent angle may be measured, and the distance of their extremes found by construction, may be taken as the fundamental base. If the land measured has a sensible and gradual declivity, as from high-water mark to low-water, then the length measured may be reduced to the horizontal distances (which is the proper distance) by making the perpendicular rise of the tide, one side of a right angled-triangle, the distance measured along the land the hypotenuse, and from thence finding the other side trigonometrically, or by protraction on paper; which will be the true length of the base-line. If the plane measured is on the dry land, and there is a sensible declivity there, the height of the descent must be taken by a spirit-level, or by a quadrant, and that made the perpendicular side of the triangle. If, in a bay, one straight line of a sufficient length cannot be measured, let two or three lines, forming angles with each other, like the sides of a polygon, be measured on the land along the circuit of the bay, these angles carefully taken with a theodolite, and exactly protracted, or calculated, will give the straight distance between the two farthest extremities of the first and last line. 3. Find the bearing of the fundamental base by the compass, as accurately as possible, with Hadley's quadrant, or any other instrument equally exact; take the angles formed at one end of the base, between the base line and lines drawn to each of the station-staves; take likewise the angles formed between the base line and lines drawn to every remarkable object near the shore, as houses, trees, windmills, churches, &c. which may be supposed useful as pilot-marks; from the other end of the base, take the angles formed between the base and lines drawn to every one of the station staves and objects; if any angle be greater than the arc of the quadrant, measure it at twice, by taking the angular distance of some intermediate object from each extreme object; enter all these angles in a book as they are taken. 4. Draw the fundamental base upon paper, from a scale of equal parts, and from its ends respectively draw unlimited lines, forming with it the angles taking in the survey, and mark the extreme of each line with the letter of the station to which its angle corresponds. The intersection of every two lines, whose extremes are marked with the same letter, will denote the situation of the station or object, to which in the rough draught that letter belongs; through or near all the points of intersection which represent station-staves, draw a waving line with a pencil, to represent the coast. 5. At low water sail about the harbour, and take the soundings, observing whether the ground be rocky, sandy, shelly, &c. These soundings may be entered by small numeral figures in the chart, by taking at the same time the bearings of two remarkable objects; in this excursion, be particular in examining the ground or points of land which project out into the sea, or where the water is remarkably smooth, without a visible cause; or in the vicinity of small islands, &c. observe the set and velocity of the tide of flood, by heaving the log while at anchor, and denote the same in the chart by small darts. The time of high water is denoted by Roman numeral letters; rocks are denoted by small crosses; sands by dotted shading, the figures upon which usually shew the depth at low water in feet; good anchoring places are marked by a small anchor; upon coming near the shore, care must be taken to examine and correct the outline of the chart, by observing the inflections, creeks, &c. more minutely. 6. In a small sailing vessel go out to sea, and take drawings of the appearance of the land, with its bearings; sail into the harbour, observe the appearance of its entrance, and particularly whether there be any false resemblance of an entrance, by which ships may be deceived into danger; remark the signs or objects, by attending to which the harbour may be entered in safety: more especially, when it can be done, let the ship steer to the anchoring place, keeping two remarkable objects in one, or on a line. 7. Coasts are shaded off on the land side; houses, churches, trees, &c. on shore are drawn small in their proper figures; in a proper place of the chart, draw a mariner's compass, to denote the situation of the rhumbs, &c. and on one side of the fleur-de-lis, draw a faint half fleur-de-lis at the point of north by compass; draw also a divided scale of miles, or leagues, which must be taken from the same original scale as the fundamental base. Charts or plans may be neatly drawn with indian ink, or the pen and common ink, and are as useful as any others, but they are frequently done in water colours: for which purpose the beginner will derive more advantage from viewing a proper drawing, or from overlooking a proficient at work, than from a multitude of written instructions.

Those who would wish to see more on this subject, we refer to Adams's Geometrical and Graphical Essays.

SURVIVOR, in law, signifies the longer liver of two joint-tenants; or any two persons joined in the right of any thing. Thus, when two or more persons are seized of a joint-estate of inheritance, for their own lives, or *pour autre vie*, or are jointly possessed of any chattel interest, the intire tenancy upon the decease of any of them, remains to the survivors, and at length to the last survivor; and he shall be entitled to the whole estate, whatever it be, whether an inheritance or a common freehold only, or even a less estate. This right of survivorship is called by ancient authors the *jus accrescendi*, because the right, upon the death of one joint-tenant, accumulates and increases to the survivors; or as they themselves express, *pars illa communis accrescit supersitibus, de persona in personam usque ad ultimum supersitem*. And this *jus accrescendi* ought to be mutual; which Judge Blackstone apprehends to be the reason why neither the king, nor any corporation can be a joint-tenant with a private person: for here is no mutuality; the private person has not even the remotest chance of being seized of the entirety, by benefit of survivorship; for the king and corporation can never die. For the encouragement of husbandry and trade, it is held that a stock on a farm, though occupied jointly, and also a stock used in a joint undertaking, by way of partnership in trade, shall always be considered as common and not as joint-property; and there shall be no survivorship therein. Blackst. Com. B. ii. p. 183. &c. p. 399.

SURVIVORSHIP. Payments which are not to be made till some future period, are termed reversioners, to distinguish them from payments which are to be made immediately. Reversioners are either certain or contingent. Of the former sort are all sums or annuities, payable certainly at the expiration of any terms, or the extinction of any lives. Of the latter sort are all reversions, the tide to which depends on any contingency; as, particularly the survivorship of any lives beyond other lives. See the System of ANNUITIES, with the tables annexed.

SUS, a Genus of quadrupeds belonging to the order of Belluæ. They have four converging fore-teeth in the upper jaw, and six prominent ones in the under jaw; the snout is truncated, prominent and moveable. We shall not enter into a detail of the different proportions of the quadrupeds of this genus; as the drawings which are very accurate will give a better idea than the description. There are six species: the scropha, or common hog, is universal, except in the frigid zones, and in Kamschatka, where the cold is very severe. Since its introduction into America by the Europeans, it abounds to excess in the hot and temperate parts. It is found wild in most parts of Europe. In the forests of South America there are vast droves, which derive their origin from the European kind relapsed into a state of nature. For representation, see Plate X. of the System of MAMMALIA, Genus 35, Species 1, Variety 1.

In America they are useful by clearing the country of rattlesnakes, which they devour with safety. Of all quadrupeds, the hog is the most rude and brutal. The imperfections of his form seem to have the influence of his nature and disposition. All his habits are gross; all his appetites are impure; all his sensations are confined to a furious lust, and a brutal gluttony. He devours indiscriminately every thing that comes in his way, even his own progeny the moment after their birth. This voraciousness seems to proceed from the perpetual cravings of his stomach, which is of an immoderate size; and the grossness of its appetites, it is probable, arises from the bluntness of its senses of taste and of feeling. The rudeness of the hair, the hardness of the skin, and the thickness of the fat, render these animals less sensible to blows. The other senses of the hog are very good. It is well known to the hunters that the wild boar hears and smells at a great distance; for in order to surprise him, they are obliged to watch him in silence during the night, and to place themselves opposite the wind, that he may not perceive the smell, which never fails to make him turn back. But the hog, though the most impure and filthy of all quadrupeds, is yet useful by the very fordidness of its manners; this alone devouring what is the refuse of all others, and contributing not only to remove what would be a nuisance to the human race, but also converting the most nauseous offals into the richest nutriment: for this reason its stomach is capacious, and its gluttony excessive; not that its palate is insensible to the difference of eatables; for where it finds variety, it will reject the worst with as distinguishing a taste as other quadrupeds.

The parts of this animal are finely adapted to its way of life. As its method of feeding is by turning up the earth with its nose for roots of different kinds, so nature has given it a more prone form than other animals; a strong brawny neck; eyes small, and placed high in the head; a long snout, nose callous and tough, and a quick sense of smelling to trace out its food. Its intestines have a strong resemblance to those of the human species. The external form of its body is very unweildy; yet, by the strength of its tendons, the wild boar (which is only a variety of the common kind) is enabled to fly from the hunters with amazing agility; the back-toe on the feet of this animal prevents its slipping while it defends declivities, and must be of singular use when pursued; it is fond of wallowing in the dirt, either to cool its surfeited body, or to destroy the lice, ticks and other insects with which it is infested. Its diseases generally arise from foul feeding and intemperance; measles, imposthumes,

and scrophulous complaints, are reckoned among them. These are best prevented by keeping the animals, as the ancients strongly recommended, very clean in their flies; allowing them air, exercise, and a sufficiency of water. Linnaeus observes, that its flesh is wholesome food for athletic constitutions, or those that use much exercise; but bad for such as lead a sedentary life; it is however, of most universal use; and furnishes numberless materials for epicurism. They can engender at the age of nine or twelve months, but it is better to restrain them till they be eighteen months or two years. The first litter of the sow is not numerous; and, when only one year old, her pigs are weak, and even imperfect. She may be said to be in season at all times. Though full, she solicits the approach of the male. This may be regarded as an excess among animals; for almost every other species refuse the male after conception. The ardour of the sow, though almost perpetual, is however marked by paroxysms and immoderate movements, which always terminate by her wallowing in the mire. She, at the same time, emits a thick whitish fluid. She goes four months with young: brings forth in the beginning of the fifth: and soon afterwards solicits the male, is impregnated a second time, and of course brings forth twice a year. The wild sow, which every way resembles the domestic kind, produces only once a year. This difference in fertility is probably owing to want of nourishment, and the necessity of suckling her pigs much longer than the domestic sow, which is never allowed to nurse her young above fifteen days or three weeks. Only eight or nine of the litter are kept longer; the rest are sold. In fifteen days pigs are excellent food.

As these creatures, though exceeding voracious, will feed almost on any thing, they are bred and kept every where, and are quickly and cheaply fattened. In miry and in marshy grounds (from which they are not averse) they devour worms, frogs, fern, rush, and sedge roots. In drier and in woody countries, they feed on hips, haws, sloes, crabs, masts, chestnuts, acorns, &c. and on this food they will grow fleshy and fat. They are a kind of natural scavengers, will thrive on the trash of an orchard, the outcasts of the kitchen, the sweepings of barns and granaries, the offals of a market, and most richly on the refuse of a dairy. If near the sea, they will search the shores for shellfish; in the fields they eat grass; and in cities and large towns they are kept in great numbers, and supported chiefly by grains. It is evident that the facility of feeding them every where at a small expence, is a national benefit, more especially in a country where the people are accustomed to eat flesh daily, and could not perhaps perform their daily labour if they did not. In no part of Europe is the management of these creatures better understood than in Britain. They are in most places regularly managed and closely attended. Tusser, many years since, affirmed, from his own experience, that a sow might bring as much profit as a cow. These animals in different counties are of very different sizes. In Leicestershire, Northamptonshire, and Pembrokehire, they are very large. In Hampshire, Wiltshire, and wherever they can run in the woods, and feed on masts and acorns, their flesh is firmer and better. The Chinese breed are common with us; they are smaller, blacker, and their legs shorter than ours; so that, when fat, their bellies literally touch the ground. They thrive exceedingly well with us, are very prolific, and their flesh admirably fine and well-tasted.

Pork, though it might be wisely prohibited in some warm countries, is found by experience equally nutritive and salutary here. As such it furnishes a very large proportion of that food which is vended in our markets. It takes salt better, and keeps longer than the flesh of any other animal: and the consumption of it is prodigious when pickled or salted, more especially in our foreign garrisons and in the sea service. Our bacon is differently cured, so as to render it acceptable to all palates; and our hams are not at all inferior to those of other countries. The dung of swine will so enrich the land, that it will bring a good sword upon it, and will graze many years afterwards. Our old husbandmen had an ill opinion of this dung, as supposing it breeds weeds, which any dung will do that abounds in salts. See the System of AGRICULTURE, Article MANURE, Sect. II. In some places they wash with hogs dung for want of soap; which answers tolerably well, if the linen hangs long enough in the air to become thoroughly sweet.

The wild boar was formerly a native of our country, as appears from the laws of Hoeldda, who permitted his grand huntsmen to chase that animal from the middle of November to the beginning of December. William the Conqueror punished with the loss of their eyes any that were convicted of killing the wild boar, the stag, or the roebuck; and Fitz-Stephen tells us, that the vast forest that in his time grew on the north side of London, was the retreat of stags, fallow-deer, wild-boars, and bulls. Charles I. turned out wild boars in the New Forest, Hampshire; but they were destroyed in the civil wars. For representation, see Plate X. Genus 35, Species 1, Variety 2.

The tajacu, or pecary, with four cutting teeth above, and six below: two tusks in each jaw; those in the upper jaw pointing down, and little apparent when the mouth is shut; the others hid; length from nose to the end of the rump about three feet; body covered with bristles, stronger than those of the European kind, and more like those of a hedge-hog; they are dusky, surrounded with rings of white; those on the top of the neck and back are near five inches

long,

S W A

long, grow shorter on the sides; the belly almost naked; from the shoulders to the breast is a band of white: no tail; on the lower part of the back is a gland, open at the top, discharging a fetid, ichorous liquor; this has been mistaken called a *navel*. Inhabits the hottest parts of South America, and some of the Antilles: lives in the forests on the mountains: not fond of mire or marshy places; less fat than the common hog. They go in great droves. They are very fierce, and will fight stoutly with the beasts of prey. They feed on fruits and roots: also on toads and all manner of serpents, which they hold with the fore-feet and skin with great dexterity. The flesh is reckoned very good food; but all writers agree that the dorsal gland must be cut out as soon as the animal is killed, or the flesh will become so infected as not to be eatable. The Indian name of this species is *paquiras*, from whence seems to be derived that of *pecary*. For representation, see Plate X. Genus 35, Species 3.

The babyrussa, or Indian hog, with four cutting teeth in the upper, six in the lower jaw; ten grinders to each jaw, in the lower jaw two tusks pointing towards the eyes, and standing near eight inches out of their sockets; from two sockets on the outside of the upper jaw two other teeth, twelve inches long, bending like horns, their ends almost touching the forehead; ears small, erect, sharp-pointed; along the back are some weak bristles; on the rest of the body only a sort of wool, such as is on the lambs: the tail long, ends in a tuft, and is often twisted: the body plump and square. Inhabits Buero, a small isle near Amboyna: it is also found in Celebes, but neither on the continent of Asia or Africa. For representation, see Plate X. Genus 35, Species 4.

The hydrochæris, or river hog, has a very large and thick head and nose; small round ears; large black eyes; upper jaw longer than the lower: two strong and great cutting teeth, and eight grinders, in each jaw; and each of those grinders form on their surface seemingly three teeth, each flat at their ends; legs short, toes long, connected near their bottoms by a small web, their ends guarded by a small hoof; no tail; hair on the body short, rough, and brown; on the nose, long and hard whiskers. It grows to the size of a hog of two years old. Inhabits the eastern side of South America, from the isthmus of Darien to the river of Amazons; lives in the fenny parts not remote from the banks of great rivers; runs slowly; swims and dives remarkably well, and keeps for a long time under water: feeds on fruits and vegetables: is very dexterous in catching fish, which it brings on shore and eats at its ease, it sits up, and holds its prey with its fore-feet; feeding like an ape; feeds in the night, and commits great ravages in gardens. They keep in large herds, and make a horrible noise like the braying of an ass. The flesh is tender, but has an oily and fishy taste. They are easily made tame, and grow very fat. For representation, see Plate X. Genus 35, Species 5.

The æthiopicus, or Ethiopian hog, no foreteeth: nose broad, depressed, and almost of a horny hardness: head very large and broad: beneath each eye a hollow; formed of loose skin, very soft, and wrinkled; under these a great lobe or wattle, lying almost horizontal, broad, flat, and rounded at the end, placed so as to intercept the view of any thing below from the animal. Between these and the mouth on each side, there is a hard callous protuberance. The mouth is small: skin dusky: bristles disposed in fasciculi, of about five each: longest between the ears and on the beginning of the back, thinly dispersed on the rest of the back: its whole length 4 feet 9 inches: height before, 2 feet 2 inches: but in a wild state, it grows to an enormous size. These animals inhabit the hottest parts of Africa, from Senegal to Congo, also the islands of Madagascar. We know little of their nature; but they are represented as very fierce and swift, and that they will not breed with the domestic sow. For representation, see Plate X. Genus 35, Species 6.

SUSPENSION *Of Arms*, in war, is a short truce which the contending parties agree on, for the burial of their dead, the waiting for succours, or the orders of their masters, &c. In oratory, suspension is a keeping the hearer attentive and doubtful, in expectation of what the speaker will conclude with.

SUSPENSION, in mechanics. *Points of Suspension* in a balance, are those points in the axis or beam wherein the weights are applied, or from which they are suspended.

SUTURE, *SUTURA*, in anatomy, a peculiar kind of juncture, or articulation, of certain bones in the animal body: thus called as resembling a seam. There are two kinds of suture; one called the *true* or *genuine* suture; wherein bones are indented like saws, and reciprocally received into each other. The other called *false*, *spurious* or *squammos* suture; wherein the bones are laid over each other, like the scales of fishes. The bones of the cranium are usually joined by three genuine sutures; see the System, part I. Sect. II Art. 1.

SUTURE, in surgery, denotes a seam made to close the lips of a wound in order to its healing.

SWALLOW, the English name of the Genus *Hirundo*; in ornithology, see *HIRUNDO*. The characters are, that the beak is extremely small, a little bending, pointed, and depressed at the base, and the opening of the mouth larger than the very head of the bird.

SWAN, *cygnus* in ornithology, a species of the Genus *Anas*. For description of the Genus, &c. see *ANAS*.

S Y M

SWEAT, a sensible moisture issuing out of the pores of the skin of animals, through too much heat, exercise, or weakness; or through the action of certain medicines called *Sudorifics*. See *PERSPIRATION*, and *SUDORIFICS*.

SWEET. By a sweet is understood any vegetable juice, whether obtained by means of sugar, raisins, or other foreign or domestic fruit, which is added to wine, with a design to improve them. It is plain, from the making of artificial must, or stum, by means of fine sugar, with a small addition of tartar, that the art of sweet-making might receive a high degree of improvement, by the using pure sugar, as one general wholesome sweet, instead of those infinite mixtures of honey, raisins, syrups, treacles, stum, cyder, &c. wherewith the sweet-makers supply the wine-coopers to lengthen out, or amend their wines; for pure sugar being added to any poor wine will ferment therewith, and improve it, and bring it to a proper degree of strength and vinosity. If the wine that is to be amended is tart of itself, no tartar should be added to the sugar; but if it be too sweet or luscious, then the addition of tartar is necessary. Shaw's Lectures, p. 203. The duty on sweets made for sale is 12s. a barrel. 10 Geo. II. c. 17. to which is added another duty of 6s. by 20 Geo. III. c. 52.

SWIMMING, the act, or art, of sustaining the body in water, and of advancing therein by the motion of the arms, legs, &c. Man alone learns to swim; all other perfect animals seem to take it naturally; though several of the imperfect swim not at all. The reason is, that the human machine differs very much in its structure and configuration from that of brutes; and particularly, which is very extraordinary, in the situation of its centre of gravity. In man, the head is exceedingly heavy, with regard to the rest of the body; by reason the head is furnished with a very great quantity of brain, and has, besides, a deal of flesh and bones, and no cavities only filled with air; so that the head immersing under water by its own gravity, the nose and ears are soon filled: thus the heavy carrying down the light, the man soon is drowned, and lost. But in brutes it is otherwise: for the head, here, having but little brain, and there being abundance of sinuses therein, its weight, with regard to the rest of the body, is much less considerable; so that they are easily able to keep their nose above water; and thus respiring freely, are out of danger of being drowned, on the principles of statics. Among the ancient Greeks and Romans, swimming made so essential a part of the discipline of their youth, that to represent a man perfectly rude and uneducated, they used to say proverbially, he had neither learned to read nor to swim.

SWORD, an offensive weapon, worn at the side, serving either to prick or cut, or both. Its parts are the blade, guard, hand or grasp, and pommel; to which may be added, the bow, scabbard, hook and chape. The masters of defence divide the sword into the upper, middle, and lower part; or the fort, middle, and foible or small and weak part. Anciently, there were a kind of two handled sword called *spados*, which were to be managed with both hands; and which in those days they accustomed themselves to brandish so nimbly, as to cover the whole body therewith. The savages of Mexico, when first visited by the Spaniards, had a kind of wooden swords, which would do as much execution as ours. In Spain, swords are only allowed of such a length, determined by authority. The ancient cavaliers gave names to their swords; Joyeuse was that of Charlemagne; Durandol, that of Orlando, &c. For rules relative to the art of using the sword, either in the defensive or offensive, see the Treatise on the Art of FENCING throughout. For representation of the several positions of the body, manœuvres, &c. See the three Plates which illustrate them annexed to the Treatise.

SWORD-Bearer, an officer in the city of London, who attends the lord-mayor at his going abroad, and to carry the sword before him as the emblem of justice. It is observed by an ancient writer of armoury, that the bearer must carry it upright, the hilts being holden under his bulk, and the blade directly up the middle of his breast, and between the sword-bearer's brows. The sword is likewise carried before the principal officers of boroughs, and other corporate towns, to represent the state and princely office of the king, as the chief governor.

SYLLABLE, in grammar, a part of a word, or an articulate sound, consisting of one or more letters which are pronounced together or which of itself conveys either no idea, or part only of what is denoted by the word. See the System, part II. Chap. I.

SYLLOGISM, *συλλογισμος*, in logic, an argument, or form of reasoning, consisting of three propositions; having this property, that the conclusion necessarily follows from the two premises; so that if the first and second propositions be granted, the conclusion must be granted in like manner; and the whole allowed for a demonstration. See the System, Part III. Sect. III. and IV.

SYMBOL, a sign or representation of any moral thing, by the images or properties of natural things. Thus we say, the lion is the symbol of courage, the pelican of paternal love, &c. Symbols are of various kinds, as types, ænigmas, parables, fables, allegories, emblems, hieroglyphics, &c. see *ÆNIGMA*, *FABLE*, &c.

SYMPHONY, *συμφωνία*, formed from *syn*, with, and *phonē*, sound, in music properly denotes a consonance, or concert of several sounds agreeable to the ear; whether they be vocal or instrumental, or both; called also *HARMONY*. See the System, Part I. Sect. I.

SYN

SYS

SYMPHYSIS, a natural coherence or connection, in anatomy, one of the manners of articulating or joining the bones. See the System, Part I. Sect. I.

SYMPTOMATICAL, in medicine, is a term often used to denote the difference between the primary and secondary diseases. Thus a fever from pain is said to be *symptomatical*, because it arises from pain only; and, therefore, the ordinary means in fevers are not in such cases, to be had recourse to; but what will remove the pain: when that ceases, the fever will cease, without any direct means taken for it.

SYNAGOGUE, **SYNAGOGA**, συναγωγή, literally importing assembly; congregation; a particular assembly of Jews, met to perform the office of their religion. Also, the place wherein they meet. The Jews use the term in the primary sense, when they speak of the great *synagogue*; meaning the court of seventy elders, which they pretend to have been instituted originally by Moses, and the members of which they afterwards increased to one hundred and twenty. Some authors take the use of synagogues to be of no old standing among the Jews; and maintain that it was not till after their return from the Babylonish captivity, that the opinion first got footing, that the worship of God was not so restrained to the temple at Jerusalem, that it could not be held any where else. The consequence of which new opinion was, that the Jews began to build them synagogues in all their cities. Others hold, that there were synagogues even in the time of David. But be this as it will, no assemblies of the Jews appear to have been called synagogues till a little before the coming of Jesus Christ; who is said to have preached in the middle of the synagogue. The synagogues were used not only for divine service, but for holding courts of justice, especially upon ecclesiastical affairs. To this use of synagogues, some have supposed that St. James refers, ch. ii. 2—4. There were reckoned four hundred and eighty synagogues in the single city of Jerusalem. There are synagogues at London, Amsterdam, Rotterdam, Avignon, Metz, &c.

SYNARTHROSIS, συναρθρωσις, formed from συν, *with*, and αρθρον, *articulus*, joint; in anatomy a kind of articulation, or jointure of the bones of the body; wherein they remain without any, at least apparent motion. See the System, part I. Sect. I.

SYNCOPE, Συνκοπή, in medicine, a deep and sudden swooning, wherein the patient continues without any sensible heat, motion, sense or inspiration: and is seized with a cold sweat over the whole body, and all the parts turn pale and cold, as if dead. For description, causes, prognosis and cure, see the System, Genus 37.

SYNECDOCHE, in rhetoric and oratory, a figure or trope whereby the whole of a thing is put for a part of it, or a part for the whole. For its exemplification in several instances, see the treatise on Oratory, Part III. Sect. I. Art. 2.

SYNOCHA, in medicine, the name of a species of fever, of which authors distinguish two kinds, the simple, and the compound. For description, causes, and cure, see the system, Genus 4.

SYNOD, in church history, a council or meeting, or assembly of ecclesiastics, to consult on matters of religion.

Provincial SYNODS, in the government of the Church of Scotland, are composed of several adjacent presbyteries, of which there are fifteen in all. The members are a minister and ruling elder out of each parish. These synods meet twice a year, and chuse a moderator, who is their prolocutor. The acts of the synod are subject to the review of the general assembly, which is the dernier resort of the kirk of Scotland; and consists of commissioners from presbyteries, royal burghs, and universities. A presbytery of twelve ministers, sends two ministers and one ruling elder; a presbytery of between twelve and eighteen, sends three and one ruling elder; of between eighteen and twenty-four, sends four, and two ruling

elders; of twenty-four, sends five, and two elders; every royal burgh sends one elder and Edinburgh two; every university sends one commissioner, usually a minister. The general assembly meets once a year, in the month of May, and is opened and adjourned by the king's royal commission appointed for that purpose.

SYNTAX, Συναξίς, in grammar, the construction or connection of the words of a language into sentences or phrases. See the System, Part II. Chap. IV.

SYNTHESIS, in logic, denotes a branch or method, opposite to analysis. In the synthesis or synthetic method, we pursue the truth by reasons drawn from principles before established, or assumed, and propositions formerly proved; thus proceeding by a regular chain, till we come to the conclusion. See the System, Part IV.

SYPHILIS, is a term used by some writers for the lues venerea, or pox. See the System of Medicine, Genus 59.

SYRINGE, formed from σφινξ, or *syrix pipe*, an instrument serving to imbibe, or suck in, a quantity of any fluid; and to squirt or expel the same with violence. In effect, a syringe is only a single pump, and the water ascends in it on the same principle as in the common sucking pump. See the System of Hydrostatics, Part II. Art. V. N° 1.

SYRUP, in pharmacy, an agreeable liquor, or composition, of a thick consistence, made of juices, tinctures, or waters of fruits, flowers, or herbs, boiled up, in order to preserve it from spoiling, by fermentation or otherwise, with sugar or honey. There are various kinds of syrups denominated from the various fruits, &c. they are extracted from, or from their virtues; as a syrup of violets, of elder, of wormwood, or poppies, &c. Syrups, which were formerly looked upon as medicines of considerable value, are at present regarded chiefly as vehicles for medicines of greater efficacy, and are used for sweetening draughts, juleps, or mixtures, and for reducing the lighter powders into boluses, pills, and electuaries. But all these purposes may be answered by the simple syrup alone, there is little occasion for any other.

SYSTEM, *systema*, formed from συνμα, *composition*, in the general, denotes an assemblage or chain of principles and conclusions: or the whole of any doctrine, the several parts whereof are bound together, and follow, or depend on each other. In this sense we say, a system of Algebra, a system of Agriculture, a system of Botany, and so of the systems in general, respecting the several sciences, as are introduced in the course of this work.

SYSTEM, in astronomy, denotes an hypothesis or supposition of a certain order and arrangement of the several parts of the universe; whereby astronomers explain all the phenomena or appearances of the heavenly bodies, their motions, changes, &c. This is more peculiarly called *the system of the world*, and sometimes *the solar system*. See the System throughout: for the solar system in particular, Sect. II. For the rise and progress of the science of astronomy, and the time of the introduction of the several systems, as the Ptolemaic, Copernican, Tyconic, &c. see the history prefixed to our system of ASTRONOMY, Sect. I.

SYSTEM, in music, an assemblage of the rules for harmony deduced from some common principle, by which they are re-united; by which their connection, one with another is formed; from whence, as from their genuine source, they naturally flow, and to which, if we would account for them, we must have recourse. See in the System, the several articles, *Chromatic*, *Diatonic*, *Enharmonic*, *Harmony*, *Interval*, &c.

SYSTOLE, in anatomy, the contraction of the heart; whereby the blood is driven out of its ventricles into the arteries, to be distributed throughout the body. See the System, Part V. Sect. III.

TAB

T

TAB

T, A consonant, and the nineteenth letter in the alphabet; the sound of which is formed by a strong expulsion of the breath through the mouth, upon a sudden drawing back of the tongue from the fore part of the palate, with the lips at the same time open. The customary sound of *T*, is that which occurs in the words *take*, *temptation*; but before an *i*, when followed by a vowel, it has the sound of an obscure *s*, as *nation*, *salvation*, except when *s* precedes *t*, as *Christian*; and in derivatives from *y*, as *mighty*, *mightier*. *Th* has two sounds; the one soft as *thus*; the other hard as *thing*. The sound is soft in these words, *then*, *thence*, *there*, with their derivatives and compounds, *that*, *these*, &c. and in all words between two vowels, as *father*; and between *r* and *vowel*, as *burthen*. In other words it is hard as *thick*, *thunder*. Where it is softened at the end of a word, an *e* silent must be added, as *breath*, *breathe*. Johnson.

TABERNACLE, **TABERNACULUM**, q. d. *a tent*; among the Jews, was a kind of moveable chapel, so contrived as to be taken to pieces and put together at pleasure, for the convenience of carrying it from place to place, during the migration of the Israelites in the wilderness, for forty years. It was erected by Moses in consequence of the express command of God, partly to be a palace of his presence as the king of Israel, and partly to be the medium of the most solemn public worship, which the people were to pay to

him. It was erected on the first day of the first month of the second year after the Israelites exodus or *exit* from Egypt. Exod. xl. 2—17. 26. 29. 34. 35. The value of the gold and silver only, used for the work of the *tabernacle*, Exod. xxxviii. 24. 25, amounted according to bishop Cumberland's reduction of Jewish talents and shekels to English coin, to upwards of one hundred and eighty-two thousand five hundred and sixty-eight pounds. Jennings's Jewish Ant. vol. ii. b. 2. c. 1. Anc. Univ. Hist. v. i. part ii. p. 651, &c. fol. we have also an account of two other *tabernacles*, before the building of Solomon's temple, besides that above described. One of these was erected by Moses for himself; in which he gave audience, heard causes, and enquired of God; and, perhaps, also, the public offices of religious worship were performed in it for some time; whence it was called *the tabernacle of the congregation*. Exod. xxxiii. 7. The other was that which David erected in his own city, for the reception of the ark, when he received it from the house of Obededom, 2 Sam. vi. 17. 1. Chron. xvi. 1.

TABES, in medicine, a general name for consumptions of all kinds. *Tabes dorsalis*, is a kind of consumption proceeding sometimes from an excessive application to venery; the proximate cause of which is a general debility of the nerves. Of the several kinds of consumptions incident to human bodies, the *tabes dorsalis* is the slowest in its progress, but the most melancholy in its circumstances;

T A L

stances; and unless timely obviated, for the most part fatal. This disease is incident only to young men of salacious dispositions; and proceeds from too early venery, an immoderate use of it, or pollutions. It seems, therefore, to derive its origin from too frequent venereal spasms. And the immoderate loss of the seminal fluid, has also a considerable share in producing the effect. The symptoms of the *tabes dorsalis* are involuntary nocturnal seminal emissions, a pain in the back, and often in the head; formication in the spine, an aching pain, rolling, and hanging down of the testicles, a weakness of memory and sight, and a mucous discharge from the urethra, especially after straining at the discharge of the excrements. The mucous discharge here mentioned, is called by Hippocrates *liquidum semen*; but it is no more than the mucous of the prostate glands. The patient has neither a fever nor loss of appetite: but after any violent exercise his head is heavy, and his ears tingle. This disease is farther attended with great melancholy and dejection of mind; and a gutta serena often follows. The eyes grow hollow, the visage meagre and thin: the body emaciated and weak, a palpitation of the heart, and shortness of breath succeed; with a concurrence of hectic complaints, ending in death. For the cure of this distemper, a regularity of the nonnaturals is of the utmost importance. As to medicines, the classes of balsamics and astringents are chiefly useful. Among the latter the peruvian bark, either in substance, extract, or tincture, the acid elixir of vitriol, and the *tinctura saturnina* or *antiphysica*, are the most efficacious. Strengthening plasters may also be laid on the loins; and the chief of all, the cold bath should be used.

TABLES, in mathematics, are systems of numbers, calculated to be ready at hand for expediting astronomical, geometrical, and other operations.

Astronomical TABLES, are computations of the motions, places, and other phenomena of the planets, both primary and secondary. See the System throughout. For Tables, relating to annuities, &c. see Annuities, Expectation of life, Life-annuities, Mortality, and Survivorship. See the System of ANNUITIES throughout.

TACTICS, the art of disposing forces in form of battle, and of performing the military motions and evolutions. See the Treatise on MILITARY AFFAIRS, Sect. III. and the four Plates annexed. For naval tactics, or the arrangement of a fleet for an engagement, see the Treatise on NAVAL AFFAIRS, Sect. II.

TACTUS, *the touch*, in midwifery, is the exploration of the state of the vagina and uterus, and of the situation of the fœtus, and whatever else is contained therein. See the System, Part IV. Sect. I.

TADPOLE. The animal called by this name is no other than the frog in its first state from the spawn; and this creature furnishes the curious in microscopic observations with a beautiful view of the circulation of the blood, especially when young.

TENIA, a genus of insects, belonging to the order of vermes zoophyta. The body is of an oblong form; and composed of evident joints or articulations, in the manner of the links of a chain, with a mouth and viscera in each joint. 1. The lata, long tape-worm, or solitary worm, infests the intestines of man and some other classes of animals, and seems to derive its nourishment from the chyle that is prepared in the stomach. This worm is long and flat, composed of many very short rings that are articulated to each other, and has a kind of vein running through its whole length, which is more or less apparent. This has occasioned the Germans to give it the name of *flat spinous worm*. Its body, which is usually several ells in length, and flattened like a ribband, becomes gradually narrow towards its upper extremity, and at length terminates in a small thread-like appearance, of a foot or more in length. The body of the worm extends itself throughout the whole intestinal canal, and often reaches even to the anus. It has been named *solitary worm*, because there commonly exists only one in the same subject; sometimes, however, two of them are found together; and sometimes, after the expulsion of the first, there regenerates a second.

2. The solium, or gourd-worm, resembles the former in many particulars, and is equally met with in the intestines of animals. It will be distinguished from the preceding one, by having neither the appearance of a head nor of a longitudinal vein; its rings are much longer than those of the solitary worm, and are striated through their whole length, being furnished only with a little lateral prominence. These rings are easily detached from each other, so that they appear as so many distinct worms, which have each of them life and motion independent as it were of the rest. The form of these rings, when viewed together, varies considerably. For the methods of destroying and expelling those worms, see the System of MEDICINE, Genus 46.

TAJACU, or **PECCARY**, a species of the Genus *sus* in the System of Mammalia. For description of the Genus, see *Sus*.

TALMUD, or **THALMUD**, from תלמוד *doctrine*, from להר *he taught*, a Jewish book, wherein is collected all that relates to the explication of their law. The Talmud is the body of the Hebrew law; a compilation of expositions of the duties imposed on the people, either in scripture, or by tradition, or by authority of their doctors, or by custom, or even by superstition: to speak more plainly still, it is the course of cases of conscience, or of moral theology, wherein the duties are explained, and the doubts cleared, not by reasoning, but generally by authority, by the custom of the nation, and

T A N

by the decisions of the most approved of the ancient doctors. The Talmud consists of two general parts: the one called the *mischna*, the other the *gemara*; which first part is also frequently called absolutely the Talmud, the general name of the whole work. The Jews divide their law into *written*, which is that contained in the books of Moses; and *unwritten*, which is that conveyed by tradition. This latter is, in effect, no other than a gloss or interpretation of the former, given by the ancient rabbins. The Talmud then contains the traditions of the Jews, their polity, doctrine, and ceremonies, which they observe as religiously as the law of God itself: they would never put them in writing till they were compelled to it by the destruction of Jerusalem, and till they saw themselves dispersed throughout the world.

TALON, in architecture, a kind of moulding, consisting of a cymatium, crowned with a square fillet; frequently found to terminate ornaments of joiners-work, as those of doors, &c. See the System, Plate VI.

TALPA, the **MOLE**; a Genus of quadrupeds belonging to the order of feræ. There are six fore-teeth in the upper jaw, and eight in the under jaw; with one large dog-tooth, and four smaller ones. There are two species, viz. 1. The European or European mole, with a tail, and five toes on each foot. It lives under-ground; burrows with vast rapidity with its fore-feet, flinging the earth back with its hind feet; has the sense of smelling exquisite, which directs it to its food, worms, insects, and roots. It does vast damage in gardens, by flinging up the soil and loosening the roots of plants. It is most active before rain, and in winter before a thaw, worms being then in motion. It breeds in the spring, and brings four or five young at a time: it makes its nest of moss, a little beneath the surface of the ground, under the greatest hillock: raises no hillocks in dry weather, being then obliged to penetrate deep after its prey. It makes a great scream when taken. *Palma christi* and white helebore, made into a paste, and laid into their holes, destroys them. None in Ireland. For representation, see the System of Mammalia, Plate VI. Genus 18. Species 1.

2. **Radiatus**, or **radiated mole**. The radiated mole is less than the European. Its fur is very close, short and fine; and its nose very curiously beset with radiated tendrils. It is a native of North America, feeds on roots, and forms subterraneous passages in different directions. It is said, that hats peculiarly fine and beautiful are made of the fur of the mole. For representation, see the System of Mammalia, Plate VI. Genus 18. Species 3.

TAMARIND, *tamarindus*, in botany, a Genus of the *triandra monogynia* class. The East-India *tamarinds* are longer than those of the West; the former containing six or seven seeds each, the latter rarely above three or four; nevertheless they seem to be the produce of the same plant: the Oriental sort is drier and darker coloured than the occidental, and has more pulp; the former is sometimes preserved without addition, but the latter has always an admixture of fugar. We owe the knowledge of the use of tamarinds, in medicine, to the Arabians. The ancient Greeks knew nothing of them; and Serapion, Mesue, and Avicenna; are the first authors who prescribe them. We use the tamarinds only in medicine; but the Africans, and the people of many of the Oriental nations, where they are common, make them into a sort of confection with fugar, which they eat as a delicacy, and which cools them in the violent heats of their climates; and at the same time keeps their bowels in a proper state of laxity. The pulp of tamarinds is an agreeable laxative acid, of common use in inflammatory and putrid disorders, for abating thirst and heat, correcting putrefactions and loosening the belly. The dose, as a laxative, is two or three drams; an ounce or two prove moderately cathartic. It is an useful addition to the purgative sweets, cassia or manna, in increasing their action, and rendering them less liable to produce flatulencies: the resinous cathartics are said to be somewhat weakened by it.

TAMUZ, in chronology, the fourth month of the Jewish ecclesiastical year, answering to part of our June and July. The 17th day of this month is observed by the Jews as a fast, in memory of the destruction of Jerusalem, by Nebuchadnezzar, in the 11th year of Zedekiah before Christ, 588.

TAN, the bark of the oak, chopped, and ground by a tanning-mill, into a coarse powder; to be used in the tanning or dressing of skins. New tan is the most esteemed; when old and stale, it loses a great deal of its effect, which consists in condensing or closing the pores of the skins; so that the longer the skins are kept in tan, the greater strength and firmness they acquire. This bark, which is more abundant in the gummy resinous part than any of our common indigenous astringents, and which, on account of its astringent gummy resinous property, serves both to preserve leather from rotting, and to render it impervious to water, is preferred to all other substances for the purpose of tanning. It is used either in the way of infusion, which is called ooze; or the dry powder is strewed between layers of hides and skins, when these are laid away in the tan-pits. The ooze is made by macerating the bark in common water, in a particular set of holes or pits, which by way of distinction from the other holes in the tan-yard, are called latches. See **OAK-LEAVES**.

TANGENT, in geometry, a right line which touches a circle; that is, meets it in such a manner, as that though infinitely produced,

T A R

it would never cut the same; that is, never come within the circumference. See the System, Part II. Sect. II.

TANGENT, in trigonometry. A *Tangent of an Arch*, is a right line, raised perpendicularly on the extreme of the diameter, and continued to a point, where it is cut by a secant, that is by a line, drawn from the centre through the extremity of the arch, whereof it is a tangent. See the Treatise.

TAPE-Worm. See **TENIA**.

TAPIR, in the System of Mammalia, a species of the Genus Hippopotamus, discovered since the time of Linnæus, who makes but one species, viz. amphibius. The tapiir, or long nosed hippopotamus, inhabits the woods and rivers of the eastern side of South America, from the isthmus of Darien to the river of Amazons. It sleeps during the day, in the darkest and thickest forests adjacent to the banks; and goes out in the night time in search of food. It lives on grass, sugar-canes, and on fruit. If disturbed, it takes to the water; swims very well, or sinks below, and, like the hippopotamus, walks on the bottom as on dry ground. It makes a sort of hissing noise. The Indians shoot it with poisoned arrows; they cut the skin into bucklers: and eat the flesh, which is said to be very good. It is a salacious, slow-footed, and sluggish animal. Gumi-lays, it will make a vigorous resistance if attacked, and scarcely fails slaying the dogs which it can lay hold of. Dampier and Bancroft give very faulty descriptions of this beast, imagining it to be the same with the hippopotamus amphibius. For an accurate representation of the tapiir, or long nosed hippopotamus, see Plate X. Order 6. Genus 34. Species 2.

TAR, or **TARR**, a gross pitchy liquor, issuing from the wood and bark of old pines, or firs, either naturally, or by burning.—Some modern writers inform us, that tar flows from the trunks of pines and firs, when they are very old, through incisions made in the bark near the root; that pitch is only tar inspissated, and both are the oil of the tree grown thick and black with age and the sun. The trees, like old men, being unable to perspire, and the secretory ducts obstructed, they are, as one may say, choked and stuffed with their own juice. It is also procured by burning them with a close smothering heat, much used in coating and caulking ships, &c. It is prepared in different parts of Germany, in North America, and in all countries where there is much wood. The wood is enclosed in a large oven, to the quantity of ten or more loads at a time: this stands within another oven, called the mantle, the space between them receiving the fire. From the bottom of the inner oven there runs a gutter, by which the tar is conveyed off in proportion as it melts out from the wood. Along with the tar there runs out an acid spirit or juice, by means of which part of the oily matter becomes soluble in water; and it is owing to this that tar infused in water communicates to it a medical virtue. Tar when distilled yields a kind of essential oil called *oleum pini*, and *oleum tædæ*, which is greatly valued by painters, varnishers, &c. on account of its drying quality: it soon thickens of itself, almost to the consistence of a balsam. Of late it has been found that the empyreumatic oil produced from pitcoal or culm, answers the purposes of tar distilled from wood. There is, however, the same difference between the two as there is between a vegetable and a bituminous empyreumatic oil. The process is much the same as when wood is used.

TARANDUS, or **REIN-DEER**, a species of the Genus Cervus, in the System of MAMMALIA. See **CERVUS**. For representation of the rein-deer, see Plate VIII. Genus 29. Species 4.

TARANTULA, in entomology, a venomous insect, whose bite gives name to a disease called *tarantismus*. It is a species of the Genus Aranea: under which article may be seen its description, together with an account of the effects of its bite, the opinions of several of the faculty upon it, and the remedy for the cure of it.

TARE and **TRET**, in commerce, any defect, waste, or diminution in the weight, the quantity, or the quality of goods. The seller is usually to account to the buyer for the tare and tret.—Tare is more particularly used for an abatement, or deduction, in the price of a commodity, on account of the weight of chests, casks, bags, &c. in which goods are put up, and whose weight may be known separately from that of the goods; and which being subtracted from the gross weight, or that of the cask, &c. and goods together, gives the weight of the goods alone, or the nett, or neat weight. The allowance, called *tret*, is calculated in the same way. For the arithmetical rules respecting this article of commerce, see the System of ARITHMETIC, Chap. VII.

TARE, a species of pulse, called also *Vetch*. For its cultivation and uses, see the System of AGRICULTURE, Sect. VII.

TARRACE, or **TERRACE**, a coarse sort of plaster, or mortar, durable in the wet, and chiefly used to line basins, cisterns, wells, and other reservoirs of water. That which is called the Dutch terrace, is made of a soft rock stone, found near Collen, upon the lower part of the Rhine; it is burnt like lime, and afterwards reduced to powder by means of mills: from thence it is brought to Holland in great quantities, where it has acquired the name of Dutch terrace: It is of a greyish colour when it is not mixt, which is very seldom the case, because it is very dear, and the demand for it in aquatic works very great. In some parts of England there is found a soft stone, resembling that of Dutch terrace, and which might serve in aquatic works. An artificial terrace may

No. 143:

T A S

be formed of two parts of lime and one part of plaster of Paris, well beaten together and used immediately. There is another sort of terrace, made for coarser uses, which is sometimes called Welch terrace, formed of one part of lime, and two parts of well-sifted coal ashes, thoroughly mixed by being well beaten together: Handm. to the Arts, Vol. ii. p. 32.

TARSUS, in anatomy, is what we call the instep; being the beginning of the foot, or the space between the ankle and the body of the foot, which is called *metatarsus*. The tarsus answers to the wrist of the hand. It consists of seven bones: for a description of which, see the System, Part I. Sect. II. Art. 7. For representation, see Plate I. Fig. 2. letter *k*.

TARTAR, **TARTARUS**, in chymistry, an acid concrete salt which rises from wines, after complete fermentation, and sticking to the top and sides of the casks, forms a crust, which hardens to the consistence of a stone. Its goodness rather depends on the number of repeated fermentations, which a succession of new wines in the same casks, for several years, makes, than on the soil or climate where the wine is produced. The sweet wines afford always less tartar than the sharp ones, and it is also less valuable. The tartar of Rhenish wine is better than that of any other; and in general those wines which have the most acid in them, afford the greatest quantity of tartar, and that in the largest crystals. It is objected by some to this system, that vinegar affords no tartar; but this is easily answered, by observing, that the wine, from which vinegar is made, has before deposited its tartar. White tartar is preferred to red, and is really better; though both kinds, when purified, are exactly the same. The marks of good tartar of either kind are, its being thick, brittle, brilliant, and but little earthy. See the System, Part I. Chap. I. Art. 1.

Cream of TARTAR, cremor tartari. Cream of tartar has a sensibly acid taste; it reddens the blue colours of vegetables; it may be saturated by uniting with any of those substances which are capable of forming with acid neutral salts; and it may be afterwards separated from these substances and recover its former appearance. Whence it may be inferred that this salt, which is concrete and crystallisable, on account of a portion of earth and oil, with which it is intimately combined, is an acid. But by the analysis of Mr. Scheel, in the Swedish transactions, part iii. for 1770, it appears, that cream of tartar is not a pure acid, but a compound salt, containing the fixed vegetable alkali, united with a superabundance of the tartareous acid; and, therefore, it differs from soluble tartar only in the proportion of acid which it contains. Cream of tartar is reputed a great sweetener of the blood; for which some take it in whey or water-gruel in the spring time, to the quantity of half an ounce every morning, for three or four weeks. Its operation is by stool; and, by its saline particles, pretty much also by urine. It is generally mixed with lenitive electuaries, in nephritic and anti-venereal cases, where it often proves serviceable.

TASTE, *savour*, a sensation excited in the soul by means of the organ of taste, viz. the papillæ of the tongue, &c. See the System, Part VII. Sect. II.

Tastes may be distinguished into simple and compound. Two faults have here been committed; the first, a defective enumerating of simple tastes; the second, a reckoning them indistinctly among such as are compounded.

Simple TASTES, of which we usually reckon only six or seven sorts, are at least sixteen: 1. *Bitter*, as in wormwood; whose contrary is, 2. *Sweet*, as in sugar. 3. *Sour*, as in vinegar; whose contrary is, 4. *Salt*. 5. *Hot*, as in cloves; to which is opposite, 6. *Cold*, as in sal prunellæ; for we may as properly say a cold taste as an hot one, since there are some bodies which do manifestly impress the sense of cold upon the tongue, though not to the touch. 7. *Aromatic*, to which is contrary, 8. *Nauseous*, or malignant. 9. *Soft*, which are either vapid, as in water, starch, whites of eggs, &c. or unctuous, as in oils, fat, &c. 10. *Hard*, of which may be reckoned four kinds. 11. *Penetrant*, which worketh itself into the tongue without any pungency; as is found in the root and leaves of the wild cucumber. 12. *Stupeficient*, as in the root of black hellebore, which, being chewed, and for some time retained upon the tongue, effects that organ with a numbness, or paralytic stupor. 13. *Astringent*, as in galls; and 14. *Pungent*, as in spirit of sal ammoniac; which two last tastes are contrary to the unctuous, as penetrant and stupeficient are contrary to the vapid one.

Compound TASTES, are very numerous; but we have words to express but six of them: 1. *Austere*, which is astringent and bitter, as in the green and soft stones of grapes. 2. *Acerb*, properly so called, which is astringent and acid, as in the juice of unripe grapes. 3. *Acrid*, which is pungent and hot. 4. *Muriatic*, which is salt and pungent, as in common salt. 5. *Lixivious*, which is saltness joined with some pungency and heat. 6. *Nitrous*, which is saltness joined with pungency and cold.

Intellectual TASTE. The external sense with which nature has furnished us, and by which we distinguish and relish the various kinds of nourishment that are adapted to health and pleasure, has in all languages given occasion to the metaphorical word *taste*, by which we express our perception of beauty, deformity, or defect, in the several arts. Taste then, in general, is a quick discernment, a sudden perception, which, like the sensation of the palate, anticipates reflection; like the palate, it relishes what is

T A S

good with an exquisite and voluptuous sensibility, and rejects the contrary with loathing and disgust; like the palate, also, it is often doubtful, and, as it were, bewildered, not knowing whether it should relish or reject certain objects, and frequently requires the influence of habit to give it a fixed and uniform determination. To have a taste, supposes something more than merely to perceive, and to discern with accuracy the beauty of any work or object. This beauty must be felt, as well as perceived; the mind must be touched and affected by it in a lively and sensible manner. This feeling, however, in order to constitute true taste, must not be a vague and confused sensation; but must be attended with a distinct view, a quick and comprehensive discernment of the various qualities, in their several relations and connexions, which enter into the composition of the object we contemplate. And in this we see another striking resemblance between the intellectual taste and the sensual one: for as a nice palate perceives immediately the mixture of different wines, so the man of taste will quickly discern the motley mixture of different styles in the same production; and, let the beauties and defects be ever so closely blended in an object, will always be capable of distinguishing the former from the latter. As the corruption of the sensual taste discovers itself by a relish for only those delicate and high-seasoned dishes, in which all the refinements of art have been employed to excite a forced sensation of pleasure; so the depravity of the intellectual taste manifests itself by an attachment to far-fetched and studied ornaments, and by a want of relish for those beauties which are unaffected and natural. The corruption of the sensual taste, which makes us delight in such aliments as are disgusting to those whose organs are in a good state, is in reality a kind of disease; nor is that depravity of the intellectual taste which makes many prefer the burlesque to the sublime, and the laboured stiffness of art to the beautiful simplicity of nature, less a disease in our mental frame.

Elegant and able artists may communicate their feeling and their discernment to others, and thus excite taste in a nation, which, without them, had never known its refined pleasures. By frequently contemplating the works of great and eminent masters in the various arts, the powers of nature arise into taste; and we imbibe, as it were, the spirit of these illustrious men, so as to come at length to look at a gallery of paintings with the eyes of a Le Brun, a Poussin, or a Le Seur; nay, we even read works of learning and genius with a portion of that spirit that appears in their composition. It is a common saying, that there is no disputing about tastes; and if by the taste here be understood the palate, which loaths certain aliments and relishes others, the maxim is just; because it is needless to dispute about what cannot be corrected, or to attempt reforming the constitution and mechanism of organs merely corporeal. But the maxim is false and pernicious, when applied to that intellectual taste which has for its objects the arts and sciences. As these objects have real charms, so there is in reality a good taste which perceives them, and a bad one which perceives them not; and there are certain methods by which we may often correct those mental defects which produce a depraved taste. But it must be granted, at the same time, that there are certain phlegmatic spirits which nothing can inflame; and also certain distorted intellects which it is impossible to rectify; with such, therefore, it is in vain to dispute about taste, because they have none at all. In many things taste seems to be of an arbitrary nature, and without any fixed or uniform direction; such as in the choice of dress and equipage, and in every thing that does not come within the circle of the finer arts. In this low sphere it should be distinguished by the name of fancy; for it is fancy, rather than taste, that produces such an endless variety of new and contradictory modes.

The taste of a nation may degenerate and become extremely depraved; and it almost always happens, that the period of its perfection is the forerunner of its decline. Artists, through the apprehension of being regarded as mere imitators, strike out into new and uncommon paths, and turn aside from the beautiful simplicity of nature, which their predecessors invariably kept in view. In these efforts there is a certain degree of merit, which arises from industry and emulation, and casts a veil over the defects which accompany their productions. The public, fond of novelty, applauds their invention; but this applause is soon succeeded by satiety and disgust. A new set of artists start up, invent new methods to please a capricious taste, and depart still further from nature than those who first ventured from its paths into the wilds of fancy. Thus the taste of a people degenerates into the grossest corruption. Overwhelmed with new inventions, which succeed and efface each other with incredible rapidity, they scarcely know where they are, and cast back their eager and anxious desires towards the period when true taste reigned under the empire of nature. But they explore its return in vain; that happy period cannot be recalled; it deposits, however, in the custody of certain choice spirits, the sublime pleasures of true taste, which they cherish and enjoy in their little circle, remote from the profane eye of the depraved and capricious multitude.

There are vast countries where taste has not yet been able to penetrate. Such are those uncultivated wastes, where civil society has never been brought to any degree of perfection, where there is little intercourse between the sexes, and where all representations of living creatures in painting and sculpture are severely prohibited

T A X

by the laws of religion. Nothing renders the mind so narrow, and so little, if we may use that expression, as the want of social intercourse: this confines its faculties, blunts the edge of genius, damps every noble passion, and leaves in a state of languor and inactivity every principle that could contribute to the formation of true taste. Besides, where several of the finer arts are wanting, the rest must necessarily languish and decay, since they are inseparably connected together, and mutually support each other. This is one reason why the Asiatics have never excelled in any of the arts: and hence also it is that true taste has been confined to certain parts of Europe.

A late excellent writer has defined taste to be the power of receiving pleasure from the beauties of nature and of art. Though taste, says this writer, be ultimately founded on a certain natural and instinctive sensibility to beauty, yet reason assists taste in many of its operations, and serves to enlarge its power. The characters of taste, when brought to its most perfect state, are all reducible to two, delicacy, which principally respects the perfection of that natural sensibility on which taste is founded, and correctness, which chiefly respects the improvement that faculty receives through its connexion with the understanding; the former of these qualities is more the gift of nature; the latter, more the product of culture and art. Among the ancient critics, Longinus possessed most delicacy; Aristotle most correctness. Among the moderns, Mr. Addison is a high example of delicate taste; and Dean Swift, if he had written on the subject of criticism, would perhaps have afforded the example of a correct one. An ingenious writer has distinguished between taste and genius. Taste, he says, consists in the power of judging; genius, in the power of executing. One may have a considerable degree of taste, in poetry, eloquence, or any of the fine arts, who has little or hardly any genius for composition or execution in any of these arts. But genius cannot be found without including taste also. Genius, therefore, deserves to be considered as a higher power of the mind than taste; genius always imports something inventive or creative, which does not rest in mere sensibility to beauty where it is perceived, but which can, moreover, produce new beauties and exhibit them in such a manner as strongly to impress the minds of others. Refined taste forms a good critic; but genius is farther necessary to form the poet, or the orator. Besides, genius, in common acceptation, extends much farther than to the objects of taste; but though it is a higher faculty than taste, it is ever, according to the usual frugality of nature, more limited in the sphere of its operations. See Dr. Blair's Lectures on Rhetoric, and Belles Letters, vol. i. Lect. ii. and iii. See also Hume's Essay on the standard of taste, in his Essays, &c. vol. i. Ess. xxiii. p. 253, edit. 1764.

TATTOOING, an operation in use among the islanders in the South Sea for marking the bodies with figures of various kinds which they consider as ornamental. It is performed by puncturing the skin, and rubbing a black colour in the wounds. The instrument used somewhat resembles a comb, the teeth of which are repeatedly struck into the skin by means of a small mallet. It is very painful; but the children are forced by their relations to submit to it. For a particular description of the manner in which the operation is performed, see Banks's system of Geography, p. 48.

TAURUS, in the system of MAMMALIA, a species of the Genus Bos. For description, see Bos. For classification, see the System. For representation, see Plate IX, Genus 32, Species 1.

TAURUS, in astronomy, the *bull*; one of the twelve signs of the zodiac, and the second in order. See the system, Sect. IX. under the head of DEFINITIONS.

TAX, a tribute or imposition laid upon the subject for the support of government. See REVENUE.

It is the ancient indisputable privilege and right of the house of commons, that all grants of subsidies or parliamentary aids do begin in their house, and are first bestowed by them; although their grants are not effectual to all intents and purposes until they have the assent of the other two branches of the legislature. The general reason given for this exclusive privilege of the house of commons, is, that the supplies are raised upon the body of the people, and therefore it is proper that they alone should have the right of taxing themselves. This reason would be unanswerable, if the commons taxed none but themselves: but it is notorious, that a very large share of property is in the possession of the house of lords; that this property is equally taxable, and taxed, as the property of the commons; and therefore the commons not being the sole persons taxed, this cannot be the reason of their having the sole right of raising and modelling the supply. The true reason, arising from the spirit of our constitution, seems to be this. The lords being a permanent hereditary body, created at pleasure by the king, are supposed more liable to be influenced by the crown, and when once influenced to continue so, than the commons, who are a temporary, elective body, freely nominated by the people. It would therefore be extremely dangerous to give the lords any power of framing new taxes for the subject; it is sufficient that they have a power of rejecting, if they think the commons too lavish or improvident in their grants. But so reasonably jealous are the commons of this valuable privilege, that herein they will not suffer the other house to exert any power but that of rejecting. They will not permit the least alteration or amendment to be made by the lords to the mode of taxing the people by a money-bill: under which appellation are

included

TEA

included all bills by which money is directed to be raised upon the subject, for any purpose or in any shape whatsoever; either for the exigencies of government, and collected from the kingdom in general, as the land tax; or for private benefit, and collected in any particular district, as by turnpikes, parish-rates, and the like. The commons, when they have voted a supply to his majesty, and settled the quantum of that supply, usually resolve themselves into what is called a committee of ways and means, to consider the ways and means of raising the supply so voted. And in this committee every member (though it is looked upon as the peculiar province of the chancellor of the exchequer) may propose such schemes of taxation as he thinks will be least detrimental to the public. The resolutions of this committee (when approved by a vote of the house) are in general esteemed to be (as it were) final and conclusive. For though the supply cannot be actually raised upon the subject till directed by an act of the whole parliament, yet no man will scruple to advance to the government any quantity of ready cash, on the credit of a bare vote of the house of commons, though no law be yet passed to establish it. The taxes which are raised upon the subject are either annual or perpetual. I. The annual taxes are those upon land and malt. See LAND and MALT. II. The perpetual are, 1. The customs. 2. The excise-duty, 3. The salt-duty. 4. The post-office. 5. The stamp duty. 6. House and window duty. 7. The duty on hackney coaches and chairs. 8. That on offices and pensions. As to the application of all these, see the articles REVENUE, NATIONAL DEBT, FUNDS, and CIVIL LIST.

TEA or THEA, the *Tea-plant*; a Genus of the Monogynia order, belonging to the Polyandria class of plants. This shrub, formerly described by Dr. Breynius in his Century of Exotic Plants, published at Dantzick in 1678, is of a very slow growth, and diminutive size. It has a black, woody, irregular branched root. The rising stem soon spreads into many irregular branches and twigs. These at the lower end and near the ground often seem to be more in number than they really are; for several seeds being put together in one hole, it frequently happens that two, three, or more shrubs grow up together, and so close to one another, as to be easily mistaken for one by ignorance or less attentive observers. The branches and twigs are slender, of different sizes, irregularly beset with simple leaves, standing on very small, fat, green footstalks; and resembling, when full grown, the leaves of the garden cherry-tree. The footstalk of the flower is about half an inch long, and ends in six very small green leaves, which serve instead of the calyx or flower cup. This description, applied by Kämpfer to the shrub, which, as he pretends, produces all the different sorts or preparations of tea, corresponds, says Linnaeus, to a particular species only, termed by him *bohea*: for some tea-plants, he observes, after Dr. Hill, produce flowers composed of nine petals, which must therefore constitute a distinct species from such as have only six. From this circumstance is constructed the other species of that author, *thea viridis*, or green tea, the flowers of which have always nine petals. The leaves also are much larger than those of the *bohea*, and of a brighter green.

Dr. Lettson, in his botanical description of the tea-plant, thinks it most probable, that there is only one species, and that the difference between the green and *bohea* teas depends on the nature of the soil, culture, age, and the manner of drying the leaves. He adds, that it has ever been observed, that a green tea-tree planted in the *bohea*-country, will produce *bohea*, and on the contrary; and that on his examining several hundred flowers, brought both from the *bohea* and green tea countries, their botanical characters have always appeared uniform.

We do not find that the tea plant grows naturally beyond the 35th degree of north latitude on the one hand, and the 45th degree on the other. The root resembles that of the peach-tree: the leaves are green, longish at the point, and pretty narrow, an inch and a half long, and jagged all round. The flower is much like that of the wild rose, but smaller. The fruit is of different forms, sometimes round, sometimes long, sometimes triangular, and of the ordinary size of a bean, containing two or three seeds, of a mouse colour, including each a kernel. These are the seeds by which the plant is propagated; a number from six to twelve or fifteen being promiscuously put into one hole, four or five inches deep, at certain distances from each other. The seeds vegetate without any other care, though the more industrious annually remove the weeds, and manure the land. The leaves which succeed are not fit to be plucked before the third year's growth, at which period they are plentiful, and in their prime. In about seven years the shrub rises to a man's height; and as it then bears few leaves, and grows slowly, it is cut down to the stem, which occasions an exuberance of fresh shoots and leaves the succeeding summer: some indeed, defer cutting them till they are of ten years growth. In Japan the tea tree is cultivated round the borders of the fields, without regard to the soil, but as the Chinese export considerable quantities of tea, they plant whole fields with it. The tea-tree loves to grow in vallies, at the foot of mountains, and upon the banks of rivers, where it enjoys a southern exposure to the sun; though it endures considerable variation of heat and cold, as it flourishes in the northern clime of Pekin, as well as about Canton; and it is observed that the degree of cold at Pekin is as severe in winter as in some of the northern parts of

TEA

Europe. However, the best tea, grows in a mild temperate climate, the country about Nankin producing better tea than either Pekin, or Canton, betwixt which places it is situated.

The leaves must not be torn off by handfuls, but plucked carefully, one by one; and are not to be gathered all at once, but at different times. Those who pluck their shrubs thrice a-year, begin their first gathering about the end of February. These small and tender leaves are reckoned much better than the rest, and, because of their scarcity and price, are disposed of only to princes and rich people: for which they are called, in Europe, imperial tea, flower of tea, gunpowder tea, &c. The second gathering, and the first of those who gather but twice a-year, is made about the latter end of March, or beginning of April: some of the leaves are then already come to perfection, others are but half grown; both, however, are plucked off promiscuously: though care is afterwards taken, previous to the usual preparation, to arrange them into classes, according to their size and goodness. The third and last gathering, which is also the most plentiful, is made in the end of May, when the leaves have attained their full growth, both in number and size. The leaves of this gathering are arranged in like manner as the former, according to their size and goodness, into different classes, the lowest of which contains the coarsest leaves of all, being full two months grown, and that sort which is commonly drank by the vulgar. The buildings, or drying-houses, that are erected for curing tea, contain from five to ten or twenty small furnaces, about three feet high, each having at the top a large flat iron pan. There is also a long low table covered with mats, on which the leaves are laid, and rolled by workmen, who sit round it: the iron pan being heated to a certain degree by a little fire made in the furnace underneath, a few pounds of the fresh gathered leaves are put upon the pan: the fresh and juicy leaves crack when they touch the pan, and it is the business of the operator to shift them as quick as possible with his bare hands, till they become too hot to be easily endured. At this instant he takes off the leaves with a kind of shovel resembling a fan, and pours them on the mats before the rollers, who, taking small quantities at a time, roll them in the palm of their hands in one direction, while others are fanning them that they may cool the more speedily, and retain their curl the longer. This process is repeated two or three times, or oftener, before the tea is put into the stores, in order that all the moisture of the leaves may be thoroughly dissipated, and their curl more completely preserved. On every repetition the pan is less heated, and the operation performed more slowly and cautiously. The tea is then separated into the different kinds, and deposited in the store for domestic use or exportation. The Chinese know nothing of imperial tea, flower of tea, and many other names, which in Europe serve to distinguish the goodness and the price of this fashionable commodity: but besides the common tea, they distinguish two other kinds, viz. the *voai*, and *saunb*, which are reserved for people of the first quality, and those who are sick. We have two principal kinds of tea in Europe: viz.

Green TEA, which is the common tea of the Chinese, &c. F. le Comte calls it *bing tea*, and says it is gathered from the plant in April. It is held very digestive, and a little astringent: it gives a palish green tincture to water, and its leaves are much twisted. The second is,

Bohea Tea, which is the *voai tea*, or *boutcha* of the Chinese. F. le Comte makes this only differ from the green tea, by its being gathered a month before it, viz. in March, while in the bud; and hence the smallness of the leaves, as well as the depth of the tincture it gives to water. Others take it for the tea of some particular province; the soil being found to make an alteration in the properties of the tea, as much as the season of gathering it. It is all bought at Nankin, and thence brought into Europe, where it is now much in vogue. Respecting the difference in colour and flavour peculiar to these two kinds, and to their varieties, Dr. Lettson thinks that there is reason to suspect that they are, in some measure, adventitious, or produced by art. He has been informed, by intelligent persons, who have resided some time at Canton, that the tea about that city affords very little smell while growing. The same is observed of the tea-plants now in England, and also of the dried specimens from China. We are not, however, as he observes, to conclude from hence, that art alone conveys to tea, when cured, the smell peculiar to each kind; for our vegetable grasses, for instance, have little or no smell till they are dried and made into hay. As to the opinion that the green tea owes its verdure to an effluence acquired from the plates of copper, on which it is supposed to be cured or dried, he shews that there is no foundation for this suspicion. The infusions of the finest imperial and bloom teas undergo no change on the affusion of a volatile alkali, which would detect the minutest portion of copper contained in them, by turning the liquors blue. The fine green colour of these teas, with as little reason, hath been attributed to green coppers; as this metallic salt would, on this being dissolved in water, immediately act on the astringent matter of the leaves, and convert the infusion into ink, as happens when a chalybeate water has been employed in the making of tea. On the whole, Dr. Lettson thinks it not improbable, that some green dye prepared from vegetable substances, is employed in the colouring of the leaves of the green teas. And Neumann suspects, that the brown colour and the flavour of the *bohea* sorts

TEA

are introduced by art. Both the green and bohea teas have an agreeable smell, and a lightly bitterish subastringent taste: with solution of chalybeate vitriol, they strike an inky blackness.— They give out their smell and taste both to watery and spirituous menstrua: to water, the green sorts communicate their own green tincture, and the bohea, their brown: but to rectified spirit they both impart a fine deep green. The extracts, obtained by gently drawing off the menstrua from the filtered tinctures, are considerably astringent, and not a little ungrateful; but the spirituous most so.

Tea is to be chosen of the briskest smell, and as whole as possible; and the greatest care is to be taken that it have not been exposed to the air to pall and evaporate. The tea which is drank, is made in China, and throughout the greatest part of the East, after the same manner as in Europe: viz. by infusing the leaves in boiling water, and drinking the infusion hot. Indeed, among us, it is usual to temper its bitterness with sugar, but the orientals use it without the addition of sugar or milk. However, the Japanese are said to prepare their liquor a somewhat different way, viz. by pulverizing the leaves, stirring the powder in hot water, and drinking it as we do coffee. From the account given by Du Halde, this method is not peculiar to the Japanese, but is also used in some provinces in China. The Chinese are always taking tea, especially at meals; it is the chief treat wherewith they regale their friends: The most moderate take it at least thrice a-day; others ten times, or more; and yet it is computed, the consumption of tea amongst the English and Dutch is as great in proportion as among the Orientals. With regard to the commercial history of tea, we may observe that it was first introduced in Europe by the Dutch East India Company, very early in the last century, and that a quantity of it was brought over from Holland by Lord Arlington and Lord Ossory, about the year 1666, at which time it was sold for 60s. a pound. But it appears that, before this time, drinking of tea, even in public coffee-houses, in this country, was not uncommon; for, in 1660, a duty of 8d. per gallon was laid on the liquor made and sold in all coffee-houses. The present consumption of it is immense. Dr. Lettson tells us, that he has been informed, that at least three millions of pounds are allowed for the annual home consumption, not including the incredible quantity smuggled into the kingdom; and that the East India Company have generally in their warehouses a supply for three years. As to the properties of tea, they are strangely controverted; the eastern nations are at least as much possessed with an idea of their extraordinary virtues as the Europeans; but it is, perhaps, because imagination bears as great a sway there as here. The immoderate use of it, however, has been very prejudicial to many, who have been thereby thrown into the diabetes. In Europe, infusions of tea-leaves have been extravagantly condemned by some and commended by others. From the contradictory opinions even of medical writers on this subject, the natural inference seems to be, that they possess neither noxious nor beneficial powers in any very considerable degree. They seem, when moderately used, to be for the most part innocent; in some cases they seem to be salutary; in some they are apparently prejudicial.— They dilute thick juices, and quench thirst more effectually, and pass off by the natural excretories more freely than more watery fluids; they refresh the spirits in heaviness and sleepiness, and seem to counteract the operation of inebriating liquors. From their manifest astringency they have been supposed to strengthen and brace up the solids: but this effect experience does not countenance; as it is in disorders, and in constitutions, wherein corroborants are most serviceable, that the immoderate use of tea is peculiarly hurtful; in cold indolent habits, cachexies, chlorosis, dropsies, and debilities of the nervous system. Lewis's Mat. Med. Dr. Lettson has particularly enquired into the medical qualities and effects of tea; and having observed that infusion of bohea and green tea contribute to preserve sweet some small pieces of beef immersed in them, he infers that they possess an antiseptic power, when applied to the dead animal fibre, and from their striking a purple colour with salt of iron, he deduces their astringent quality. From other experiments he concludes, that the activity of tea chiefly resides in its fragrant and volatile parts; and that if the use of it be beneficial or injurious to any particular constitution, it becomes so principally by means of this odorous fragrant principle. He apprehends that it is the safest course to use the infusion of the more ordinary kinds of this plant, which abound less with this fragrant principle. Or the tea may be boiled a few minutes in order to dissipate this volatile part, which stands charged as the cause of those nervous affections that are said to be produced, or aggravated, by the use of this liquor. By this process may likewise be extracted more copiously the more fixed, bitter, and stomachic parts of this vegetable.

Dr. Lettson, who seems to be thoroughly persuaded of the occasional noxious effect of this volatile principle, in the finer teas especially, recommends this last mentioned mode of making tea, or the substitution of the extract instead of the leaves; by the use of which the nervous relaxing effects, which follow the drinking of tea in the usual manner, would be in great measure avoided.— This extract has been imported hither from China, in the form of small cakes, not exceeding a quarter of an ounce each in weight, ten grains of which might suffice one person for breakfast: but it

TEL

might easily be made here by simple decoction and evaporation, by those who experience the noxious qualities of the volatile principles of this plant.

Tea is, perhaps, less injurious, than many other infusions of herbs, which, besides a very slight aromatic flavour, have very little, if any stypticity, to prevent their relaxing debilitating effects. So far, therefore, tea, if not too fine, if not drank too hot, nor in too great quantities, is perhaps preferable to any other known vegetable infusion. And if we take into consideration, likewise, its known enlivening energy, our attachment to it will appear to be owing to its superiority in taste and effects to most other vegetables. See Dr. Lettson's Natural History of the Tea-tree, with Observations on the Medical Qualities of Tea, and Effects of Tea-drinking, 4to. 1772.

TEA-Tree of new Zealand, is a species of myrtle, of which an infusion was drank by Captain Cook's people in their voyages round the world. Its leaves were finely aromatic, astringent, and had a particular pleasant flavour at the first infusion; but this went off at the next filling up of the tea-pot, and a great degree of bitterness was then extracted; for which reason it was never suffered to be twice infused. See Banks's System of GEOGRAPHY, page 12.

In our account of this valuable plant we have extracted all that is essential and interesting; to have treated more copiously would have been too tedious for our purpose. Those who wish for more particular information are referred to Kämpfer's History of Japan, vol. ii. Appendix.

TELEGRAPHE, from *τελος*, distance, and *γραφω*, I describe, an instrument lately invented by the French, for the purpose of communicating intelligence from place to place, though very distantly remote, more effectually and speedily than by any other mode of conveyance previously discovered. As the public curiosity has been much excited by this new discovery, we present the following account of its construction, application, and uses.

Provide a circle of wood, A, B, C, D, of about four feet in diameter: and divide its circumference, which will be about 12 feet, into 25 equal parts. In one of those spaces cut an open square, and through each of the others cut one of the 25 letters of the alphabet (the letter I serving for J.) Over the spaces that are cut paste a thin oiled paper, on the top of a pole, P, fixed to the ground or floor, place a frame of wood, E, F, in which there is to be an opening of the same size with one of the divisions of the wheel. On the outside of this opening, let there be a door, by which it may be occasionally closed. To the pole let the wheel be fixed at its centre G, round which it must turn, and be placed at such a height that the letters on its circumference may answer to the hole in the frame. Behind that part of the pole which is opposite the board, let there be fixed, on a stand, a strong light.

When you would communicate your intelligence, open the door on the outside of the frame; then put that division of the wheel on which the square is cut against the opening, and place the light behind it, that serves as a signal to your correspondent, which he answers by putting his wheel in the same position.

What you intend to communicate being written on paper, and placed before you in a proper position, you turn the wheel round, till that division which contains the first letter of the first word comes before the opening, and keep it while you tell four: you then turn the wheel, either backward or forward, to the second letter, and keep it before the opening the same time; so of all the letters of that word, and between every one you place the vacant division before the opening, while you tell four. When you have finished the whole of your intelligence, you shut the door of the frame, or withdraw your light.

Where the distance is considerable, it will be necessary to be provided with proper telescopes. Your apparatus should be placed some way within the room that it may not be observed by passengers. It is evident, from the construction of the instrument, that it is full as well adapted for a correspondence by night as by day. A machine of this sort may be constructed at a trifling expence; and the utility of it is obvious from the successful experiments the French have made with it. If one be apprehensive lest any other person than his particular correspondent knows what passes, instead of letters, as Mr. De Lolme observes, twenty-four characters may be used, with which the correspondent may also be previously acquainted. There is one circumstance, however, which will render this entirely useless, and that is a thick fog or mist; for in that case, let the light be ever so strong, and the letters as large as they may, it will be impossible to discover them at any considerable distance.

TELESCOPE, formed of *τὴλὲς*, far, and *σκοπεῖν*, I observe, an optical instrument, consisting of several glasses or lenses fitted into a tube; through which remote objects are seen as if nigh at hand; or more generally, a telescope is an optical instrument, which serves for discovering and viewing distant objects, either directly by glasses, or by reflection, by means of specula or mirrors. The invention of the telescope is one of the noblest and most useful these ages have to boast of: by means hereof the wonders of the heavens are discovered to us, and astronomy is brought to a degree of perfection which former ages could have no notion of. The optical principles, whereon telescopes are founded, are contained in Euclid, and were well known to the ancient geometricians; and it is for want of

attention

attention thereto, that the world was so long without that admirable invention; as no doubt, there are numerous others lying hid on the same principles, only waiting for reflection or accident to bring them forth.

TEMPERAMENT, among physicians, the same with constitution, or a certain disposition of the solids and fluids of the human body, by which it may be properly denominated strong, weak, lax, &c. In every person there are appearances of a temperament peculiar to himself, though the ancients only took notice of four, and some have imagined these were deduced from the theories of the four humours or four cardinal qualities; but it is more probable that they were first founded on observations, and afterwards adapted to those theories, since we find that they have a real existence, and are capable of receiving an explanation. The two that are most distinctly marked, are the sanguineous and melancholic, viz. the temperament of youth and age.

1. *Sanguineous*. Here there is a laxity of solids, discoverable by the softness of hair and succulency; large system of arteries, redundancy of fluids, florid complexion; sensibility of the nervous power, especially to pleasing objects; irritability from the plethora; mobility and levity from lax solids. These characters are distinctly marked, and are proved by the diseases incident to this age, as hæmorrhages, fevers, &c. but these, as they proceed from a lax system, are more easily cured.

2. *Melancholic Habit*. Here greater rigidity of solids occurs, discoverable by the hardness and crispature of the hair; small proportion of the fluids, hence dryness and leanness; small arteries, hence pale colour; venous plethora, hence turgescency of these, and lividity; sensibility, frequently exquisite, but with great accuracy; moderate irritability, with remarkable tenacity of impressions; steadiness in action and slowness in motion, with great strength; for excess of this constitution in maniacs gives the most extraordinary instance of human strength we know: this temperament is most distinctly marked in old age, and in males: the sanguineous temperament of youth makes us not distinguish the melancholic till the decline of life, when it is very evident, from diseases of the veins, hæmorrhoids, apoplexy, cachexy, obstructions of the viscera, particularly of the liver, dropsies, affections of the alimentary canal, chiefly from slower and weaker influence of the nervous power. So much for the sanguineous and melancholic temperaments; the other two are not so easily explained: the choleric temperament takes place between youth and manhood. In the

3. *Choleric*, the distribution of the fluids is more exactly balanced; there is less sensibility, and less obesity, with more irritability, proceeding from greater tension, less mobility and levity, and more steadiness in the strength of the nervous power. As to the

4. *Phlegmatic*: This temperament cannot be distinguished by any character of age or sex. It agrees with the sanguineous in laxity and succulency. It differs from that temperament, and the melancholic, by the more exact distribution of the fluids. Again, it differs from the sanguineous, by having less sensibility, irritability, mobility, and perhaps strength, though sometimes indeed this last is found to be great. These are the ancient temperaments. The temperaments, indeed, are much more various; and very far from being easily marked and reduced to their genera and species, not only on account of variety of temperaments themselves, but also on account of idiosyncrasy, or particular aversions and inclinations to certain things in certain persons.

TENACITY, in natural philosophy, that quality of bodies by which they sustain a considerable pressure or force without breaking. Tenacity is the opposite quality to fragility or brittleness.

TENESMUS, in medicine, a continual painful inclination to go to stool, yet without voiding any thing; unless sometimes a little purulent or bloody slime: this disorder is usually attended with some tumour, sometimes with a very considerable one, in the part: this is properly no primary disease, but merely a symptomatic one, and differs in degree according to the disease on which it is an attendant.

TENSION, the state of a thing bent, or the effort made to bend it. Animals only sustain and move themselves by the tension of their muscles and nerves. A chord, or string in a musical instrument, gives an acuter or deeper sound, as it is in a greater or less degree of tension.

TEPID, in natural history, a term used by writers on mineral waters, to express such of them as have a less sensible cold than common water. They distinguish all the medicinal springs into three kinds; the hot, the tepid, and the cold; but the middle term might easily be misunderstood to mean a great deal more than they express by it; all that have what can be called the least sensible warmth, are called hot; and the tepid are distinguished from the absolutely cold, only by their being less cold.

TERRAQUEOUS, compounded of *tera*, and *aqua*, earth and water, an epithet given to our globe or earth, considered as consisting of land and water, which together constitute one mass. Some philosophers, particularly, Dr. Burnet, tax the frame and fashion of the terraqueous globe, as rude, unartful, and disorderly, and conclude it highly absurd to suppose it came thus out of the hands of the Creator: and, therefore, have recourse to the deluge for making it thus. But others can perceive much art and conveniency, even in this apparent disorder; Dr. Derham particularly observes, that the distribution of land and water is admirable; the one being

laid over the other so skilfully through all the world, that there is a just equipose or balance of the whole globe. Thus the northern ocean balances the southern, and the American continent is a counterpoise to the European, African, and Asiatic. And what some may object, that the waters occupy too great a part of the globe, which they imagine would be of more use if it were dry land, he obviates, by shewing that this would deprive the world of a due quantity of vapours and rain; for if the cavities which contain the sea and other waters were deeper, though the quantity of water were the same, and only the surface less and narrower, the evaporations would be so much the less, inasmuch as they are made from the surface, and consequently are in proportion to it. See the Article **EARTH**, the Treatise on the **GLOBES**, and the Plate annexed, Fig. 3.

TERROR. The act of terror, or of sudden frights, in diseases, is often very great. Sudden frights, in acute diseases, have evidently killed many, by the agitation into which they have thrown the spirits, already too much disordered. We have also accounts of persons absolutely killed by terrors, when in perfect health at the time of receiving the shock from them. The general effects of terror are a contraction of the small vessels, and a repulsion of the blood in the large and internal ones; hence proceed the suppression of perspiration, the general oppression, trembling, and anguish of the heart and lungs overcharged with blood, &c. When a person is affected with terror, the principal endeavour should be to restore the circulation to its due order, to promote perspiration, and to allay the agitation of the patient. For these purposes he may drink a little warm liquor, as chamomile tea, &c. the feet and legs may be put into warm water, the legs rubbed, and the chamomile tea repeated every six or eight minutes, and when the skin is warm, and there is a tendency to perspiration, sleep may be promoted by a gentle opiate. For the effects of terror on the countenance, see Treatise on **DRAWING**, Sect. VII. and the Plate annexed.

TERTIAN, **TERTIANA**, a fever or ague intermitting every day, so that there are two fits in three days. See the system of **MEDICINE**, Class I. Genus I.

TEST ACT, is the statute 25 Car. II. cap. 2. which directs all officers, civil and military, to take the oaths and make the declaration against transubstantiation, in the court of King's Bench or Chancery, the next term, or at the next quarter sessions, or (by subsequent statutes) within six months after their admission; and also within the same time to receive the sacrament of the Lord's supper, according to the usage of the church of England, in some public church, immediately after divine service or sermon, and to deliver into court a certificate thereof, signed by the minister and churchwarden, and also to prove the same by two credible witnesses, upon forfeiture of 500*l.* and disability to hold the said office. The word test signifies *proof or trial*, being formed of *testis*, witness; this act being established with a view to exclude Roman catholics from any share in the government, though it has operated to the exclusion of protestant dissenters in general. It may here be observed, that the original design of the test was not to exclude the protestant dissenters, but the papists. It was brought in by the patriots, in the reign of Charles the Second, under their apprehension of popery, and a popish successor; and when, during the debate in the house of commons, it was observed, that it was drawn in such a manner as to comprehend the protestant dissenters, the court strenuously endeavoured to avail themselves of that circumstance in order to defeat the bill. But the dissenting members disappointed them, by declaring, that they had rather confide in the justice and generosity of parliament, to pass some future bill in their favour, than be the occasion of retarding or defeating the security which the present bill was calculated to afford to the liberties of their country. Their patriotism produced soon afterwards a bill for their relief, from the penal laws; but the parliament was prorogued, through the resentment of the court, to prevent its passing: and when, notwithstanding this, a bill in favour of the dissenters did afterwards pass both houses, and lay ready for the royal assent, the court ventured upon a very extraordinary expedient: the clerk of the crown was ordered to convey away the bill, and, accordingly, it was never afterwards to be found. The particular test of receiving the sacrament according to the rites of the church of England, was calculated to exclude the papists rather than the protestant dissenters; as it was no uncommon thing for the latter, at that time, to receive the sacrament occasionally in the church of England, in order to express their charity towards it, as a part of the church of Christ. If it had been the design of the legislature to exclude all from civil offices but those who have a real affection to the constitution and worship of the church, it is apprehended they would have appointed the test to be, not merely once-taking the sacrament at church, but a stated and constant conformity to its religious services. Furneaux's Letters to judge Blackstone, p. 133. Motions have frequently been made in the house of commons, for bringing in a bill for a repeal of this act in favour of protestant dissenters, but it has hitherto been constantly negatived by a considerable majority.

TESTACEA, in the Linnæan System of natural history, is a denomination given to the third order of *vermes* or worms; the characters of which are, that they are animals of the **MOLLUSCA** or soft kind, of a simple make, and commonly covered with a cal-

T E T

careous habitation. See VERMEOLOGY. This order comprehends the whole tribe of shells under 36 genera, and disposed by Linnæus in a new method. For the several genera of this order, see the System of CONCHOLOGY throughout, and the synoptical table annexed.

TESTACEOUS, an epithet given to those fish which are covered with a strong, thick shell; as oysters, pearl-fish, &c., in opposition to those which are crustaceous.

TESTES, in anatomy, two white, soft, oval bodies, serving for generation; usually called, diminutively, testicles. See TESTICLE.

TESTICLE, a double part in animals of the male kind, serving for the office of generation. See GENERATION. They are called testicles, by diminution of *testes*, witnesses; as giving testimony of virility; they are what we properly call *genitores*, *genitalia*. The Greeks call them *didymi*, or twins. In man, and most animals, the testicles are exterior; in some, as fowls, interior. See the system of ANATOMY, Part III. Sect. XV. Art. I. and Plate X. fig. 4 and 5. For the formation of these parts in Quadrupeds, Birds, and Fishes, see the system of COMPARATIVE ANATOMY, Chap. I. II. and III.

Tumours of the TESTICLE. Tumours and inflammations of one or both the testicles are not unfrequently the consequence of falls, blows, and contusions, and very often are also brought on by venereal disorders. For the method of treatment in the last instance, see the System of MEDICINE, Genus 76.

TESTUDO, the TORTOISE, in amphibiology, the name of a Genus belonging to the order of Amphibia Reptilia. It has four legs and a tail, and the body is covered with a strong shell. There are 15 species, principally distinguished by peculiarities in their feet. The shell is so strong, that several men may stand on it without doing it any injury. It digs round holes in the sand, in which it lays several membranaceous eggs. It grows to a very large size; some having been found weighing 480lb. These creatures are said to continue several weeks in the act of copulation. They are found in great numbers in the West Indies and the fourth seas. Those who take them, watch them from their nests on shore; in moonlight nights; and, before they reach the sea, turn them on their backs, and leave them till morning; when they are sure to find them; since they are utterly unable to recover their former posture: at other times they hunt them in boats, with a peculiar kind of spear, striking them with it through the shell; and as there is a cord fastened to the spear, they are taken much in the same manner as the whales. For other particulars see the System.

TETANUS, *τετανος*, formed from *τετειναι*, to stretch, strain, in medicine, a kind of tonic spasmus, or convulsion, wherein the anterior and posterior muscles of the head, neck, and body, are rendered rigid and inflexible; so that the patient can neither bend one way nor the other, the head being much retracted. Tetanus is also a name sometimes given to a kind of partial spasm, in which the anterior and posterior muscles of the head and neck are rendered inflexible, so that it can neither bend one way nor the other.

TETRADYNAMIA, in botany, the fifteenth class of plants; for description and classification, see the System, Sect. III. For representation of the orders, appertaining to this class, see Plate V.

TETRANDRIA, in botany, the fourth class of plants, which have hermaphrodite flowers, with four stamina or male parts in each, of equal length. See the System, Sect. III. For representation of the orders appertaining to this class, see Plate IV.

TETRAO, in ornithology, a Genus of birds, belonging to the order of Gallinæ, distinguished by having the part of the forehead near the eyes naked and papillose: there are many species, distinguished principally by their colour, their having rough or naked feet, &c. the following are the principal.

The moor-fowl or grouse is peculiar to the British islands; the male weighs about 19 ounces; and is in length 15½ inches: the bill is black; the irides hazel-coloured: the throat is red; the plumage on the head and neck is of a light tawny red; each feather is marked with several transverse bars of black. For representation, see Plate III. Genus 53.

The perdrix, or partridge, is so well known, as to render any technical description unnecessary. "These birds (says Willoughby) hold the principal place in the feasts and entertainments of princes; without which their feasts are esteemed ignoble, vulgar, and of no account: the Frenchmen so highly value, and are so fond of the partridge, that if they be wanting, they utterly slight and despise the best spread tables; as if there could be no feast without them." But however this might be in the times of our historian, the partridge is now too common in France to be considered as a delicacy; and this, as well as every other simple dish, is exploded for luxuries of a more compound invention. In England, where the partridge is much scarcer, and a great deal dearer, it is still a favourite delicacy at the tables of the rich; and the desire of keeping it to themselves has induced them to make laws for its preservation, no way harmonizing with the general spirit of English legislation. The partridge seems to be a bird well known all over the world, as it is found in every country, and every climate; as well in the frozen regions about the pole, as the torrid track under the equator. It even seems to adapt itself to the nature of the climate where it resides. In Greenland the partridge, which is brown in summer, as soon as the icy winter sets in, begins to

T H E

take a covering suited to the season: it is then clothed with a warm down beneath; and its outward plumage assumes the colour of the snow, amongst which it seeks its food: thus it is doubly fitted for the place, by the warmth and the colour of its plumage; the one to defend it from the cold, the other to prevent its being noticed by the enemy. The dog, as every body knows, is trained to this exercise by a long course of education; by blows and caresses he is taught to lie down at the word of command; a partridge is shewn him, and he is then ordered to lie down; he is brought into the field, and when the sportsman perceives where the covey lies, he orders his dog to crouch: at length the dog, from habit, crouches wherever he approaches a covey; and this is the signal which the sportsman receives for unfolding and covering the birds with his net. A covey thus caught, is sometimes fed in a place proper for their reception; but they can never be thoroughly tamed like the rest of our domestic poultry. Latham in his system makes the perdrix or partridge a distinct genus. For representation, see Plate III. Genus 54.

The coturnix, or quail, is not above half the size of the partridge. The feathers of the head are black, edged with rusty brown; the breast is of a pale yellowish red, spotted with black; the feathers on the back are marked with lines of pale yellow, and the legs are of a pale hue. Except in the colours thus described, and the size, it every way resembles a partridge in shape, and, except that it is a bird of passage, all other of the poultry kind in its habits and nature. The quail is by all known to be a bird of passage; and yet, if we consider its heavy manner of flying, and its scantiness of plumage with respect to its corpulence, we shall be surprised how a bird so apparently ill qualified for migration, should take such extensive journeys: their ardour in courtship yields scarce to any other bird, as they are fierce and cruel at that season to each other, fighting most desperately, and (a punishment they richly deserve) being at that time very easily taken. Quail-fighting was a favourite amusement among the Athenians. They abstained from the flesh of this bird, deeming it unwholesome, as supposing that it fed upon the white hellebore: but they reared great numbers of them for the pleasure of seeing them fight; and staking sums of money, as we do with regard to cocks, upon the success of the combat. Fashion, however, has at present changed with regard to this bird; we take no pleasure in its courage, but its flesh is considered as a very great delicacy.

TEXT, a relative term contradistinguished to *gloss* or *commentary*, and signifying an original discourse, exclusive of any note or interpretation. Infinite pains have been taken by the critics, to restore, reconcile, settle, explain, &c. the text of the Bible, and that of the classics. Mr. Whiston accounts for all those misunderstandings between the Old and New Testament, particularly as to the prophecies in the Old, cited as fulfilled in the New, from the corruption of the text of the Old Testament; and to obviate objections made against Christianity on that head, has published an *Essay towards restoring the true Text of the Old Testament*. This restoration he attempts to effect from the Samaritan Pentateuch, the Roman Psalter, the Apostolical Constitutions, &c. It sufficiently appears, from the learned and acceptable labours of the late Dr. Kennicott, in collating the Hebrew manuscripts of the Old Testament, that the alterations introduced into the text, &c. are mostly of a trivial nature, and by no means affect the authority of the sacred writings.

THALIA, in mythology, one of the nine muses, who presided over comedy and pastorals. She is distinguished from the other muses by her mask, and from the tragic muse by her shepherd's crook; her aspect is likewise milder than that of Melpomene, and her dress shorter and less noble than that of the other muses.

THEOCRACY, formed from *θεος*, God, and *κρατος*, power, empire, a state governed by the immediate direction of God alone. According to Josephus, the ancient government of the Jews was theocratic; God himself ordering and directing every thing belonging to the sovereign authority. By the oracle of Jehovah himself, all laws were enacted, war was proclaimed, and magistrates were appointed, in which three particulars the *summa potestas*, or sovereign authority of any state consists. And as Jehovah was the king, as well as the God of Israel, the PRIESTS and LEVITES, who were the stated attendants on his presence, and to whom the execution of the law in many cases was committed, were properly ministers of state and of civil government, as well as of religion. The sacrifices also, besides their religious use, were intended for the support of the state and civil government. This theocracy lasted till the time of Saul, when the Israelites, weary thereof, desired they might have a king, like other nations; and thence forward the state became monarchic.

THEODOLITE, a mathematical instrument much used in surveying, for the taking of angles, distances, altitudes, &c. It is made variously; several persons having their several ways of contriving it, each attempting to make it more simple and portable, more accurate and expeditious, than others. For description and methods of adjusting this instrument, see the System of SURVEYING, Sect. I. For representation, see the Plate annexed, fig. 7.

THEOGONY, formed from *θεος*, God, and *γονη*, generation, seed, offspring, that branch of the heathen theology which taught the genealogy of their gods.

T H E

DISSERTATION ON THEOLOGY.

THEOLOGY, compounded of *Θεος*, *God*, and *λογία*, *discourse*, *Divinity*; a science, which instructs us in the knowledge of God and divine things; or which has God, and the things he has revealed, for its object. *Theology* is a science which shews us what we are to believe of God, and the manner wherein he would be served. It is divided into many branches, such as follow:

Natural THEOLOGY, is the knowledge we have of God from his works, by the light of nature and reason.

Supernatural THEOLOGY, is that which we learn from revelation.

Positive THEOLOGY, is the knowledge of the holy Scriptures, and of the signification thereof, conformably to the opinions of the fathers and councils; without the assistance of any argumentation. But some will have it, that this ought to be called *expositive*, rather than *positive*.

Moral THEOLOGY, is that which teaches us the divine laws relating to our manners and actions; in contradistinction to

Speculative THEOLOGY, which explains and establishes the doctrines of religion, as objects of faith.

Scholastic, or **School THEOLOGY**, is that which proceeds by reasoning; or that derives the knowledge of several divine things from certain established principles of faith. The ancients, according to Varro, Scævole, and Plutarch, had a three-fold theology; the first *μυθικη*, *mythic*, *fabulous*, which flourished among the poets; and was chiefly employed in the theogony, or genealogy, and history of the gods: to whom all things were attributed, which men, and even the vilest of them, could be guilty of. Nevertheless, the popular religion and worship were in a great measure founded upon that mythology, which run through the whole of their religion, and was of great authority with the people. Many unexceptionable proofs of this are produced by Dr. Leland, in his *Advantage and Necessity of the Christian Revelation*, vol. i. part. i. chap. 6. The second, *πολιτικη*, *political* or *civil*, was that established by the Roman laws, and chiefly embraced by the politicians, priests, and people, as most suitable and expedient to the safety, quiet, and prosperity of the state. This, though not the true, was the vulgar theology, and constituted the public and authorised religion. It was that which the philosophers themselves, whatever private opinions or speculations they might entertain, or dispute of in their schools, universally conformed to in their own practice, and also exhorted others to do so. Varro informs us, that this theology particularly determined what gods they were publicly to worship, what sacred rites they were to observe, and what sacrifices to offer.

Although even the vulgar among the pagans seem, in general, to have had some notion of one supreme God, yet their theology was properly polytheism; and the providence they acknowledged was the providence not of one god, but of many gods. The learned Dr. Cudworth, who seems inclined to put the most favourable construction upon the pagan theology, acknowledges, that the civil theology, as well as the poetical, had not only many fantastic gods in it, but an appearance of a plurality of independent deities; several being made supreme in their respective territories or functions. Aristotle (*Oper. tom. i. p. 1246. edit. Paris 1629*) intimates, that according to the laws of cities and countries, that is in the civil or political theology, there seems to be no one absolutely powerful or all-perfect being, but a plurality of gods, one of whom is supposed to be more powerful in one respect, and another in another respect. Besides, the public religion was made up partly of the physical and partly of the poetical theology. Those poetical fables which Varro censures as unworthy of the gods, and as ascribing to them actions which none but the vilest of men could be guilty of, were not only permitted to be acted on the public theatres, and heard with pleasure by the people, but they were regarded as things pleasing to the gods themselves, by which they were propitiated and rendered favourable; and accordingly they were taken into the public religion. Games were celebrated, and plays were founded upon them; and the public games and plays were on certain occasions considered as acts of religion, encouraged by their deities, and celebrated in honour of them. It is also justly observed, that the images, forms, habits, and ornaments of their gods, their different sexes and ages, and the sacred festivals instituted to their honour, had all of them a reference to the fables of the poets and mythologists, and were founded upon them; so that the civil and the fabulous theology might each of them be called civil, and each fabulous. Hence proceeded many absurd and ridiculous, and many immoral and inhuman rites, which were made use of in the worship of their gods, and which were either prescribed by the laws, or were established customs, countenanced by the magistrates, and which had obtained the force of laws, and may, therefore, be regarded as belonging to the public religion of the pagans. The philosophers likewise referred the people for instruction in divine matters to the oracles, which were managed by the priests; this was particularly the case with Socrates, Plato, and the Stoics. The worship of inferior deities was recommended by them, under pretence that it tended to the honour of the supreme. Some of the most eminent of them endeavoured to colour over the most absurd part of the pagan poetical theology, by allegorizing the most indecent fables: they apologized for the Egyptian animal worship, which the generality of the vulgar pagans in other nations ridiculed: they vindicated idolatry and

T H E

image-worship, as necessary to keep the people from falling into irreligion and atheism; and added, that some of the more refined philosophers were against any external worship of the supreme God. Many of the philosophers, and of the learned and polite pagans, denied a providence. Of those who professed to acknowledge it, some confined it to heaven and heavenly things; others supposed it to extend to the earth and to mankind, yet so as only to exercise a general care and superintendency, but not to extend to individuals; others, again, supposed all things, the least as well as the greatest, to be under the care of divine providence; but they ascribed this not to the supreme God, who, they thought, was above concerning himself with such things as these, and committed the care of them wholly to inferior deities. See the illustration and proof of these several allegations of Dr. Leland, *ubi supra*, cap. 7. 10--17.

The third, *φυσικη*, *natural*, was chiefly cultivated by the philosophers, as most agreeable to nature and reason. The physical or natural theology acknowledged one only supreme God; to which it added dæmons or spirits, as mediators between him and man.

THEOLOGY as it relates to the Study of the Christian Religion.

To ascend by a chain of reasoning from things visible to things invisible, from palpable to impalpable, from terrestrial to celestial, from the creature even up to the Creator, is the business of theology: it is not surprising, therefore, that the union of many doctrines is necessary completely to form such a science. To understand, and properly to interpret, the scripture, or revelation, demands not less sagacity than assiduity. The gift of persuasion is also essential to the ministers of the gospel. And lastly, the civil government has committed to their care certain functions of society, which relate, or seem to relate, either to the doctrines or morality of the gospel. They assemble, for example, in bodies to form consistories; they judge in matrimonial cases; they carry consolation and hope to the souls of the sick; they prepare for death those criminals which justice sacrifices to public safety; they take upon themselves the inspection of pious foundations; they distribute alms; they administer the sacraments, &c.

Qualifications necessary to form the Theologian.

In order to the true understanding of the sacred text of all the books contained in the Holy Bible, whether of the Old or New Testament, it is absolutely necessary that the theologian be thoroughly acquainted, not only with the languages in which these books were originally wrote, but likewise with the history and antiquities of those remote times in which their authors lived. With regard to researches into the history of the Jewish nation, their antiquities, their morals, and their customs, it will be found advantageous to pursue it as far as the nature of the subject will admit, without, however, engaging in critical subtilties that lead to a labyrinth to which there is no end, and have spread more clouds over theology than even the scholastic controversies have formerly done. Furnished with ideas from such sources, the theologian may venture to investigate the true sense of those passages of Holy Scripture that may appear to him obscure, contradictory, or difficult, and to interpret them to others; but he will be more wise and less vain than to attempt to impose his decisions on mankind, at all times, as authentic and infallible: the human discernment is ever confined and imperfect; and God has not granted to any man, to any theologian, or assembly of divines, an exclusive power of interpreting his divine word: he has moreover denounced his anathema against all those who shall add or take away a single word thereof. But to explore the true sense of any passage, and to explain it to others, cannot certainly be deemed either adding or retrenching.

To discharge fully so many duties, the theologian has need, 1. Of several preparatory studies: 2. Of some theoretic sciences: and 3. Of many doctrines which have for their object his ministerial office. The languages are these: his native language, in which he is to preach and exercise his ministry, and with which he ought to be perfectly acquainted. The Latin language, which is the language of the learned world in general. The Greek language, in order to understand the New Testament. The Hebrew language, of which the Talmudian and Rabbinical idioms are a part. The Arabic language. The Syriac language. The French language. And the English language: the two latter of which now appear necessary to every man of letters, and particularly to a theologian, on account of the excellent works which are wrote in those languages. The principal parts of philosophy, as, Logic, Metaphysics, Moral Philosophy; and Rhetoric and Eloquence, or the art of speaking correctly, of writing with elegance, and of persuasion: to which may be added, the Elements of Chronology, and Universal History. He who would devote himself to the important employment of a theologian, and has the noble ambition to excel in it, should early impress on his mind these truths: that the years which are passed at a university are few; that they run rapidly away; that they are entirely engrossed by the theoretic sciences; and that he who does not carry with him to the university a fund of knowledge in the preparatory parts of learning, commonly brings very little away, when his age or his parents oblige him to quit it.

The theoretic sciences of a theologian are, the dogmatic, or the theory of theology, which some Latin authors name also *thetica*, or *systematica*; the exegesis, or the science of attaining the true sense of the holy scriptures: the hermeneutic, or the art of interpreting and explaining the scriptures to others; this differs in general but little

THE

little from the exegesis, and in some respects is quite the same; polemic theology, or controversy: natural theology: moral theology; the history of the church under the Old and New Testaments. The practical sciences are, homiletic theology: catechetical theology; and casuistic theology.

RELIGIOUS TENETS.

Every positive religion must naturally have a system of certain points of doctrine to propose to its followers; otherwise each one would form a particular system according to its own fancy: there would be as many different religions as there are individuals on the earth, and each society would consist of a confused mass of fantastic opinions; as the different modes of thinking, and the different degrees of discernment, are varied and compounded by mankind to infinity: but truth, on the contrary, is uniform and invariable. The Christian religion is as compound in its dogmas as it is simple in its moral principle. It includes, 1, the dogmas or tenets founded on the light of reason: 2, those drawn from the Old Testament, and the law of Moses: 3, those taken from the New Testament and the doctrine of Jesus Christ: 4, those that the fathers of the church have drawn from the Holy Scriptures: 5, those that the church under the New Testament has prescribed to Christians by oecumenical and other councils assembled in different ages: 6, the dogmas that the popes, in quality of heads of the church, have established by their bulls: and to these must be added, on the part of the Protestants, 7, the dogmas that the reformers, especially Luther and Calvin, have taught: 8, the decisions of synods; and lastly, the tenets that are maintained by the different sects, as Socinians, Anabaptists, Quakers, &c. Each of these particular religions or sects pretend to support their dogmas both by reason and revelation: we do not here offer a work of controversy, and are very far from attempting to determine on which side truth and reason are to be found.

Our zeal for the Christian religion in general, which we regard as perfectly divine, and as the only religion adapted to promote the happiness of mankind in this world, and secure it in the next, and the desire we have that it may endure to the end of time, compels us to make in this place one important reflection; which is, that simplicity is ever an essential attribute of perfection, as complexity is of imperfection. Now, it cannot be denied, without doing violence to truth, that among the different dogmas, or tenets, of which we have been speaking, there are several that seem to be founded on speculations very abstruse, on subtilties very intricate, and on interpretations very ambiguous. God certainly never intended that all mankind should be theologians; he has not given them his divine word to be the cause of discord among men, nor that they should pass their whole lives in a painful search after objects of belief and articles of faith; and that they should forego, in that pursuit, the necessary offices of life, and their duties as citizens: the tenets, then, essentially necessary to the welfare of mankind, ought to consist of a small number, and to bear the marks of simplicity and perspicuity; without which they must be imperfect, and consequently the work of man. Our intention, in making this remark, is, to extend our voice, if it be possible, even to posterity, whom we would conjure not to injure our religion, so holy and so admirable, by a multiplicity of tenets. It is necessary, however, that the divine, who makes it his study and his profession, should be thoroughly acquainted with the theory of this science, in order that he may be able to instruct the sincere Christian, and to explain the nature of each particular tenet, as well as the solidity of its proofs; and to that it is that the study of the dogmatic leads; of which we shall now continue the analysis.

The dogmatic is then nothing but a *succinct exposition of all the dogmas of the Christian religion, in a natural and philosophical order*. By the word philosophic, we do not here precisely mean the method of mathematicians, in the manner the late M. Wolff has applied it to philosophy; every subject is not capable of a demonstration so exact and rigid; but a regular order is required in the arrangement of the general system, and a connexion is to be preserved in the several matters that form it: the definitions should be just; the divisions exact; the arguments solid; the proofs clear; the citations conclusive; the examples striking; and, in a word, every thing should be adduced that appertains to so important a discipline. It is very essential, moreover, in the dogmatic, at the beginning of each thesis, to explain the several terms that are peculiar to it, and that use has established in treating of theology; to draw from each definition certain axioms, and from thence to form propositions, and to illustrate them by solid reasoning.

The systematic part of the Christian religion, among the great number of its dogmas or theses, has three principal, from which all the rest are derived, and which form the basis of its whole doctrine: 1, the existence of one God: 2, the necessity of a Mediator or Redeemer: 3, the real appearance of the Mediator or Messiah on the earth.

Whoever writes, professes, or teaches the dogmatic, should be, above all things, careful well to establish these important truths: to evince them by the strongest and most evident proofs, drawn partly from the light of reason, and partly from revelation: and he will then see with what facility all other theses flow from, and how easy it will be to prove them by, these truths.

Revealed religion being founded (at least in great part) on natural religion, and philosophy being the source from whence the

THE

principles and the knowledge of the latter are derived, it is evident that philosophy is intimately connected with theology: nevertheless, the aid of the former is to be employed with precaution, and is not to be regarded as the foundation of the theological dogmas, or tenets, but only as a mean by which they may be explained and enforced. The Holy Scriptures constitute perpetually the true basis of revealed theology: philosophy effectually concurs, however, to prove the existence and the attributes of the Supreme Being; the necessity of the creation of the universe by Almighty God, in opposition to every other possible manner of its being produced: it furnishes, moreover, plausible conjectures concerning the intention of the Almighty in creating this world; it proves the necessity of a perpetual power to preserve it; it supposes, that as God could not produce any thing that was not perfect in its kind, he could not have created man as he now is; it vindicates the conduct of the Supreme Being, in appointing chastisements for transgressions, by showing that moral evil was not introduced into the world by absolute necessity, but by the abuse of liberty, the most noble prerogative of the human soul; it determines the necessity of a Mediator; it furnishes argument for the belief of the immortality of the soul, and of a future state that has a relation to the moral action of this life, and lastly, it inspires a love of God as a Being of sovereign perfection, a gratitude towards him as our Creator and Preserver, and a submission to his will as our Supreme Ruler and Director; motives of all others the most powerfully conducive to a virtuous conduct.

MORAL THEOLOGY.

The evangelists are the only historians of the Messiah; it is to their labours that we owe the knowledge of his actions upon earth and his divine doctrine. The four Evangelists, and the Acts of the Apostles wrote by St. Luke, contain therefore alone the history of the life of Jesus Christ, and the doctrine that he taught. His apostles and disciples began by paraphrasing his doctrine, as well by the evangelic sermons as in the epistles they addressed to the faithful of several Christian churches; they have given explanations and have added pastoral instructions, which are in effect admirable; but which, nevertheless, form not the original text of the discourses of our Saviour. It is not the same with regard to the mortality of Jesus Christ, every one may read it in the Gospel; and to know which, it is not necessary to become learned, nor to study a complicated system: The Saviour of the world has not enjoined any part of mankind to engage in disputes or abstract refinements: the sole command that he has given them, is, *to believe in his gospel*; and that is comprised in one word only, LOVE: the grand and only principle on which the whole of his sacred doctrine is founded. By the word Love in regard to bodies in general, is meant a tendency, a mutual inclination that urges them to join and to coalesce; and with regard to man in particular, a lively affecting pleasure that possesses the mind on contemplating the perfections of any object: this pleasure is always accompanied with a desire either to possess that object, or to render it propitious. By adopting therefore this principle, and this last definition of Love, it follows, that all the duties of man consist, 1. In the love of God in preference to all other objects. 2. in the love of himself. 3. In the love of his own species. 4. In the love of every other creature to a certain degree: the doctrines of Jesus Christ are, in these respects, the most explicit.

From this principle flows our duty towards God, towards ourselves, our neighbour, and to those beings that are subject to our power. The first rule is to communicate to all those, whom it is our duty to love, all the good, and to preserve them from all the evil in our power. The second, to do to no one what we would not have done to ourselves in similar circumstances. The third, which is the simple effect of love, is to endeavour to please the object that we ought to love. The fourth, to endeavour to render the pleasures that we communicate to others, as lively as possible, and those inevitable evils, which we are sometimes constrained to do them, as supportable as we can; and so of the rest. The whole evangelic doctrine of our Saviour is replete, from beginning to end, with admirable precepts for these purposes; and these precepts, with their applications, general and particular, we learn from that science which we call *moral theology*.

POLEMIC THEOLOGY, or CONTROVERSY.

We cannot sufficiently lament, that the church of the God of peace should be a church-militant; and that a doctrine so simple and clear as that of the Gospel should be the cause of discord even among Christians themselves. Nevertheless, as the truth is so difficult to discover in all things, and especially in matters of religion; as it is so frequently covered with the clouds of interest and ambition; as the same object appears so different to different men; and as error in the face of the world commonly assumes the mask of truth; it is but just that the true religion be furnished with arms to combat error, and to pluck off that deceitful mask by which so many poor mortals are seduced. The theologian, who has made the proper preparatory studies, who is thoroughly instructed in natural religion, in the dogmatic and the hermeneutic, and who joins to these sound logic, is already well prepared for this spiritual combat: he is armed, but he is still to learn how to use these arms: he must also be made acquainted with the enemies he is to encounter, to know their force, and the arts they will use against him: force is

ever

ever an infallible proof of the want of argument. The propagation of a religion by the sword, after the manner of Mahomet; persecutions either secret or open; constraint, violence, every sort of religious war, is so atrocious, so contrary to the spirit of the Gospel, in a word so detestable, that every true Christian must avert his sight from such infamous horrors.

The principal contests in which the theologian may be engaged, are, 1. Against those who admit of no revealed religion; as the atheist and deist. 2. Against those who admit of a revealed religion, but adopt not the true Revelation; as the Heathens, the Mahometans, &c. 3. Against those who believe only a part of the true Revelation; as the Jews. 4. Against those who add to the true Revelation matter foreign to it; as traditions, &c. 5. Against those who make a false interpretation of the sacred text, and draw from it erroneous systems; as the heretics and the schismatics, &c. And lastly, 6. Against those who make a wrong use of certain expressions of Revelation, and build on whimsical notions, ridiculous systems; as the Fanatics, &c.

According to this division, the theologian will have to combat principally with, 1. The Atheists, with Spinoza at their head. 2. The Deists. 3. The Heathens and Idolaters. 4. The Mahometans. 5. The modern Jews. 6. The Arians and the Manicheans, or rather those who in these days follow their ancient errors. 7. The Socinians. 8. The Catholics, opposed to the Protestants. 9. The Protestants, opposed to the Catholics. 10. The Molinists, opposed to the Jansenists. 11. The Jansenists, opposed to the Molinists. 12. The Reformers, opposed to the Lutherans. 13. The Lutherans, opposed to the Reformers. 14. The Arminians. 15. The Anabaptists. 16. The Quakers. 17. The Fanatics, at the head of whom is Jacob Bohm. 18. The Pietists. 19. The Moravian Brethren, or the Herenuters, &c. Now, as each of the religions, communions, or heresies above mentioned, have not scrupled to publish to the world their dogmas and creeds, the theologian ought carefully to instruct himself in those symbolic books, in which each of them have comprised its system; to study and to make a good analysis of them; and to prepare such arguments as are the most just, the most weighty, and proper to confute them. There is one remark to be made, or rather one caution that is very essential, which we would offer to the young theologian; which is, that the polemic is useful, and even necessary, in the study of theology in general; but that it is a discipline which ought to be treated with great prudence and moderation. Disputation in general is a dangerous art; and religious disputation is a deceitful art, and of infinite peril. The student will do right well to remember, that there is no sect, no communion on earth, that is perfectly true in all its tenets without exception; that there are some small errors in all religions; that infallibility never was, nor ever will be, the portion of humanity. He should likewise remember, that the masters who teach him, or the books that he reads, are constantly partial to the religion they profess; and that when he has supported a thesis, and confuted his adversaries in a collegial dispute, (where his adversaries, as well as his preceptors, are of the same side of the question, and will not fail to adjudge him the victory), he should be persuaded, that the victory would not have been so easily obtained had he contended with able adversaries of the opposite religion; he should remember, that he triumphs without glory, when he combats without danger; because it is very possible that he may go off victorious from such a dispute, that he may receive vast applause from his professors and his colleagues, and at the same time have reasoned without judgment. On the other hand, the most able theologians, and the most consummate professors in this science, ought to be constantly on their guard against the abuse of polemic theology; which frequently serves less to clear and confirm the truth of the dogmas of a communion, than to establish perpetual discord and hatred among Christians. Every theologian should also remember, that, by the nature of the subject, it is not possible to produce demonstration in support of his theses and opinions; but that his arguments will be only valid, and preponderate in proportion to their degree of evidence; and lastly, that it is a ridiculous and insufferable vanity to imagine, that every man, who does not think precisely as we do, is guilty of palpable error.

PASTORAL THEOLOGY.

It is in vain that a theologian possesses all the sciences that belong to his profession, that he is an agreeable and even a renowned preacher, if he do not give a life, an efficacious spirit, to his ministry, by a good example; for that is the first precept in pastoral theology. He is at the head of a flock, and ought to be their guide; but how absurd, if his words and his actions be at continual variance with each other! How scandalous, if he be not the first to practise these lessons of wisdom that he preaches! How indecent, if, while he edifies by his discourses, he disgusts by his morals! But this exemplary conduct should be free from all affectation in the external behaviour. A singularity of dress, and an air of austerity; the head declined, the eyes turned up to heaven, the hands constantly clasped, a plaintive tone of voice, and a solemn gait; a scrupulosity in things indifferent, and a dogmatic and clerical manner of deciding in the common affairs of life; a ridiculous inclination to discover iniquity in innocent actions; to confound pleasure with vice, and to be an enemy to joy, the greatest boon that God has bestowed on man; and a hundred other sopperies there are, with which the-

ligious make a parade, that is shocking both to good sense and evangelical morality, and which render their ministry, in the eyes of sensible people, more contemptible than respectable. These are rocks on which the young theologian is much too liable to run, and of which he cannot be sufficiently cautioned.

CASUISTIC THEOLOGY.

By casuistic theology, is meant, the science that decides in doubtful cases of moral theology, and that calms the scruples of conscience which arise in the Christian's mind during his sojourn in this world. The studies relative to these objects, which the theologian is supposed to have made, and the confidence that the common rank of Christians place in their pastors, afford them the means and the opportunities of rendering signal service to those of their fellow-citizens who have need of their counsel and consolation: for where there is one man of a philosophic spirit, one Christian of a well-grounded knowledge in theology, there are in society a thousand that are not, and who are yet desirous of being instructed, guided, comforted, and established. It is therefore both just and important that he who devotes himself to the service of the altar, should early study all those sciences that will enable him worthily to perform this important part of his ministry. God forbid, however, that we should countenance the abuse that is made, in some Christian countries, of the duties that we have here explained. In a word, to assume an absolute authority over the consciences of mankind, is a pernicious invention, contrary to the evangelical moral, to the welfare of society, to the interest of the state, and to the sovereign authority. He who is charged with the duties of the ministry by a lawful vocation, should remember that there are four classes of men with whom he will be engaged: 1. With those of weak minds; of little knowledge and little ability. 2. With those whose spirits are afflicted by some great reverse of fortune. 3. With those of nice and timorous consciences, who suffer by their scruples, whether they be vain or rational. 4. And lastly, the wicked, the hardened and incorrigible sinner. The grand art here consists in representing to each of these classes of men, the truth, in a manner so clear, so strong and full, that they can no longer retain any doubts, that conviction must take place, and consolation or conversion be the consequence. Truth is in its nature highly problematic: each one, however, is persuaded that he knows it, that he possesses it, and is guided by it; every man thinks himself in the right. We should therefore begin by discovering the truth in the subject before us, and in placing it upon a solid foundation. This business of demonstrating the truth to others, is attended in the mean time with infinite difficulty. Every mind is not capable of discovering it at the first glance; nor can all discern it from the same point of view. Sometimes men require conviction by abstract or philosophical arguments, and sometimes by the express decisions of the Holy Scripture. Sometimes by authority, sometimes by gentle remonstrance, and sometimes by dreadful menaces. Sometimes they are to be reclaimed by properly exposing the necessary and fatal consequences that result from their conduct; and at others, by the alluring promises of the gospel. Vice should be boldly confronted; and the transgressor is to be conducted into the right path by artful turnings: the sinner's crimes are to be painted in the strongest colours; and sometimes a veil should be lightly cast over them; and we should even indulge a favourite inclination, in order to induce them to abandon a more pernicious passion.

As it is impossible that the books which have been wrote on this subject, though of an immense quantity, can contain every case that daily occurs in the ministry of the gospel; and as these cases are not always justly decided by these authors; and, if they were, the consulting such enormous works would take up too much of a theologian's time, and divert him from his other studies; and as these casuistic writers contain, moreover, a number of puerile subtleties and wretched chimeras; it is highly proper that the minister of the altar, whom we suppose to have a complete knowledge of the principles and morals of the Christian religion, should endeavour to draw from the true source the means that he is to employ on each occurrence, and not have recourse to books for their decisions.

THERMOMETER, an instrument for measuring the increase and decrease of heat and cold. It is an instrument of modern invention, but authors are not agreed on the person who was the first inventor. Sanctorius affirms, that he himself had this honour; and his assertion is corroborated by the testimonies of Borelli and Malphigi. Boerhaave, however, ascribes it to Cornelius Drebbel, about the beginning of the 17th century, Muchenbroek to the Venetian Paul Sarpi; and Viniani to Galileo. It is not well known what was the form of the first instruments of this kind, only it is certain that they were far from being as perfect as they are at present. They were very clumsy; and air being the fluid employed, they acted also as a kind of *barometers*, and thus were entirely unfit for comparing the degrees of heat at the distance of any considerable time: the first improvement in their construction was made by Ferdinand II. great duke of Tuscany, or the members of the Academy del Cimento under his protection, about the middle of the 17th century. Spirit of wine inclosed in glass tubes hermetically sealed, was now employed; by which means evaporation was prevented, and likewise the pressure of the external air kept off. Instruments of this kind were introduced into England by Mr. Boyle, and very soon came to be universally used among the virtuosi in different parts

of the world. However, they still laboured under great disadvantages; for as they were not adjusted to any common scale, though they would each of them shew the comparative degrees of heat and cold in the bodies to which they were applied: yet they could never be compared with one another, nor could the observations made in different parts of the world be collected in such a manner as to answer any useful purpose.

The only difficulties which remained in the construction of thermometers were the choice of a proper fluid, the adjusting of the two fixed points, and the divisions of the space between them in such a manner as to make proper allowance for any inequalities that might happen to be in the diameter of the tube through which the fluid moves. With regard to the fluid, quicksilver has universally obtained the preference, as being sooner heated and cooled than any other with which we are acquainted, and requiring so great a degree of cold to congeal it, that till very lately it was thought impossible to do so; though the contrary is now shewn by undeniable experiments. The heat also which quicksilver requires to make it boil, is very considerable, so that the scale on a quicksilver thermometer may be enlarged greatly beyond that made with any other fluid. In extreme degrees of cold, indeed, where quicksilver freezes, the thermometer should be filled with highly rectified spirit of wine, or the fluid petroleum, called *naphtha*; both of which are found unalterable in the greatest degrees of cold, either natural or artificial, hitherto observed in any part of the world. The adjustment of the two fixed points of heat, viz. that of boiling and that of freezing water, has been found a matter of considerable difficulty, as they vary considerably according to the height of the mercury in the barometer at the time. Hence the greatest philosophers have not thought it below them to bestow their labour in attempting to bring this matter to its utmost exactness; and for this purpose a committee of the Royal Society was appointed. This inaccuracy in the heat of boiling water at different times, was observed by Mr. Fahrenheit, a celebrated artist at Amsterdam, from whom the kind of thermometers now mostly used took their name. He supposed the variation to be much greater than it really is; but Mr. de Luc, by a great number of experiments made at different heights above the level of the sea, found a rule by which the difference in the boiling point, answering to different heights in the barometer, is determined with great exactness. According to this rule, the alteration of the boiling point by the variation of the barometer from 29½ to 30½ inches, is 1°. 59 of Fahrenheit. The committee of the Society (of whom Mr. de Luc was one,) after a number of experiments (which our limits will not allow us to insert, laid down the following practical rules for adjusting the boiling and freezing points.

RULES TO BE OBSERV'D IN ADJUSTING THE BOILING POINT.

"The most accurate way of adjusting the boiling point is, not to dip the thermometer into the water, but to expose it only to the steam, in a vessel closed up in the manner presented in the Miscellaneous Plate, *fig. 14.* where *ABba* is the vessel containing the boiling water, *Dd* the cover, *E* a chimney made in the cover intended to carry off the steam, and *Mm* the thermometer passed through a hole in the cover. Those who would make use of this method, must take care to attend to the following particulars.

"1st. The boiling point must be adjusted when the barometer is at 29.8 inches; unless the operator is willing to correct the observed point in the manner directed below.

"2dly. The ball of the thermometer must be placed at such a depth within the pot, that the boiling point shall rise very little above the cover; for otherwise part of the quicksilver in the tube will not be heated; and therefore the thermometer will not rise to its proper height. The surface of the water in the pot also should be at least one or two inches below the bottom of the ball; as otherwise the water, when boiling fast, might be apt to touch the ball: but it does not signify how much lower than that the surface of the water may be.

"3dly. Care must be taken to stop up the hole in the cover through which the tube is inserted, and to make the cover fit pretty close, so that no air shall enter into the pot that way, and that not much steam may escape. A piece of thin flat tin plate must also be laid on the mouth of the chimney, so as to leave no more passage than what is sufficient to carry off the steam. The size of this plate should not be much more than sufficient to cover the chimney, that its weight may not be too great; and the mouth of the chimney should be made flat, that the plate may cover it more completely. It must be observed, that when the tin-plate is laid on the mouth of the chimney, it will commonly be lifted up by the force of the steam, and will rattle till it has slipped aside sufficiently to let the steam escape without lifting it up. In this case it is not necessary to put the plate back again, unless by accident it has slipped aside more than usual. If the artist pleases, he may tie each corner of this plate by a string to prongs fixed to the chimney, and standing on a level with the plate, as thereby it will necessarily be kept always in its place. *Fig. 13.* is a perspective view of the chimney and tin-plate; *ABCD* is the plate; *E* the chimney; *Ff*, *Gg*, *Mm*, and *Nn*, the prongs fastened to the chimney, to which the four corners of the plate are to be tied by the strings, *AF*, *BG*, *CM*, and *DN*; the ends *F*, *G*, *M*, and *N*, of the prongs, must be on a level with the plate, and the strings should not be stretched tight: but we would by no means recommend having it made with a

hinge, as that might be apt to make it stick, in which case the included vapour might be so much compressed as to cause an error. It is most convenient not to make the cover fit on tight, but to take on and off easily; and to wrap some spun cotton round that part of the cover which enters into the pot, in order to make it shut closer.

"There are various easy ways by which the hole in the cover, through which the tube of the thermometer is passed, may be stopped up, and by which the thermometer may be suspended at the proper height. The hole in the cover may be stopped up by a cork, which must first have a hole bored through it big enough to receive the tube, and be then cut into two, parallel to the length of the hole. Another method more convenient in use, but not so easily made, is represented in *fig. 16.* which exhibits a perspective view of the apparatus; *Aa*, is the cover; *H*, the hole through which the thermometer is passed; *Bb*, a flat piece of brass fixed upon the cover; and *DdEe*, a sliding piece of brass, made so as either to cover the hole *H*, or to leave it uncovered, as in the figure, and to be tightened in either position by the screw *S* sliding in the slit *Mm*; a semi circular notch being made in the edge *Bb*, and also in the edge *Dd*, to inclose the tube of the thermometer: pieces of woollen cloth should also be fastened to the edges *Bb* and *Dd*, and also the bottom of the sliding-piece *DdEe*, unless that piece and the cover are made sufficiently flat, to prevent the escape of the steam. In order to keep the thermometer suspended at the proper height, a clip may be used like that represented in *fig. 12.* which, by the screw *S*, must be made to embrace the tube tightly, and may rest on the cover. That part of the clip which is intended to bear against the tube had best be lined with woollen cloth, which will make it stick tighter to the tube, and with less danger of breaking it. Another method, which is rather more convenient when the top of the tube of the thermometer is bent into a right angle, in the manner frequently practised at present for the sake of more conveniently fixing it to the scale, is represented in *fig. 16.* *GgFf*, is a plate of brass, standing perpendicularly on the cover; and *L/Nn*, a piece of brass, bent at bottom into the form of a loop, with a notch in it, so as to receive the tube of the thermometer, and to suffer the bent part to rest on the bottom of the loop: this piece must slide in a slit *Kk*, cut in the plate *L/Nn*, and be tightened at any height by the screw *T*.

"4thly. It is best making the water boil pretty briskly, as otherwise the thermometer is apt to be a great while before it acquires its full heat, especially if the vessel is very deep. The observer, too, should wait at least one or two minutes after the thermometer appears to be stationary, before he concludes that it has acquired its full height.

"5thly. Though, as we said before, this appears to be the most accurate way of adjusting the boiling point; yet, if the operator was to suffer the air to have any access to the inside of the vessel, he would be liable to a very great error: for this reason, we strongly recommend it to all those who use this method, not to deviate at all from the rules laid down, without assuring themselves, by repeated trials with a pretty sensible thermometer, that such alteration may be used with safety. But the covering the chimney with the tin-plate ought by no means to be omitted; for though, if the cover of the pot fits close, it seldom signifies whether the plate is laid on or not, yet, if by accident the cover was not to fit close, the omitting the tin-plate would make a very great error.

"Another way of adjusting the boiling point is, to try it in a vessel of the same kind as the former, only with the water rising a little way, namely from one to three or four inches above the ball, taking care that the boiling point shall rise very little above the cover, as in the former method. In this method there is no need to cover the chimney with the tin-plate; and there is less need to make the cover fit close, only it must be observed, that the closer the cover fits, the less the operator will be incommoded by the steam. The height of the barometer at which the boiling point should be adjusted, when this method is used, is 29½ inches, or three-tenths of an inch less than when the former method is used.

"The greatest inconvenience of this method of adjusting the boiling point is the trouble of keeping a proper depth of water in the pot; as to do this it is necessary first to find the height of the boiling point coarsely by trying it in an open vessel, and then to put such a quantity of water into the pot that it shall rise from one to three or four inches above the ball when the thermometer is placed at such a depth within the pot that the boiling point shall rise very little above the cover. The operator must be very careful that the quantity of water in the pot be not so small as not entirely to cover the ball. A third way of adjusting the boiling point is to wrap several folds of linen rags or flannel round the tube of the thermometer, and to try it in an open vessel, taking care to pour boiling water on the rags, in order to keep the quicksilver in the tube as nearly of the heat of boiling water as possible. The best way is to pour boiling water on the rags three or four times, waiting a few seconds between each time, and to wait some seconds after the last time of pouring on water before the boiling point is marked, in order that the water may recover its full strength of boiling, which is in good measure checked by pouring on the boiling water. In this method the boiling point should be adjusted when the barometer is at 29.8 inches, that is, the same as when the first method is used; the water should boil fast, and the thermometer should be held upright, with its ball two or three inches under water, and in that part of the vessel where the current of water ascends. In a vessel

vessel of boiling water, one may almost always perceive the current of water to ascend on one side of the vessel, and to descend on the other. Which-ever of these methods of adjusting the boiling point is used, it is not necessary to wait till the barometer is at the proper height, provided the operator will take care to correct the observed height according to the following table.

Height of the barometer when the boiling point is adjusted according to,		Correction in 1000ths of the interval between 32° and 212°.	Height of the barometer when the boiling point is adjusted according to,		Correction in 1000ths of the interval between 32° and 212°.
1st or 3d method.	2d method.		1st or 3d method.	2d method.	
	30.64		29.69	29.39	1
	53	9	58	28	2
30.71	41	8	47	17	3
59	29	7	36	06	4
48	18	6	25	28.95	5
37	07	5	14	84	6
25	29.95	4	03	73	7
14	84	3	28.92	62	8
03	73	2	81	51	9
29.91	61	1	70	—	10
80	50	0	59	—	11

"To make use of this table, seek the height which the barometer is found to stand at in the left hand column, if the boiling point is adjusted either in the first or third method, and in the second column if it is adjusted in the second method; the corresponding number in the third column shews how much the point of 212° must be placed above or below the observed point, expressed in thousandths parts of the interval between the boiling and freezing point: for example, suppose the boiling point is adjusted in steam, when the barometer is at 29 inches, and that the interval between the boiling and freezing points is 11 inches: the nearest number to 29, in the left hand column, is 29.03, and the corresponding number in the table is 7 higher, and therefore the mark of 212° must be placed higher than the observed point by $\frac{7}{1000}$ of the interval between boiling and freezing, that is, by $\frac{7}{1000}$ or .007 of an inch.

"This method of correcting the boiling point is not strictly just, unless the tube is of an equal bore in all its parts; but the tube is very seldom so much unequal as to cause any sensible error, where the whole correction is so small. The trouble of making the correction will be abridged by making a diagonal scale, such as is represented in fig. 15. It is not very material what kind of water is used for adjusting the boiling point, so that it is not at all salt; only, if any kind of hard water is used, it is better that it should be kept boiling for at least ten minutes before it is used. But we would advise all those desirous of adjusting thermometers in the most accurate manner, for nice experiments, to employ rain or distilled water, and to perform the operation in the first mentioned manner, that is, in steam.

ON THE FREEZING POINT.

"In adjusting the freezing as well as the boiling point, the quicksilver in the tube ought to be kept of the same heat as that in the ball. In the generality of thermometers, indeed, the distance of the freezing point from the ball is so small, that the greatest error which can arise from neglecting this precaution is not very considerable, unless the weather is warmer than usual; but as the freezing point is frequently placed at a considerable distance from the ball, the operator should always be careful either to pile the pounded ice to such a height above the ball, that the error which can arise from the quicksilver in the remaining part, of the tube not being heated equally with that in the ball, shall be very small; or he must correct the observed point, upon that account, according to the following table.

Heat of the air Correction.	
42°	.00087
52	.00174
62	.00261
72	.00348
82	.00435

"The first column of this table is the heat of the air, and the second is the correction expressed in 1000th parts of the distance between the freezing point and the surface of the ice; for example, if the freezing point stands seven inches above the surface of the ice, and the heat of the room is 62, the point of 32° should be placed $7 \times .00261$, or .018 of an inch lower than the observed point. This correction also would be made more easy by the help of a diagonal scale, similar to that proposed for the boiling point.

ON THE PRECAUTION NECESSARY TO BE OBSERVED IN MAKING OBSERVATIONS WITH THERMOMETERS.

"In trying the heat of liquors, care should be taken that the quicksilver in the tube of the thermometer be heated to the same degree as that in the ball; or, if this cannot be done conveniently, the observed heat should be corrected on that account." After having adjusted the fixed points of thermometers in this manner, the division of the scale is easy; for by making a certain quantity of mercury, suppose as much as fills the tube the length of half an inch, pass through the whole length of it when open at both

ends, we can perceive what length of space it occupies in different parts of the tube, and divide accordingly. However, even after thermometers are constructed in this manner with the utmost accuracy, a very considerable inconvenience still attends the using them, namely, that to know the extreme heat or cold of the air, during any given period, the observer's eye must be on the instrument the very instant that the mercury stands at the highest or lowest degree; for, since the time when that may happen is utterly uncertain, if it be not immediately noticed, it can never afterwards be known. The sultry heat of the summer's day, and the freezing cold of the winter's night, render it very unpleasant to be abroad at such times in the open air, although it is absolutely necessary that the thermometer should be so. It would therefore be a very great improvement could a thermometer be constructed in such a manner as to shew the greatest height to which it had ascended, or the lowest point to which it descended, in the observer's absence. One of this kind has been constructed by Mr. James Six, of which the following account is given by him in the 72d volume of the Phil. Trans.

"Fig. 17, *ab* is a tube of thin glass, about 16 inches long, and five sixteenths of an inch in diameter; *cdefgh*, a smaller tube with the inner diameter, about one fortieth, joined to the larger at the upper end *b*, and bent down, first on the left side, and then, after descending two inches below *ab*, upwards again on the right, in the several directions *cde*, *fgh*, parallel to and one inch distant from it. On the end of the same tube, at *h*, the inner diameter is enlarged to half an inch from *b* to *i*, which is two inches in length. This glass is filled, with highly rectified spirits of wine, to within half an inch of the end *i*, excepting that part of the small tube from *d* to *g*, which is filled with mercury. From a view of the instrument in this state, it will readily be conceived, that when the spirit in the large tube, which is the bulb of the thermometer, is expanded by heat, the mercury in the small tube on the left side will be pressed down, and consequently cause that on the right side to rise; on the contrary, when the spirit is condensed by cold, the reverse will happen, the mercury on the left side will rise, as that on the right side descends. The scale, therefore, which is Fahrenheit's (fig. 21), beginning with *o* at the top of the left side, has the degrees numbered downwards, while that at the right side, beginning with *o* at the bottom, ascends. The divisions are ascertained by placing this thermometer with a good standard mercurial one in water gradually heating or cooling, and marking the divisions of the new scale at every 5°. The divisions below the freezing point are taken by means of a mixture of sea salt and ice, as described by Nolle, De Luc, and others. Thus far this thermometer resembles, in some respects, those of Mr. Bernoulli and Lord Charles Cavendish: but the method of shewing how high the mercury had risen in the observer's absence, the essential property of an instrument of this kind, is wholly different from theirs, and effected in the following manner. Within the small tube of the thermometer, above the surface of the mercury on either side, immersed in the spirit of wine, is placed a small index, so fitted, as to pass up and down as occasion may require: that surface of the mercury which rises, carries up the index with it, which index does not return with the mercury when it descends but by remaining fixed, shews distinctly, and very accurately, how high the mercury had risen, and consequently what degree of heat or cold had happened.

"Fig. 18. Represents one of these indexes drawn larger than the real ones, to render it more distinct. *a* is a small glass tube, three quarters of an inch long, hermetically sealed at each end, inclosing a piece of steel wire nearly of the same length: at each end *cd* is fixed a short piece of a tube of black glass, of such a diameter as to pass freely up and down within the small tube of the thermometer. The lower end floating on the surface of the mercury, is carried up with it when it rises, while the piece at the upper end being of the same diameter, keeps the body of the index parallel to the sides of the thermometrical tube. From the upper end of the body of the index at *e* is drawn a spring of glass to the fineness of a hair, about five sevenths of an inch in length, which being set a little oblique, presses lightly against the inner surface of the tube, and prevents the index from following the mercury when it descends, or being moved by the spirit passing up or down, or by any sudden motion given to the instrument, by the hand or otherwise; but at the same time the pressure is so adjusted as to permit this index to be readily carried up by the surface of the rising mercury and downwards whenever the instrument is to be rectified for observation. To prevent the spirit from evaporating, the tube at the end *i* is closely sealed. When this tube is closed (not hermetically, but only so as to prevent the spirit's evaporating) the thermometer must be brought to the greatest heat it is likely at any time after to sustain; and though no more air is enclosed than what remains at that time above the spirits, yet that will, by its elasticity pressing on the fluid, answer every purpose as well as if the external air was freely admitted. Fig. 21, represents the thermometer on its frame; the plates on which the scale is graven on either side are made to slide out, and the frame is open to the back behind the large tube, which does not touch it, except at each end. The cap *a*, and the base *b*, are made to fix on with screws, and only cover the turning of the small tube. By a screw at the bottom of the frame, it may be made fast to the wall against which it is to hang without doors, to prevent its

its being shaken by violent winds. Towards evening an observer may visit the thermometer, and see at one view, by the index on the left side, the cold of the preceding night; and by that on the right, the heat of the day. These he may minute down, and then apply a small magnet to that part of the tube against which the indexes rest, and move each of them down to the surface of the mercury; thus, without heating, cooling, separating, or at all disturbing the mercury, or moving the instrument, may this thermometer, without a touch, be immediately rectified for another observation.

In some cases it may be found expedient, instead of the double thermometer first described, to make two single ones; one to shew the greatest degree of heat only, and the other the cold, each having its proper index (see fig. 22 and 33) in the Miscellaneous Plate, which contains all the preceding figures on this subject. The first has the small tube bent down on the left side, and the lower end immersed in a bulb or small cistern of mercury, to which the external air has free access; the other has the small tube turned up on the right side, with some mercury let down to the bottom, and the upper end closely sealed, as in the double thermometer. We shall here insert some observations made with the thermometers of Fahrenheit.

Observations by Fahrenheit's thermometer.

At 600 degrees mercury boils; 546 oil of vitriol boils; 242 spirit of nitre boils; 240 Lixivium tartari boils; 213 cow's milk boils; the above is according to Muschenbroeck, the barometer being at 29 Rhinland inches.

At 212 deg. water boils; 206 fresh human urine boils; 190 brandy boils; 174 alcohol boils; 156 serum of blood and white of eggs harden; 146 killing heat for animals, in a few minutes; 108 a hen hatching eggs, but seldom so hot; 107 to 103 heat of skin in ducks, geese, hens, pigeons, partridges, and fowls.

At 106 deg. heat of skin in a common ague and fever; from 103 to 100 heat of skin in dogs, cats, sheep, oxen, swine, and other quadrupeds; 99 to 92 heat of the human skin in health.

At 80 deg. heat of the air in the shade, in very hot weather; 74 butter begins to melt; 64 heat of the air in the shade, in warm weather; 48 temperate air, in England and Holland; 43 oil of olive begins to thicken and grow opaque; 39 mercury freezes; 32 water just freezing, or snow and ice just thawing; 30 milk freezes; 28 urine and common vinegar freezes; 25 blood out of the body freezes; 20 good Burgundy, strong claret, and Madeira freezes; 7 one part of spirits of wine mixed with three parts water freezes; 5 greatest cold in Pennsylvania in 1731-2 40° lat.; 4 greatest cold at Utrecht in 1728-9; 0 a mixture of snow and salt, which is able to freeze oil of tartar, *per deliquium*, but not brandy.

Martine's Essays, p. 284, &c.

We must here observe that the heat of a hen hatching chickens is placed, by this table, at 108 of Fahrenheit's thermometer; but it appears from M. Raumur's experiments, that eggs will hatch in a heat no greater than that of the human skin. See HATCHING. For further information on this subject of thermometers, see Martine's Essays, Medical and Philosophical, printed at London in 1740, 8vo. Desaguliers's Exp. Phil. vol. ii. p. 289, &c. Muschenbroeck's Int. ad. Phil. Nat. vol. ii. p. 625, &c. ed. 1762. De Luc's Recherches sur les Modifications de l'Atmosphere, tom. 1. part ii. chap. 2. Nollet's Leçons de Physique, tom. iv. p. 375, &c.

THESIS, *thesis, position*, in the Schools, a general proposition, which a person advances, and offers to maintain. In the college it is frequent to have placards, containing a number of these theses in theology, in medicine, in philosophy, in law, &c. The maintaining a thesis, is a great part of the exercise a student is to undergo for a degree.

THESIS, in logic, &c. Every proposition may be divided into thesis and hypothesis: thesis contains the thing affirmed or denied, and hypothesis the conditions of the affirmation or negation. Thus, in Euclid, if a triangle and parallelogram have equal bases and altitudes (is the hypothesis) the first is half of the second (the thesis).

THIGH, a part of the body of men, quadrupeds, and birds, between the leg and trunk. We have an account in the Philosophical Transactions of a large piece of a young man's thigh bone being taken out, and the place so well supplied by a callus, that he walked straight. See No. 461. sect. 2.

THIGH-BONE, or *femoris*, in anatomy. For description, see the System, Part II. Sect. IV. Art. 4. For representation, see Plate I. fig. 1. Letter a.

THINKING, *cogitation*, a general name for any act or operation of the mind. When the mind turns its view inward upon itself, the first idea that offers, says Mr. Locke, is thinking; wherein it observes a great variety of modifications, and thereof frames to itself distinct ideas: thus the perception annexed to any impression on the body, made by an external object, is called sensation. When an idea recurs without the presence of the object, it is called remembrance. When sought after by the mind, and brought again in view, it is called recollection. When held there long under attentive consideration, it is called contemplation. When ideas float in the mind without regard or reflection, it is called a reverie; when they are taken express notice of, and as it were registered in the memory, it is attention; and when the mind fixes its view on any one idea, and considers it on all sides, it is study and attention. These are the most obvious modes of thinking; but there are several others which we know of, and doubtless the

mind is capable of infinite others, whereof we have no notion at all.

THIRD, in music, a concord resulting from a mixture of two sounds, containing an interval of two degrees. It is called third, as containing three terms or sounds, between the extremes. Chromatically it is composed of four semitones; two whereof are greater, and the third less. See the System, Part II. Sect. XIV.

THIRST, an uneasy sensation arising from a deficiency of the saliva to moisten the inward parts of the mouth. Hence arises a strong desire for drink; and thirst is a symptom generally attending fevers of all kinds. Thirst is best allayed by acids; water kept a while in the mouth, then spit out, and repeated as required; a bit of bread chewed with a little water, which latter may be gradually swallowed; if the person is very hot, brandy is the best for holding in the mouth, but should be spit out again: except in fevers, large draughts of cold water are hurtful.

THISTLE, in botany. See **CARDUUS**. The dried flowers of the *carduus lanceolatus* or spear-thistle, and *carduus nutans* or musk-thistle, are used in some countries as a runnet for curdling their milk: the tender stalks of the palustris, or marsh-thistle, and indeed of most thistles, are esculent, being first peeled and boiled. In this manner the inhabitants of Smaaland, in Sweden, as Linnæus informs us, often eat them. For a copious account of the most approved method of destroying this noxious weed, see the System of AGRICULTURE, Sect. 29.

Order of the THISTLE, or of St. Andrew, is a military order in Scotland; instituted, as some say, by Hungo, or Hungo, king of the Picts, after a victory obtained over Athelstan: the legend is, that a cross of St. Andrew (the patron of that kingdom) appearing to him at the time of the engagement, he blessed the happy augury, took the figure thereof into his standard in honour of his protector, and instituted an order of knights whose collar is of gold interwoven with thistle-flowers and sprigs of rue. From the collar hangs a medal, on which is the image of St. Andrew with his cross on his breast, with this motto, *Nemo me impune lacesset*. No body shall provoke me unpunished. For description, see **KNIGHTHOOD**, and the System of HERALDRY, Plate VII.

THORACIC, in anatomy, an epithet given to two branches of the axillary artery, on account of the conveying the blood into some parts of the thorax. The thoracic arteries are distinguished into upper and lower: there are likewise thoracic veins, an upper and under, destined for the reconveyance of the blood from the thorax to the axillary vein. See the System, Part IV. Sect. I.

THORACIC Duct, is a thin transparent canal arising from, or rather it is a continuation of, the exit or mouth of the *receptaculum chyli*, and running along the spina dorsa, between the vena azygos and aorta, as high as the fifth vertebra of the back, or higher. See the System, Part I. Sect. V.

THORACICI, in Ichthyology, the name of the third order of bony fishes, respicing by means of gills only: the character of which is, that the ventral fins are placed underneath the pectoral fins. See the System, Sect. V.

THORAX, in anatomy, that part of the human body which forms the capacity of the breast, and wherein are included the heart and lungs. See the System, Part IV. throughout. For the bones of the thorax. See the System, Part I. Sect. III. Art. 2. For representation, see Plate I. letters a, b, c, d, &c. For the Muscles, see Part II. Table of Muscles, Art. 17, and Plate V. fig. 3.

THOUGHT, *sentiment*, a general name for all the ideas consequent on the operations of the mind, and even for the operations themselves. As, in the idea of thought, there is nothing included of what we include in the idea of an extended substance; and that whatever belongs to body, may be denied to belong to thought; we may conclude, that thought is not a mode of extended substance, it being the nature of a mode not to be conceived, if the thing, whereof it is a mode, be denied. Hence we infer, that thought, not being a mode of extended substance, must be the attribute of some other substance very different. The followers of Sir Isaac Newton, and the new philosophy, deny extension to be the essence of matter; and the followers of Mr. Locke deny thought to be the essence of the mind. See **THINKING**.

When speaking with a particular reference to the belles lettres and polite arts, we mean, by thoughts, the ideas which the artist attempts to raise by his performance, in contradistinction to the manner in which they are raised or expressed. In works of art, thoughts are what remains of a performance, when stripped of its embellishments. Thus, a poet's thoughts are what remains of his poems, independently of the versification, and of some ideas merely serving for its decoration and improvement. Thoughts, therefore, are the materials proposed and applied by art to its purposes: the dress in which they appear, or the form into which they are moulded by the artist, is merely accidental. Consequently, they are the first object of attention in every work of art; the spirit, the soul of a performance, which, if its thoughts are indifferent, is but of little value, and may be compared to a palace of ice, raised in a most regular form of an habitable structure, but, from the nature of its materials, totally useless. While, therefore, you are contemplating an historical picture, try to forget that it is a picture: forget the painter, whose magic art has, by lights and shades, created bodies where there are none. Fancy to yourself that you are actually looking at men, and then attend to their actions.

Observe

THU

TIL

Observe whether they are interesting; whether the persons express thoughts and sentiments in their faces, attitudes and motions; whether you may understand the language of their airs and gestures, and whether they tell you something remarkable. If you find it not worth your while to attend to the persons thus realised by your fancy, the painter has thought to little purpose. Whilst listening to a musical performance, try to forget that you are hearing sounds of an inanimate instrument, produced only by great and habitual dexterity of lips and fingers. Fancy to yourself, that you hear a man speaking some unknown language, and observe whether his sounds express some sentiments; whether they denote tranquillity or disturbance of mind, soft or violent, joyful or grievous, affections; whether they express any character of the speaker; and whether the dialect be noble or mean. If you cannot discover any of these requisites, then pity the virtuoso for having left so much ingenuity destitute of thought.

In the same manner we must also judge of poems, especially of the lyric kind. The ode is valuable, which, when deprived of its poetical dress, still affords pleasing thoughts or images to the mind. Its real merit may best be discovered by transposing it into simple prose, and depriving it of its poetical colouring. If nothing remains that a man of sense and reflection would approve, the ode, with the most charming harmony and the most splendid colouring, is but a fine dress hung round a man of straw. How greatly then are those mistaken, who consider an exuberant fancy and a delicate ear as sufficient qualifications for a lyric poet! It is only after having examined the thoughts of a performance in their unadorned state, that we can pronounce whether the attire, in which they have been dressed by art, fits and becomes them well or ill. A thought, whose value and merit cannot be estimated but from its dress, is, in effect, as futile and insignificant as a man who affects to display his merit by external pomp.

THROAT, the anterior part of an animal, between the head and the shoulders, wherein is the gullet. Physicians include, under the word throat, all that hollow, or cavity, which may be seen when the mouth is wide open. It is sometimes also called isthmus, because it is narrow, and bears some resemblance to what is called by the geographers isthmus.

THUMB, POLLEX, in anatomy, one of the members or parts of the hand. For the bones, see the System, Part I. Sect. IV. Art. 3. and Plate I. Fig. I. For the Muscles, see Part II. Sect. II. Table of Muscles, Art. 23. and Plate II. Fig. III. letter *i*.

THUNDER, the noise occasioned by the explosion of a flash of lightning echoed back from the inequalities on the surface of the earth, in like manner as the noise of a cannon is echoed, and in particular circumstances forms a rolling lengthened sound. Although thunder, properly speaking, is only a mere sound, capable of producing very little effect, yet the word is generally supposed to include the phenomena of lightning also; and electrified clouds are by universal consent called thunder-clouds, and the explosions of many flashes of lightning produced from them are generally called thunder-storms. Though the phenomena of lightning, therefore, have been at great length explained and accounted for under the articles **ELECTRICITY** and **LIGHTNING**, and though the immediate cause of electrical explosions from clouds is explained under the article **RAIN**; yet the ultimate cause remains still to be shewn, and properly belongs to the present article. It is universally allowed, that the variation of the electricity in different parts of the atmosphere is the cause of thunder. Under the article **ELECTRICITY**, it has been shewn why lightning explodes after the thunder-clouds are charged. Under the article **LIGHTNING** it is shewn why that meteor puts on the various forms in which we see it, why it sometimes strikes houses or animals, and sometimes not, &c.; and under the article **RAIN**, why the atmosphere in some cases parts with the vapours which at other times it so obstinately retains. It remains, therefore, only to show why rains are sometimes attended with thunder, and sometimes not; which, to those who attentively peruse the articles above-mentioned, may be done in few words. By the struggle of two other winds as well as those of the east and west, may a thunder-storm be produced; but it is always necessary that the resistance of the air to the motion of the clouds should be very great, and nearly equal all round. For if the vapour should get off to a side, no thunder would take place; the electricity would then be carried off as fast as it was collected, and rain would only be the consequence, by reason of the electrified vapours parting with their latent heat, as is explained under the article **RAIN**. In fact, we very often observe that in the time of rain the clouds evidently move across the wind, and the nearer their motion is to a direct opposition, the heavier will the rain be; while, on the other hand, if they move briskly before the wind, let the direction be what it will, the atmosphere soon clears up. The nearness, or distance, may be estimated by the interval of time between the flash and the noise. Dr. Wallis observes, that, ordinarily, the difference between the two is about seven seconds, which at the rate of 1142 feet in a second of time, gives the distance about a mile and a half; but sometimes it comes in a second or two, which argues the explosion very near us, and even among us. And in such cases, the doctor assures us, he has more than once foretold the mischiefs that happened.

THUNDERBOLT. If what we call lightning acts with extraordinary violence, and breaks or shatters any thing, it is called a

thunderbolt, which the vulgar, to fit it for such effects, suppose to be a hard body, and even a stone. But that we need not have recourse to a hard solid body to account for the effects commonly attributed to the thunderbolt, will be evident to any one, who considers those of the pulvis fulminans, and of gunpowder; but more especially the astonishing powers of electricity, even when collected and employed by human art, and much more when directed and exercised in the course of nature. When we consider the known effects of electrical explosions, and those produced by lightning, we shall be at no loss to account for the extraordinary operations vulgarly ascribed to thunderbolts. As stones and bricks struck by lightning are often found in a vitrified state, we may reasonably suppose, with signior Beccaria, that some stones in the earth, having been struck in this manner, first gave occasion to the vulgar opinion of the thunderbolt.

THUNDER-house, in electricity, is an instrument for illustrating the manner by which buildings receive damage from lightning; and to evince the utility of metallic conductors in preserving them from it. See the System, Sect. II. Art. V. and Plate II. Fig. 35.

THYMUS, in anatomy, an oblong glandular body, round on the upper part, and divided below into two or three lobes, of which that towards the left-hand is the longest. It is that part which in a breast of veal we call the sweetbread. See the System, Part IV. Sect. III.

THYMUS, in surgery, is used for a kind of wart, growing on the parts of generation, the fundament, and several other places of the body, with cloven asperities, like those of the herb thyme, whence its name. The ordinary method of curing a thymus, is by ligature, and desiccative lotions, or by caustics; and, if large, by incision; taking care first to secure the greater vessels, by tying them.

THYRO-Aritenoidai, in anatomy, are two very broad muscles, each of which is situated laterally between the thyroids and cricoidei. See the System, Part II. Table of Muscles, Art. 13.

THYROIDÆA Glandula, **THYROIDE Gland**, is a large whitish mass which covers the anterior convex side of the larynx. See the System, Part IV. Sect. V.

TIBIA, in anatomy, the bony part of the leg, between the knee and the ankle. The tibia consists of two bones, called *foeils*, the one on the inside of the leg, called the *fibula*, or *little foeil*; the other on the outside, called by the common name *tibia*, or the *great foeil*, to which may be added the *patella*. See the System, Part I. Sect. IV. Art. 5, and 6, and Plate I. Fig. I. letters *g*, *h*, *f*.

TIBIALIS, of *Tibialis*, in anatomy, a name given to two muscles of the leg; distinguished by *anticus* and *posticus*. *Tibialis anticus*, is a long muscle, fleshy at the upper part, and tendinous at the lower, situated on the fore-side of the leg, between tibia and the extensor digitorum longus. *Tibialis posticus*, is situated between the tibia and fibula, on the back side of the leg, and covered by the extensor digitorum longus. *Tibialis gracilis*, a muscle of the leg, called also *plantaris*. It is a small pyriform muscle, situated obliquely in the ham, below the external condyle of the os femoris. For the origin, insertion, and uses of these several muscles, see the System, Part II. Sect. II. Table of Muscles, Art. 26.

TIDES, two periodical motions of the waters of the sea; called also the flux and reflux, or the ebb and flow. When the motion of the water is against the wind, it is called a windward-tide; when wind and tide go the same ward, leeward-tide; when it runs very strong, it is called a tide-gate. For a copious explanation of the flux and reflux of the sea, see the System of ASTRONOMY, Sect. X. throughout; to find the time of high-water at any given place, see the system of NAVIGATION, Part VI. Sect. II. and the table annexed, shewing at what hour it is high-water on the full and change of the moon.

TIGER, **TIGRES**, in the system of mammalia, a species of the genus *Felis*. For description of the genus, see *FELIS*: for representation of the tiger, see Plate IV. Genus 13, Species 2.

TILBURY-Water, in medicine, is an acidulous or saline water, issuing from a spring, situated near a farm-house at *West Tilbury*, near *Tilbury Fort*, in Essex. This water is of a straw colour, soft and smooth to the taste, but leaving, after agitation in the mouth, a small degree of roughness on the tongue: it throws up a scum variegated with several colours, which feels greasy, and effervesces with spirit of vitriol; it mixes smooth with milk, but curdles with soap; when boiled, it turns milky, but is fined by a fourth part of mountain-wine, and by acids; it operates chiefly by urine, though it is somewhat purgative, and increases perspiration. This water is esteemed for removing glandular obstructions, and hence is also recommended in scurvy and cutaneous diseases; it is good in bloody-fluxes, purgings, and the like: in disorders of the stomach arising from acidity, in the gravel, fluor-albus, and immoderate flux of the menses. As a diuretic, it is beneficial in dropical complaints. It gently warms the stomach, strengthens the appetite, and promotes digestion. The usual dose is a quart a day. This water is supposed to owe its virtue to a native alkaline salt, which may be obtained from it by evaporation; and to its fixed air, which, however, being very volatile, soon exhales when the water is heated or stands for some time exposed. Elliot's Account of Mineral Waters, &c. p. 220.

TILLING, **TILLAGE**, in agriculture, a moving or stirring of the ground with a plough, spade, hoe, or other instrument; which

T I M

being performed on the surface, enters to a certain depth, and makes the lower and upper parts change place; by which means the goodness of the earth is kept from being spent in feeding useless plants; and the ground is divided by attrition, as the addition of dung does by fermentation. For copious directions respecting this important branch, see the System, Sect. XXVI. and XXVII. For description of the instruments used, see Sect. XXVIII. For representation of them, see the Plates annexed to the System.

TIMBER, includes all kind of felled and seasoned woods, used in the several parts of a building; as carpentry, joinery, turnery, &c.

The kinds of **TIMBER** are numerous: we shall only mention some of the most useful, from Evelyn's *Sylvia*, &c. As, 1. Oak, the uses whereof need no enumeration; to endure all seasons and weathers, there is no wood like it; hence its use in pales, shingles, posts, rails, boards, &c. For water-works, it is second to none; and where it lies exposed both to air and water, there is none equal to it. 2. Elm: this, felled between November and February, is all spine or heart, and no sap; and is of singular use in places where it either is always wet, or always dry; its toughness likewise makes it of use to wheelwrights, millwrights, &c. nor must it be omitted, that its not being liable to break and fly in chips, makes it fit for dressers and planks to chop on. 3. Beech: its chief use is in turnery, joinery, upholstery, and the like, as being of a clean, white, fine grain, not apt to bend, nor split; it has been sometimes, especially of late, used for building timber, and if it lie constantly wet, it is judged to outlast oak. 4. Ash: its use is almost universal; it is good for building, or other occasions, where it may lie dry; it serves the carpenter, cooper, turner, ploughwright, wheelwright, gardener; and also it is used at sea for oars, handspikes, &c. 5. Fir, commonly known by the name of deal, is of late much used in building, especially within-doors, for stairs, floors, wainscot, and most works of ornament. 6. Walnut-tree: this is of universal use, excepting for the outsides of buildings; none is better for the joiner's use, it being of a more curious brown colour than beech, and less subject to worms. 7. Chestnut-tree, next to oak, is the timber most sought for by joiners and carpenters: it is very lasting. 8. Service-tree, used in joinery, as being of a delicate grain, and fit for curiosities: it also yields beams of considerable bigness, proper for building. 9. Poplar, aspen, differing very little from one another, are much used of late instead of fir; they look as well, and are tougher and harder. 10. Alder, much used for sewers or pipes to convey water: when kept always wet it grows hard like a stone; but where sometimes wet, and sometimes dry, it rots presently. The uses of timber are so many, and so great, that the procuring of a sufficient supply of it extremely well deserves the care of every state; as it must be a great disadvantage to it to be obliged to have recourse to its neighbours, and purchase, at a very considerable and continually renewed expence, what might, by an easy economy, be sufficiently supplied at home. This economy, however, must be applied in time; for our natural indolence, our love to reap the advantages of every thing ourselves, and our little care for posterity, give great room to fear succeeding ages will want wood, both for private and public exigencies. All our art should be employed on this subject, with two views, the one to preserve and cherish our growing wood, the other to renew the trees which have been and are continually cut down. For the organization and construction of timber, as viewed by the microscope, see **MICROSCOPIC OBJECTS**. For representation, see Plate III. annexed to this article, Fig. 1, 2, 3, 4, 5, and 6.

TIMBERS, in ship-building, the ribs of a ship, or the incurvated pieces of wood, branching outward from the keel, in a vertical direction, so as to give strength, figure, and solidity to the whole fabric. For a general description of the construction of ships, see the Treatise on **NAVAL AFFAIRS**, Sect. IV. For representation, see the plate annexed, with the explanation in the treatise.

TIME, a succession of phenomena, in the universe, or a mode of duration marked by certain periods or measures, chiefly by the motion and revolution of the sun. The general idea which time gives in every thing to which it is applied, is that of limited duration. Thus we cannot say of the Deity, that he exists in time; because eternity, which he inhabits, is absolutely uniform, neither admitting limitation nor succession.

TIME, in music, is an affection of sound, whereby we denominate it *long* or *short*, with regard to its continuance in the same degree of tune. The signs of characters by which the time of notes is represented, are specified in the System of **MUSIC**, where the names, proportions, &c. are also expressed. For representation, see Plate I.

TIME, in fencing. There are three kinds of time; that of the sword, that of the foot, and that of the whole body. All the times that are perceived out of their measure, are only to be considered as appeals, or feints, to deceive and amuse the enemy. See the introductory part of the Treatise on **FENCING**.

TIMEKEEPERS, in a general sense, denote instruments adapted for measuring time, see **CHRONOMETER**. In a more peculiar and definite sense, timekeeper is a term first applied by Mr. John Harrison to his watch, for the performance of which, in determining the longitude in a voyage to the West Indies, in compliance with the act of the 12th of queen Anne, he obtained from the British parliament a moiety of the reward of twenty thousand pounds

T I T

offered by the said act. This appellation is now become fashionable amongst artists, to distinguish such watches as are made with extraordinary care and accuracy for nautical or astronomical observations.

TIN, one of the seven perfect metals. This metal is found very plentifully in the southern parts of Britain, particularly Cornwall, to which and Devonshire the mines are now principally confined. Though in itself the lightest, it is in its ore the heaviest of all the metals. It is very seldom, if ever, found pure, and the appearances of its ore are very different. The finest and richest are styled *tin grains*, or *corns of tin*, being crystals, of a black colour, of different sizes. It is also found in a heavy black stone, sometimes in a more porous yellow-coloured one, and is commonly intermixed with spar, arsenic, &c. Tin-mines are generally found on the sides of the hills, though veins sometimes pass through vallies, or brooks between two hills, and may be traced to the opposite hill. The miners work with the utmost difficulty through hard rocks from three to seventy fathoms deep; and it is no less troublesome, as well as dangerous, where the earth is loose and apt to crumble. The veins are of an uncertain thickness; from three inches to three feet. Tin grains or corns of tin yield five parts in eight of metal; whereas tin stones yield only from one in 40 to one in 60, and to one in 120; for these last are also wrought with some small profit. After melting, it is called *block tin*; but before it can be exposed to sale it is carried to one of the five coinage towns, where, after examination of a piece that is broke from the corner of a block, the arms of the duchy of Cornwall are impressed with a hammer, and then it is called *white-tin*. For a further account, see the System of **CHEMISTRY**, Part III. Chap. II. Sect. II.

The duty on coinage, which is four shillings on the hundred-weight, belongs to the prince of Wales, as duke of Cornwall, and produces a revenue of upwards of 10,000*l.* per annum.

TIN-plates an article of manufacture very common among us, and vulgarly called tin. It is iron plated over with tin. The French call it *fer blanc*, *white iron*, as we sometimes do in England. It was once known under a distinct name, *latten*. We shall here add, with regard to the history of this manufacture, that in the year 1681, tin-plates were made in England, by one Andrew Yarrington, who was sent to Bohemia to learn the manner of making them. But the manufacture was discontinued by his employers, and afterwards so much disregarded as to be reckoned among the projects, called bubbles, of the year 1720: however, it was revived, and brought to such perfection about the year 1740, that very little of it was imported from foreign parts; our own plates being of a finer gloss, or coat, than those made beyond sea, the latter being hammered, and ours being drawn under a rolling-mill. And. Hist. Com. vol. ii. p. 175. 361.

TINCTURE, in pharmacy, a separation of the finer and more volatile parts of a mixed body, made by means of a proper menstruum dissolving the same. Tincture is more particularly used for an extract of part of the substance of a body, especially its flavour and colour, which are hereby communicated to the menstruum. We have cephalic tinctures, antiscorbutic tinctures, stomachic tinctures, anticholic tinctures, invigorating tinctures, &c. and tinctures drawn from roses, from coral, &c.

TINCTURE is applied by heraldic writers, to the colours used in escutcheons, or coats of arms; as are likewise the two metals, *or* and *argent*. Tincture comprehends colours and furs. See the System, Sect. III. and Plate II.

TINNING, the covering or lining any thing with melted tin, or with tin reduced to a very thin leaf. Looking-glasses, are foliated or tinned with thin leaves of beaten tin, applied and fastened thereto by means of quicksilver. Kitchen utensils are tinned with melted tin; and locks, bits, spurs, &c. with leaf tin, by the help of fire.

TINNITUS Auris, tinkling or buzzing of the ear, a disease frequent in the ear, consisting in the perception of a sound which is not, or at least is not external; and the ear being thus filled with a certain species of sound, cannot admit other sounds, unless they are very violent. This perception may be occasioned by the beating of an artery in the ear, by an inflammation or abscess of the tympanum, or the labyrinth, by the admission of foreign bodies, by commotion of the cranium, or blows on the ear, &c. Extraordinary and irregular motions of the animal spirits are also found to occasion the *tinnitus*, as we find in deliriums, frensies, vertiges, &c. The tinkling of the ear is reckoned one of the diagnostic signs of the plague. The *tinnitus* is of two kinds, the one proceeding from an distemperature of the organ of hearing, the other from a disorder of the brain; and the cure is to be attempted accordingly. In those of the sharper kind, which are usually occasioned by inflammations and pains in the ear, where the parts are usually very tense and dry, we must use the same means as in acute pains, and tensions of the membrana tympani; but in dull humming heavy noises, which are usually occasioned by rheums and suppurations, where the membranes are relaxed, we are to use the same remedies which give relief in pains occasioned by cold: after which it will be no difficulty to choose the most proper, while we have a due regard to the circumstance from which the more just indications may be taken.

TITHES, in ecclesiastical law, are defined to be the tenth part of the increase, yearly arising and renewing from the profits of lands, the

the stock upon lands, and the personal industry of the inhabitants: the first species being usually called *predial*, as of corn, grass, hops, and wood; the second *mixed*, as of wool, milk, pigs, &c. consisting of natural products, but nurtured and preserved in part by the care of man; and of these the tenth must be paid in gross; the third *personal*, as of manual occupations, trades, fisheries, and the like; and of these only the tenth part of the clear gains and profits is due. We shall, in this article, consider 1. The origin of the right of tithes. 2. In whom that right at present subsists. 3. Who may be discharged, either totally or in part, from paying them.

1. As to their origin, we will not put the title of the clergy to tithes upon any divine right. Yet an honourable and competent maintenance for the ministers of the gospel, is undoubtedly *jure divino*, whatever the particular mode of that maintenance may be. For, besides the positive precepts of the New Testament, natural reason will tell us, that an order of men who are separated from the world and excluded from other lucrative professions for the sake of the rest of mankind, have a right to be furnished with the necessaries, conveniences, and moderate enjoyments of life, at their expence, for whose benefit they forego the usual means of providing them. Accordingly all municipal laws have provided a liberal and decent maintenance for their national priests or clergy; our's, in particular, have established this of tithes, probably in imitation of the Jewish law: and perhaps, considering the degenerate state of the world in general, it may be more beneficial to the English clergy to found their title on the law of the land, than upon any divine right whatever, unacknowledged and unsupported by temporal sanctions.

We cannot precisely ascertain the time when tithes were first introduced into this country. Possibly they were cotemporary with the planting of Christianity among the Saxons by Augustin the monk, about the end of the sixth century. But the first mention of them which we have met with in any written English law, is a constitutional decree, made in a synod held A.D. 786, wherein the payment of tithes in general is strongly enjoined. This canon or decree, which at first bound not the laity, was effectually confirmed by two kingdoms of the heptarchy, in their parliamentary convention of estates, respectively consisting of the kings of Mercia and Northumberland, the bishops, dukes, senators, and people, which was a few years later than the time that Charlemagne established the payment of them in France, and made that famous division of them into four parts; one to maintain the edifice of the church, the second to support the poor, the third the bishop, and the fourth the parochial clergy. The next authentic mention of them is in the *Sadus Edwardi et Guthrumi*; or the laws agreed upon between king Guthrum the Dane, and Alfred and his son Edward the Elder, successive kings of England, about the year 900. This was a kind of treaty between those monarchs, which may be found at large in the Anglo-Saxon laws; wherein it was necessary, as Guthrum was a Pagan, to provide for the subsistence of the Christian clergy under his dominion; and accordingly, we find the payment of tithes not only enjoined, but a penalty added upon non-observance; which law is seconded by the laws of Athelstan, about the year 930: and this is as much as can certainly be traced out with regard to their legal authority.

2. Upon the first introduction, though every man was obliged to pay tithes in general, yet he might give them to what priests he pleased, which were called arbitrary consecrations of tithes; or he might pay them into the hands of the bishop, who distributed among his diocesan clergy the revenues of the church, which were then in common. But when dioceses were divided into parishes, the tithes of each parish were allotted to its own particular minister; first by common consent, or the appointments of lords of manors, and afterwards by the written law of the land. However, arbitrary consecrations of tithes took place again afterwards, and became in general use till the time of king John; which was probably owing to the intrigues of the regular clergy, or monks of the Benedictine and other rules, under archbishop Dunstan and his successors; who endeavoured to wean the people from paying their dues to the secular or parochial clergy (a much more valuable set of men than themselves) and were then in hopes to have drawn, by sanctimonious pretences to extraordinary purity of life, all ecclesiastical profits to the coffers of their own societies; and this will naturally enough account for the number and riches of the monasteries and religious houses which were founded in those days, and which were frequently endowed with tithes. For a layman who was obliged to pay his tithes somewhere, might think it good policy to erect an abbey, and there pay them to his own monks, or grant them to some abbey already erected; since for this donation, which really cost the patron little or nothing, he might, according to the superstition of the times, have masses for ever sung for his soul. But in process of years, the income of the poor laborious parish-priests being scandalously reduced by these arbitrary consecrations of tithes, it was remedied by pope Innocent III. about the year 1200, in a decretal epistle sent to the archbishop of Canterbury, and dated from the palace of Lateran; which has occasioned Sir Henry Hobart and others to mistake it for a decree of the council of Lateran, held in 1179, which only prohibited what was called the *infestation of tythes*, or their being granted to mere laymen; whereas this letter of pope Innocent to the archbishop, enjoined the payment of tithes to the parsons of the respective parishes where every man inhabited,

agreeably to what was afterwards directed by the same pope in other countries. This epistle, says Sir Edward Coke, bound not the lay subjects of this realm; but being reasonable and just, it was allowed of, and so became *lex terra*. This put an effectual stop to all the arbitrary consecrations of tithes; except some footsteps which still continue in those portions of tithes which the parson of one parish hath, though rarely, a right to claim in another; for it is now universally held, that tithes are due, of common right, to the parson of the parish, unless there be a special exemption. This parson of the parish may either be the actual incumbent, or else the appropriator of the benefice: appropriations being a method of endowing monasteries, which seems to have been devised by the regular clergy, by way of substitution to arbitrary consecrations of tithes.

Lands and their occupiers may be exempted or discharged from the payment of tithes, either in part or totally, first, by a real composition: or, secondly, by custom or prescription. First, a real composition is when an agreement is made between the owner of the lands and the parson or vicar, with the consent of the ordinary and the patron, that such lands shall be for the future discharged from payment of tithes, by reason of some land or other real recompense given to a parson in lieu and satisfaction thereof. This was permitted by law, because it was supposed the clergy would be no losers by such a composition; since the consent of the ordinary, whose duty it is to take care of the church in general, and of the patron, whose interest it is to protect that particular church, were both made necessary to render the composition effectual: and hence have arisen all such compositions as exist at this day by force of the common law. But experience shewing that even this caution was ineffectual, and the possessions of the church being by this and other means every day diminished, the disabling statute 13 Eliz. c. 10, was made; which prevents, among other spiritual persons, all parsons and vicars from making any conveyances of the estates of their churches, other than for three lives, or 21 years. So that now, by virtue of this statute, no real composition made since the 13 Eliz. is good for any longer term than three lives, or 21 years, though made by consent of the patron and ordinary: which has indeed effectually demolished this kind of traffic; such compositions being now rarely heard of, unless by authority of parliament. Secondly, a discharge by custom or prescription, is where, time out of mind, such persons or such lands have been, either partially or totally, discharged from the payment of tithes. And this immemorial usage is binding upon all parties; as it is in its nature an evidence of universal consent and acquiescence, and with reason supposes a real composition to have been formerly made. This custom or prescription is either *de modo decimandi*, or *de non decimando*. A *modus decimandi*, commonly called by the simple name of a *modus* only, is where there is by custom a particular manner of tithing allowed, different from the general law or taking tithes in kind, which are the actual tenth part of the annual increase. This is sometimes a pecuniary compensation, as two-pence an acre for the tythe of land: sometimes it is a compensation in work and labour, as that the parson shall have only the twelfth cock of hay, and not the tenth, in consideration of the owner's making it for him: sometimes, in lieu of a large quantity of crude or imperfect tithe, the parson shall have a less quantity when arrived to greater maturity, as a couple of fowls in lieu of tithe eggs, and the like. Any means, in short, whereby the general law of tithing is altered, and a new method of taking them is introduced, is called a *modus decimandi*, or special manner of tithing.

A prescription *de non decimando* is a claim to be entirely discharged of tithes, and to pay no compensation in lieu of them. Thus the king by his prerogative is discharged from all tithes. So a vicar shall pay no tithes to the rector, nor the rector to the vicar, for *ecclesia decimas non solvit ecclesie*. But these personal privileges (not arising from or being annexed to the land) are personally confined to both the king and the clergy; for their tenant or lessee shall pay tithes though in their own occupation their lands are not generally tithable. And, generally speaking, it is an established rule, that in lay hands, *modus de decimando non valet*. But spiritual persons or corporations, as monasteries, abbots, bishops, and the like, were always capable of having their lands totally discharged of tithes by various ways: as, 1. By real composition. 2. By the pope's bull of exemption. 3. By unity of possession; as when the rectory of a parish, and the lands in the same parish, both belonging to a religious house, those lands were discharged of tithes by this unity of possession. 4. By prescription; having never been liable to tithes, by being always in spiritual hands. 5. By virtue of their order; as the Knights Templars, Cistercians, and others, whose hands were privileged by the pope with a discharge of tithes. Though, upon the dissolution of abbeys by Henry VIII. most of these exemptions from tithes would have fallen with them, and the lands become tithable again, had they not been supported and upheld by the statute 31 Henry VIII. c. 13, which enacts, that all persons who should come to the possession of the lands of any abbey then dissolved, should hold them free and discharged of tithes, in as large and ample a manner as the abbeys themselves formerly held them. And from this original have sprung all the lands, which being in lay hands do at present claim to be tithe-free; for if a man can shew his lands to have been such abbey-lands, and also immemorially

morally discharged of tithes by any of the means beforementioned, this is now a good prescription *de non decimando*. But he must shew both these requisites; for abbey-lands, without a special ground of discharge, are not discharged of course; neither will any prescription *de non decimando* avail in total discharge of tithes, unless it relates to such abbey-lands.

TITHING, TITHINGA, from the Sax. *THEOTHUNGE*, i. e. *Decuriam*, is in its first appointment the number or company of ten men, with their families, held together in a society, all being bound for the peaceable behaviour of each other; and of these companies there was one chief person, who was called *teothung-man*, at this day *tithing-man*: but the old discipline of tithings is long since left off. In the Saxon times, for the better conservation of the peace, and more easy administration of justice, every hundred was divided into ten districts or tithings; and within every tithing, the tithing-men were to examine and determine all lesser causes between villages and neighbours; but to refer greater matters to the then superior courts, which had a jurisdiction over the whole hundred.

TITHING-Men, are now a kind of petty-constables, elected by parishes, and sworn into their offices in the court-leet, and sometimes by justices of the peace, &c. There is frequently a tithing-man in the same town with a constable, who is, as it were, a deputy to execute the office in the constable's absence: but there are some things which a constable has power to do, that tithing-men and headboroughs cannot intermeddle with. When there is no constable of a parish, the office and authority of a tithing-man seems to be all one, under another name.

TITLE, an application of dignity, distinction, or pre-eminence, given to persons possessed of the same. The king of Spain has a whole page of titles, to express the several kingdoms and signories he is master of. The King of England takes the title of King of Great-Britain, France, and Ireland: the king of France, had the title of King of France and Navarre; but since the revolution has been effected, till the abolition of the kings in that country, he was called king of the French, and all other titles are abolished in France: the king of Sweden entitles himself King of the Swedes and Goths; the king of Denmark, King of Denmark and Norway; the king of Sardinia, among his titles, takes that of King of Cyprus and Jerusalem: the duke of Lorraine, the title of King of Jerusalem, Sicily, &c.

TITMOUSE, in ornithology, the English name of a species of the genus *Parus*. For description of the Genus, see *PARUS*.

TOAD, the English name of the genus *Rana*. See *RANA*.

TOBACCO, *Nicotiana*, for the introduction and general uses of this plant, see *NICOTIANA*.

TODUS, in ornithology, according to Linnæus, is the 25th genus of the order *Pica*; but Latham in his improved arrangement makes it the 26th genus of the same order; the characters of which are, that the bill is awl-shaped, depressed, obtuse, straight, and beset with bristles; and the feet are formed for walking. For representation, see Plate II. Genus 25.

TOES, by anatomists called *digiti pedis*, are the extreme divisions of the feet: answering to the fingers of the hand, and resembling them in figure, and makes the third part of the foot. For the bones, see the System, Part I. Sect. IV. Art. 7 and 8, and Plate I. Fig. 1. Letters *m, n, o, p*. For the muscles, see Part II. Sect. II. Table of Muscles, Art. 27, and Plate I. Fig. 2, letters *p, q*.

TOLERATION, in religion, a term which has made a great figure in the disputes among Protestants, who have been exceedingly divided about the measures of toleration, or the degrees to which heretics and schismatics are, or are not, to be suffered. Many of the church of England have zealously opposed the toleration of presbytery, &c. nor has the church of Scotland been behindhand with them in their zeal against episcopacy. But all who have reasoned consistently from the principles of reformation, have been for toleration; as well perceiving they had no right to oblige any person to follow their particular sentiments; but the difficulty is, the setting of bounds to this toleration. By civil toleration, is meant impunity and safety in the state for every sect which does not maintain any doctrine inconsistent with the peace and welfare of the state. This civil, or political toleration, implies a right of enjoying the benefit of the laws, and of all the privileges of the society, without any regard to difference of religion. Ecclesiastical toleration is an allowance of certain opinions, which, not being fundamentals, do not hinder those who profess them from being esteemed members of the church. But as to the quality and number of these fundamental points, they never could, nor in all probability ever will, be agreed upon. See the articles *DISSENTERS*, *GOVERNMENT*, *LIBERTY*, and *NONCONFORMISTS*.

On the subject of religious toleration, we have the following observations in Dr. Robertson's History of Charles V. "Among the ancient heathens, all whose deities were local and tutelary, diversity of sentiments concerning the object or rites of religious worship seems to have been no source of animosity; because the acknowledging veneration to be due to one God, did not imply a denial of the existence or the power of any other God: nor were the modes and rites of worship established in one country incompatible with those which other nations approved and observed. Thus the errors in their system of theology were of such a nature as to be productive of concord: and notwithstanding the amazing number of their deities, as well as the infinite variety of their ceremonies,

a social and tolerating spirit subsisted almost universally in the Pagan world.

"But when the Christian revelation declared one Supreme Being to be the sole object of religious veneration, and prescribed the form of worship most acceptable to him, whoever admitted its truth, held every other mode of religion to be absurd and impious. Hence the zeal of the first converts to the Christian faith in propagating its doctrines, and the ardour with which they laboured to overturn every other form of worship. They employed, however, for this purpose, no methods but such as suited the nature of religion. By the force of powerful arguments, they convinced the understanding of men; by the charms of superior virtue, they allured and captivated their hearts. At length the civil power declared in favour of Christianity, and though numbers, imitating the example of their superiors, crowded into the church, many still adhered to their ancient superstitions. Enraged at their obstinacy, the ministers of religion, whose zeal was still unabated, though their sanctity and virtue were much diminished, forgot so far the nature of their own mission, and of the arguments which they ought to have employed, that they armed the imperial power against these unhappy men; and as they could not persuade, they tried to compel them to believe.

"At the same time, controversies concerning articles of faith multiplied, from various causes, among Christians themselves; and the same unhallowed weapons which had first been used against the enemies of their religion were turned against each other. Every zealous disputant endeavoured to interest the civil magistrate in his cause, and each in his turn employed the secular arm to crush or to exterminate his opponents. Not long after the bishops of Rome put in their claim to infallibility in explaining articles of faith, and deciding points in controversy: and, bold as the pretension was, they, by their artifices and perseverance, imposed on the credulity of mankind, and brought them to recognize it. To doubt or to deny any doctrine to which these unerring instructors had given the sanction of their approbation, was held to be not only a resisting of truth, but an act of rebellion against their sacred authority; and the secular power, of which, by various arts, they had acquired the absolute direction, was instantly employed to avenge both.

"Thus Europe had been accustomed, during many centuries, to see speculative opinions propagated or defended by force; the charity and mutual forbearance which Christianity recommends with so much warmth, were forgotten, the sacred rights of conscience and of private judgment were unheard of; and not only the idea of toleration, but even the word itself, in the sense now affixed to it, was unknown. A right to extirpate error by force, was universally allowed to be the prerogative of those who possessed the knowledge of truth; and as each party of Christians believed they had got possession of this invaluable attainment, they all claimed, and exercised, as far as they were able, the rights which it was supposed to convey. The Roman Catholics, as their system rested on the decisions of an infallible judge, never doubted that truth was on their side, and openly called on the civil power to repel the impious and heretical innovators who had risen up against it. The Protestants, no less confident that their doctrine was well-founded, required with equal ardour the princes of their party to check such as presumed to impugn or oppose it. Luther, Calvin, Crammer, Knox, the founders of the reformed church in their respective countries, inflicted, as far as they had power and opportunity, the same punishments which were denounced against their own disciples by the church of Rome, on such as called in question any article in their creeds. To their followers, and perhaps to their opponents, it would have appeared a symptom of diffidence in the goodness of their cause, or an acknowledgment that it was not well founded, if they had not employed in its defence all those means which it was supposed truth had a right to employ. It was towards the 17th century, before toleration, under its present form, was admitted first into the republic of the United Provinces, and from thence introduced into England. Long experience of the calamities of mutual persecution, the influence of free government, the light and humanity acquired by the progress of science, together with the prudence and authority of the civil magistrate, were all requisite in order to establish a regulation so repugnant to the ideas which all the different sects had adopted from mistaken conceptions concerning the nature of religion, and the rights of truth."

TONE, or **TUNE**, in music, a property of sound, whereby it comes under the relation of *grave* and *acute*; or, the degree of elevation any found has, from the degree of swiftness of the vibrations of the parts of the sonorous body. See the System, Sect. XII. and XIII.

TONGUE, in anatomy, an oblong member, whose form and situation are sufficiently known, and whose use is to be the organ of taste, and the principal instrument of speech and deglutition. See the System, Part VII. Sect. II. For the Muscles, see Part II. Sect. II. Table of Muscles, Art. II.

TONGUE-tied, a distemper of the tongue in children, when it is tied down too close to the bottom of the mouth, by a ligament connected all along its middle, and called its *frænulum*, which requires to be divided, to give the tongue its proper motion. For the management of children labouring under this disorder, see the System of MIDWIFERY, Part IX. Sect. III.

TONIC, is applied to a certain motion of the muscles, wherein the fibres being extended, continue their extension in such manner, as that the part seems immovable, though in reality it be in motion. See the *System of ANATOMY*, Part II. Sect. II.

TONSILS, in anatomy, two round glands, situate near the root of the tongue, on each side the uvula, under the common membrane of the fauces, with which they are covered; they are called also *amygdalæ*, or *almonds of the ears*. See the *System*, Part III. Sect. XIII.

TONTINE, denotes annuities on survivorship. The name is derived from an Italian, called *Tonti*, who is said to have first formed the scheme of these life-annuities.

TOOTHACHE, a very common disease, by physicians called *odontalgia*. For description, causes, and cure, see the *System of MEDICINE*, Genus 23.

TOOTHDRAWING. This operation, however wrong in many cases, yet is certainly right and necessary in others. 1. In children, for the removing of their lacteal or deciduous teeth, for when these are left too long in their sockets, they displace the new ones, and turn them awry. 2. In infants it is also necessary to draw such teeth as grow out of the palate, or out of improper parts of the mouth, and are placed so as to impede their speaking or sucking. 3. In the toothache, proceeding from a tooth being carious, and giving way to no medicines, drawing is the last resort, and is absolutely necessary. 4. Those teeth ought to be drawn, which, by their irregular figure and position, lacerate the gums and lips, and cannot be brought into shape by the file. And, lastly it is sometimes necessary to draw a tooth for the curing of a fistula, or ulceration of the gums near the roots of the teeth.

TOP-Mast, in a ship, the second division of a mast, or that part which stands between the upper and lower pieces.

TOP-Gallant-Mast, in a ship, or two, viz. *MAIN-top-gallant-mast*, and *FORE-top-gallant-mast*, which are small round pieces of timber, set on their respective top-masts; on the top of which masts are set the flagstaffs, on which the colours, as flags, pendants, &c. hang. See the *Treatise on NAVAL AFFAIRS*, Sect. IV. and plate annexed.

TOP-Sails, and **TOP-gallant-sails**, in a ship, are those belonging to the top-masts, and top-gallant-masts. For description of the masts and sails of a ship, see the *Treatise on NAVAL AFFAIRS*, Sect. IV. For representation of a ship with three masts, and all her sails set, see the Plate annexed.

TOPAZ, in mineralogy, a gem called by the ancients *chrysolite*, as being of a gold colour. The finest topazes in the world are found in the East-Indies; but they are very rare there of any great size; the Great Mogul, however, at this time, possesses one which is said to weigh 157 carats, and to be worth more than 20,000 pounds. The topazes of Peru come next after these, in beauty and in value. The European are principally found in Silesia, and Bohemia, and are generally full of cracks and flaws, and of a brownish yellow. Besides all these degrees of value in the genuine topazes, our jewellers keep what they call a *kind* of them, inferior greatly to the true ones; all these are common hexangular crystals, coloured to a paler or deeper yellow in mines; these they cut into stones for rings, and sell under the name of topazes; and most of the stones we see under that name are such. See *MINERALOGY*, Class I. Ord. 4.

TOPHUS, in medicine, a stoney or chalky concretion in any part of an animal body: as in the bladder, kidneys, &c. or in the joints. Dr. RUTTY, in his *Treatise of the Urinary Passages*, takes the stone to arise from the attraction between volatile saline particles; of which particles the stone when viewed with a microscope, seems to be made up: he thinks the fault of these aggregates of saline particles ought generally to be supposed to begin in, or proceed from, the papillæ of the kidneys, and not from the sediment of urine in the bladder. The reason why wine-drinkers are more subject to the stone, and other concretions, than malt or water-drinkers, he supposes to be, that volatile and saline or earthy particles are contained in the wine in greater quantities than in the ale, &c. A calculus, he observes, reduced to a *caput mortuum*, will upon the effusion of warm water, dissolve and entirely mix; but in a short time will again settle, and the particles thereof so closely unite or attract, as that, by repeated effusions, they cannot be brought again to dissolve. See *STONE*.

TOPICS, or **TOPICAL Remedies**, in medicine, are commonly used for what we otherwise call *external remedies*, i. e. such as are applied outwardly to some particular diseased and painful part. Such are plasters, caraplasms, blisters, unguents, salves, collyriums, &c.

TOPOGRAPHY, a description or draught of some particular place or small tract of land; as that of a city, or town, manor or tenement, field, garden, house, castle, or the like; such as surveyors set out in their plots, or make draughts of, for the information and satisfaction of the proprietors. Topography differs from chorography, as a particular from a more general.

TORIES, or **TORYS**, a party or faction in England, opposite to the *WHIGS*. These two celebrated parties, which have so long divided our country, make a considerable article in the English history. The division has gone so far, that it is presumed, no Englishman, who has any concern or principles at all, but inclines more to one side than the other; for which reason, we shall borrow our account of them from the mouths of foreigners, who may be supposed more impartial: and particularly from M. de Cize, a

French officer, some time in the service of England, who has written the *History of Whiggism and Toryism*, printed at Leipzig, and M. Rapin, whose *Dissertation sur les Weighs & les Torys*, printed at the Hague the same year, is well known; and reprinted at the close of the second volume of his *History of England*, fol. ed. During the unhappy war which brought king Charles I. to the scaffold, the adherents of that king were first called *Cavaliers*, and those of the parliament *Roundheads*; which two names were afterwards changed into those of *tories* and *whigs*, on the following occasion: A kind of robbers, or banditti, in Ireland, who kept on the mountains, or in the islands formed by the vast bogs of that country, being called *tories*, a name they still bear, indifferently with that of *rapparees*; the king's enemies, accusing him of favouring the rebellion in Ireland, which broke out about that time, gave his partisans the name of *tories*; and, on the other hand, the *tories*, to be even with their enemies, who were closely leagued with the *Scots*, gave them the name of *whigs*, who, living in the fields and woods, fed much on milk; *whig* signifying *whey*. But for a more probable etymology of *whig*, see *WHIGS*. The cavaliers, or *tories* had then principally in view the political interests of the king, the crown, and the church of England; and the *roundheads*, or *whigs*, proposed chiefly the maintaining of the rights and interests of the people, and of protestantism. Nor have the two factions yet lost their first views; though their first names cavalier and roundhead, be now entirely disused.

We should here confine ourselves to the *tories*; and for what regards the *whigs*, refer to that article; but since, by comparing and confronting the two parties together, both the one and the other will appear in the stronger light, it will be imprudent to separate them, so that we rather choose to say the less under the word *whigs*, and refer thence hither. The factions we are speaking of, may be considered either with regard to the state, or to religion. The state *tories* are either violent or moderate; the first would have the sovereign to be absolute in England, as in other countries, and his will to be a law. This party, which is not very numerous, has yet been considerable; 1. On account of its leaders, who have been lords of the first rank, and generally ministers and favourites. 2. In that, being thus in the ministry, it engaged the church *tories* to maintain rigidly the doctrine of passive obedience. 3. Because they have been frequently supported by the crown. The moderate *tories* would not suffer the king to lose any of his prerogatives; but neither would they sacrifice those of the people. The state *whigs*, again, are republican or moderate: the first, according to our author, are the remains of the long parliament; who took in hand to change the monarchy into a commonwealth: these make so slender a figure, that they only serve to strengthen the party of the other *whigs*. The *tories* would persuade the world, that all the *whigs* are of this kind; as the *whigs* would make us believe, that all the *tories* are violent. The moderate state *whigs* are much in the same sentiments as the moderate *tories*; and desire the government may be maintained on its ancient foundation, and that the king may be reduced to an incapacity of abusing his power, by leaving him the possession of his just rights; all the difference is, that the moderate *tories* lean a little more to the side of the king, and the moderate *whigs* to that of the parliament and people. Before we consider our two parties with regard to religion, it must be observed, that the Reformation, as carried on to a greater or less length, divided the English into episcopalians, and presbyterians or puritans; the first contended, that the episcopal jurisdiction should be continued on the same footing, and the church on the same form, as before the Reformation; the latter maintained, that all ministers and priests had equal authority; and that the church ought to be governed by presbyteries, or consistories of priests and lay-elders. See *PURITANS* and *PRESBYTERIANS*.

After long disputes, the more moderate of each party relaxed a little of their rigidity; and thus formed two branches of moderate *whigs*, and moderate *tories*, with regard to religion; but there were others who kept to their principles with inconceivable firmness; and these constituted two branches of rigid episcopalians and presbyterians, comprised under the general names of *whigs* and *tories*; in regard the first join the *tories*, and the latter the *whigs*. The former consisted of rigid churchmen, who were against the least change in the discipline of the church, while the more moderate among the ecclesiastical *tories* were less scrupulous and obstinate, and may be called the low or moderate churchmen. The latter were the rigid presbyterians, who would be contented with nothing less than the destruction of the hierarchy, while the more moderate among them would have been satisfied with much less, and put up, says Mr. Rapin, with a bare toleration. From what has been observed, we may conclude, that as the names *tory* and *whig* have a regard to two different objects, they are equivocal, and of consequence ought never to be applied without expressing in which sense it is done; for the same person may be, in different respects, both *whig* and *tory*. For the rest, the general motives that have formed and kept up the two parties, appear, in the main, to be no other than the private motives of particular persons; self-interest is the *primum mobile* of their actions; ever since the rise of these factions, each has struggled earnestly to get the advantage over the other; inasmuch as from such superiority accrue places, and honours, and promotions, &c. which the prevailing party usually distributes

among its own members, exclusive of the contrary party. There are, however, men belonging to each of these parties, though the distinction is almost worn out, who act from conviction; some of whom are for the extension, and others for the limitation, of the royal prerogative, with a view to the good of the state, as their principles lead them to form different notions of the most effectual method of promoting it. The names, it is true, are almost sunk into oblivion: but the operation of the distinguishing sentiments of whigs and tories is discoverable in every period of the English history: and the true interest of a limited monarchy always inseparably connected with the rights of the people, renders the distinction of importance, and should prevent its ever being disregarded. It is with the whigs and tories on those points, which have discriminated the two parties, says Dr. Gregory Sharpe, as it is with all other sects of men under the agitation of hope and fear, ambition and interest; they tighten or relax their principles as suits best their convenience. When the tories have had the exercise of the powers of the prerogative, they have been eager to extend those powers; when the edge has been turned against them, they have been as eager in the defence of popular liberty; and, in like manner, the whigs, who withstood the storm, have melted in the sunshine: so that, in point of court complaisance, the administrations of the one have differed very little from those of the other. Holberg's Int. to Universal History, by Sharpe, p. 260.

As to the characters commonly attributed to the whigs and tories; the tories, says M. Rapin, appear fierce and haughty: they treat the whigs with the greatest contempt, and even sometimes with rigour, when they have the advantage over them: they are very hot and vehement, and proceed with a rapidity which yet is not always the effect of heat and transport, but has its foundation sometimes in good policy: they are very subject to change their principles, as their party prevails, or is humbled. If the rigid presbyterians prevailed in the whig party, it would not be less hot and zealous than that of the tories; but it is said they have not the direction thereof; which gives room to affirm, that those at the head of the whig party are much more moderate than the chiefs of the tories: and that they usually conduct themselves on fixed principles, proceed to their end gradually, and without violence; and their slowness is not less founded on good policy than the hastiness and precipitation of the tories. Thus much, says our author, may be said to the advantage of the moderate whigs, that, in the general, they maintain a good cause, viz. the constitution of the government as by law established.

TORPEDO, **CRAMPFISH**, or **ELECTRIC RAY**, in ichthyology, a sea fish, famed both among the ancient and modern naturalists, for a remarkable numbness wherewith it strikes the arm of such as touch it. For a copious description of the electrical properties of this fish, see the close of the System of ELECTRICITY, under the article **TORPEDO**.

TORPOR, a numbness, or defect of feeling and motion. Galen says it is a sort of intermediate disorder between palsy and health.

TORTOISE, the English name of the genus *Testudo*. See **TESTUDO**.

TORTOISE-SHELL, the shell, or rather scales, of the testaceous animal, called a **TORTOISE**; used in inlaying, and in various other works, as for snuff-boxes, combs, &c. Mr. Catelby observes, that the hard strong covering which incloses all sorts of tortoises, is very improperly called a shell; being of a perfect boney contexture; but covered on the outside with scales, or rather plates, of a horny substance: which are what the workmen call tortoise-shell. Phil. Trans. No. 438, p. 117.

TORUS, in architecture, a large round moulding used in the bases of columns. For representation of this part, and the ornaments that embellish it, see Plate VI.

TORY: See **TORIES**.

TOUCAN, otherwise called *Anser Americanus*, or American goose, in astronomy, a modern constellation of the southern hemisphere, consisting of nine small stars. See the System, Sect. VIII.

TOUCAN, in ornithology, the English name of the genus *Ramphastos*. For description of the genus, see **RAMPHASTOS**.

TOUCHING, is sometimes used for the sense of **FEELING**. This sense may be injured by any thing that obstructs the nervous influence; or prevents its being regularly conveyed to the organs of touching, as pressure, extreme cold, &c. also by too great a degree of sensibility, when the nerve is not sufficiently covered with the scarf-skin, or where there is too great tension, or it is too delicate. For an anatomical description of this organ of *sense*, see the System of ANATOMY, Part VI. Sect. I.

TOWER, **TURRIS**, a high building, consisting of several stories, and usually of a round form, though sometimes square or polygonal. Before the invention of guns, they used to fortify places with towers, and to attack them with moveable towers of the wood, mounted on wheels, to set the besiegers on a level with the walls, and drive the besieged from under the same. These towers were sometimes twenty stories, and thirty fathoms high; they were covered with raw skins, and a hundred men were employed to move them. Towers are also built to enable people, by their elevation, to view to a great distance. These are of all figures, as square, round, pentagonal, &c. In China is a famous tower of porcelain, whereof the Dutch relate wonders. Towers are also built for fortresses, prisons, &c. as the tower of London, &c. The tower of London is not only a

citadel to defend and command the city, river, &c. but also has been a royal palace, where our kings, with their courts, have sometimes lodged. It contains a royal arsenal, wherein are arms and ammunition for 80,000 soldiers, the offices of ordnance, a treasury for the jewels and ornaments of the crown; a mint for coining of money; the great archive, wherein are preserved all the ancient records of the courts of Westminster, &c. and is the chief prison for state criminals. The tower liberty, which is subject to no jurisdiction but that of the tower itself, includes both the tower-hills, part of East-Smithfield, Rosemary-lane, Welleclose-square, Little-Minories, Artillery-street, French-alley, Duke-street, Steward-street, Gun-street, Fore-street, and the other courts and allies within their compass, in Spitalfields.

TRACHEA, in anatomy, a large arterial vessel, called also *ap-pa* *arteria*, and popularly the *wind-pipe*, being the canal or tube which carries the air into the lungs for the use of respiration and speech. See the System, Part V. Sect. V. For representation, see Plate V. Fig. 3, letter A.

TRACHEAL Artery, in anatomy, a branch of the right sub-clavian, running up from it in a winding course along the aspera arteria. See the System, Part V. Sect. I.

TRADE, **TRAFFIC**, **COMMERCE**, the act or art, of dealing, buying, selling, exchanging, &c. commodities, bills, money, &c. For the origin, progress, &c. of *trade*, see **COMMERCE**.

TRADE-WINDS, denote certain regular winds at sea, blowing either constantly the same way, or alternately this way and that; thus called from their great use in navigation, and the Indian commerce. The *trade-winds* are of different kinds, some blowing three or six months in the year one way, and then the like space the opposite way: these are very common in the Indian Seas, and are called **MONSOONS**. Others blow constantly the same way: such is the general wind between the tropics, which off at sea is found to blow all day long from east to west. For the phenomena of each, with their physical causes, see **WIND**.

TRADITION, in matters of religion, is applied to those laws, doctrines, relations, &c. which have been handed down to us by our forefathers, without being written.

TRAGEDY, a dramatic poem, representing some signal action, performed by illustrious persons, and which has generally a fatal issue to end. Aristotle more scientifically defines tragedy, the imitation of one grave and entire action, of a just length, and which, without the assistance of narration, by raising of terror and compassion, refines and purges our passions. Our English authors are more favourable to the definition; by the purging of our passions, they understand not the extirpating of them, but the reducing them to just bounds; for by shewing the miseries that attend a subjection to them, they say it teaches us to watch them more narrowly; and by seeing the great misfortunes of others, it lessens the sense of our own.

As these dramatic poems were originally sung and accompanied by a chorus which might fatigue the fingers, as well as tire the audience, they bethought themselves to divide the singing of the chorus into several parts, and so have certain recitations in the intervals. Accordingly, Thespis first introduced a person to speak upon the stage with this view: Æschylus, finding one person insufficient, introduced a second to entertain the audience more agreeably by a kind of dialogue: he also clothed his persons more decently, and first put on them the buskin. The persons who made their recitations on the scene, were called *actors*; so that tragedy at first was without many actors; and what they thus rehearsed, whereof they were no necessary part, were called *episodes*. Tragedy and comedy were at first confounded with each other; but they were afterwards separated; and the poets in general applied themselves to the cultivating of tragedy, neglecting comedy.

The English received the first plan of their drama from the French, among whom it had its first rise towards the end of the reign of Charles V. under the title of the *chant-royal*, which consisted of pieces in verse composed in honor of the Virgin, or some of the saints, and were sung on the stage; they were called by the title *chant-royal*, because the subject was given by the King of the year, or the person who had borne away the prize the year preceding. The first essay was in the bourg St. Maur, and their subject the passion of our Saviour. The prévôt of Paris prohibiting their continuing of it, they made application to court; and to render it the more favourable to them, erected themselves into a friary, or fraternity, under the title of *Brothers of the Passion*; which title has given some occasion to suspect them to have been an order of religious. The king on seeing and approving some of their pieces, granted them letters of establishment in 1402, upon which they built a theatre, and for an age and a half acted none but grave pieces, which they called *moralities*; till the people growing weary of them, they began to intermix farces or interludes taken from profane subjects. This mixture of farce and religion displeasing many, they were re-established by an arret of parliament in 1548, on condition of their acting none but profane, yet lawful and decent, subjects, without intermeddling with any of the mysteries of religion; and thus were the Brothers of the Passion despoiled of their religious character; upon which they mounted the stage no more in person, but brought up a new set of comedians, who acted under their direction. Thus was the drama established, and on this

this foundation arrived in England. In process of time, as it was improved, it became divided into two branches, agreeably to the practice of the ancients, and the nature of things, viz. into tragedy and comedy, properly so called; and this last again was subdivided into pure comedy and farce. See COMEDY.

TRAGI-COMEDY, a kind of dramatic piece, representing some action passed among eminent persons, the event whereof is not unhappy or bloody, and wherein it sometimes admitted a mixture of less serious characters. The tragi-comedy, was formerly very common on the English stage; there was scarcely such a thing in the seventeenth century as a pure tragedy without a spice of comedy or farce to make the people laugh. Now, that the stage and our taste are brought nearer to the model of nature and the ancients, the tragi-comedy is disused.

TRANGLE, in heraldry, the diminutive of a fesse, commonly called a *bar*.

TRANSACTION, an accommodation of some business or dispute between two parties, by a mutual and voluntary agreement or contract between them.

Philosophical TRANSACTIONS, are a kind of journal of the principal things that come before the Royal Society of London. The Transactions contain the several discoveries and histories of nature and art, made by the members of the society, communicated by them from their correspondents, with the several experiments, observations, &c. made by them or transmitted to them, &c. See ROYAL SOCIETY.

TRANSFIGURATION, among divines, that miraculous change wrought by Jesus Christ, in presence of St. Peter, St. James, and St. John, on mount Thabor, where he appeared in his glory, in company with Moses and Elias. See the description thereof in St. Matthew, chap. xvii.

TRANSFORMATION of Equations, in algebra, is a method of changing equations into others, of a different form, but of equal value. See the System, Sect. V. Art. XVII.

TRANSFUSIONS of the Blood, is particularly used for the letting out of the blood of one animal, so as to be immediately received into the body of another. However, according to Heister, this operation could scarce be ventured upon even in the most desperate cases: "for (says he) almost all the patients, who have been this way treated, have degenerated into a stupidity, foolishness, or a raving or melancholy madness; or else have been taken off with sudden death, either in or not long after the operation. These lamentable and fatal consequences have brought the art of injections and transfusion into neglect at present: so that being suspected and condemned by proper judges at Paris, where they most flourished, we are told they were in a little time prohibited by a public edict of that parliament." Yet, a little after, the same author adds, "But whether or no this method of injecting proper medicines into the blood may succeed, especially in desperate apoplexies, anginas, hydrophobia, &c. and whether it may not be often useful to discharge the morbid blood, and transfuse such as is sound, or warm milk or broth in its stead, ought, in my opinion, to be determined by future and repeated experiments."

TRANSIT, in astronomy, signifies the passage of any planet, just by, or over, a fixed star, or the sun; and of the moon, in particular, covering or moving over any other planet. Mercury and Venus, &c. in their transits over the sun, appear like dark specks. See the System, Sect. VI.

TRANSITIVE, in grammar, an epithet given to such verbs as signify an action which passes from the subject that does it, to or upon another subject which receives it. Under the head of verbs *transitive*, come what we usually call verbs active and passive: other verbs, whose action does not pass out of themselves, are called *neuters*, and by some grammarians, *intransitives*. See the System, Part II. Chap. III. Art. V.

TRANSMIGRATION, is particularly used for the passage of a soul out of one body into another; the same with what we otherwise call *METEMPSYCHOSIS*. See *METEMPSYCHOSIS*. The Siamese, F. Tachard informs us, from a belief of the transmigration of souls into other bodies, forbear killing any beast; lest, by that means, they should dispossess the souls of their deceased relations.

TRANSMUTATION, the act of transforming or changing one nature into another. The term is chiefly used in chymistry and medicine. It has been greatly questioned, whether the transmutation of silver into gold, and of tin into silver, so much sought by the chymists, be possible, or not? See *ALCHYMY*.

The purest and subtlest parts of the food are transmuted, or assimilated into the proper substance of the body. See *NUTRITION*.

Nature, Sir Isaac Newton observes, seems delighted with transmutations: he goes on to enumerate several kinds of natural transmutations; gross bodies and light, he suspects, may be mutually transmuted into each other; and adds, that all bodies receive their active force from the particles of light which enter their composition.

TRANSOMS, in a ship, are beams and timbers extended across the stern-post of a ship, to fortify her after-part, and give it the figure most suitable to the service for which it is calculated. See the Treatise on NAVAL AFFAIRS, Sect. IV. and the Plate annexed.

TRANSPARENCY, in physics, a quality in certain bodies, whereby they give passage to the rays of light: in contradistinction

to opacity, or that quality of bodies which renders them impervious to the rays of the light. It has been generally supposed by philosophers, that transparent bodies have their pores disposed in straight lines, by which means the rays of light have an opportunity of penetrating them in all directions; but some experiments in electricity have made it apparent, that by the action of this fluid the most opaque bodies, such as sulphur, pitch, and sealing wax, may be rendered transparent as glass, while yet we cannot suppose the direction of their pores to be any way altered from what it originally was. A curious instance of an increase of transparency we have in rubbing a piece of white paper over one that has been written upon or printed: while the white paper is at rest, the writing or print will perhaps scarce appear through it: but when in motion, will be very easily legible, and continue so till the motion is discontinued.

TRANSPLANTATION, in gardening, the act of removing trees or plants from the places where they are sowed or raised, and planting them in others. For particular instructions respecting this part of gardening, see the System, Article *Fruit-Garden* throughout.

TRANSPORTATION, the act of conveying or carrying a thing from one place or country to another. In matters of commerce, transportation is of equal import with re-examination, viz. taking up of commodities in one foreign state or kingdom, bringing them hither, and paying duties for them: and then conveying them to some foreign state; by which it is distinguished from importation, and exportation; where the commodities are either carried originally out of, or brought finally into, our own kingdom.

TRANSPOSITION, in algebra, the bringing any term of equation over to the other side. See the System, Sect. V. Article XVII.

TRANSPOSITION, in music, is a changing of the notes of a piece of music, or the shifting a song from its former situation, to let it higher or lower, or in another octave. Of this there are two kinds; the first with respect to the cleff, the second with respect to the key. See the System, Part II. Sect. XI. No. 178.

TRANSUBSTANTIATION, in the Roman theology, the supposed conversion or change of the substance of the bread and wine, in the eucharist, into the body and blood of Jesus Christ. Transubstantiation, taken in its general and literal sense, implies any change of one substance into another. Thus the change of Moses's rod into a serpent; of the waters of the Nile into blood, of Lot's wife into a pillar of salt; were preternatural transubstantiations: and the change of the food we eat, into the substance of our bodies, is a natural transubstantiation. But the word, in its proper and technical sense, is restrained to the miraculous change which the Romish church holds is wrought in the sacrament, by the consecration of the priest. One of the great articles of that church, rejected by the reformed, is that of transubstantiation; the latter maintaining the transubstantiation to be only figurative, and the former affirming it to be real. This doctrine was established in the fourth general Lateran council, under pope Innocent III. in 1215, who is said to have introduced and established the use of the term transubstantiation, which was hitherto absolutely unknown; though some say that Stephen, bishop of Autun, first used this term. Burnet on the Articles, p. 312. The reformed interpret *est*, in the text, *Hoc est corpus meum*, *This is my body*, by *significat*; *q. d.* *This signifies my body*: but the council of Trent stand up strenuously for the literal sense of the verb. Thus in can. 1, sess. 23. of that council, it is expressly decreed, that in transubstantiation, the body and blood of our Lord Jesus Christ are truly, really, and substantially; under the species of bread and wine. It is added, that by *truly*, we mean *properly*; and not only by signification, as if the eucharist were no more than a sign of the body and blood of Jesus Christ; that by *really* we mean *in fact*, and not only in figure, as if the eucharist were only a figure and representation of the body and blood of the Saviour of the world; and that by *substantially*, we mean *in substance*, and not only in virtue and energy. Thus is *truly* opposed to a single sign, *really* to a figure, and *substantially* to energy or virtue.

TRANSVERSALIS, in anatomy, a name given to several muscles, &c. in respect of their situation, progress, &c. For the origin, insertion, and uses of these several muscles, as they relate to the different parts of the human economy, see the System, Part II. Sect. II. Table of Muscles throughout.

TRAPEZIUM (Os), in anatomy, is one of the bones of the CARPUS or WRIST. See the System, Part I. Sect. IV. Art. 3.

TRAVERSE, or *TRANSVERSE*, something that goes athwart another, i. e. that crosses and cuts it obliquely.

TRAVERSE, in navigation, is the variation or alteration of a ship's course, occasioned by the shifting of the winds, currents, &c. or a traverse is a compound course, wherein several different courses and distances are known. *Traverse sailing* is used when a ship, having set sail from one port towards another, whose course and distance from the port sailed from is given or known, is, by reason of contrary winds, or other accidents, forced to shift and sail on several courses, which are to be brought into one course, to learn, after so many turnings and windings, the true course and distance made from the place sailed from, and the true point or place where the ship is; that so, the wind coming fair, it may be known how after.

afterwards, to shape a course for the place intended. For the rules and methods respecting this branch, see the System, Sect. I. throughout.

TRAVERSE Table, in navigation, is the same with a table of difference of latitude and departure. This table is one of the most necessary things a navigator has occasion for; for by it he can readily reduce all his courses and distances, run in the space of twenty-four hours, into one course and distance; whence the latitude he is in, and his departure from the meridian, may be found. See a table of this kind, in the System, Sect. I.

TREACLE, in pharmacy, &c. See **THERIACA**.

The word treacle is also popularly used for melleases; and in this sense it is that Dr. Shaw, in his Essay on Distillery, has endeavoured to bring into use several sorts of treacles, which might be made at home, and would serve very conveniently for the distillation of spirits, or the making of potable liquors. These are the inspissated juices or decoctions of vegetables; such as the sweet juice of the birch, or sycamore, procured by tapping or piercing the trees in spring, and the common wort made from malt, or from other vegetable substances, treated in the same manner. These liquors are severally to be boiled down in a copper till they begin to inspissate, and then to be poured into a balneum marie, when the remainder of the evaporation may be finished without burning the spissated juices: thus prepared, it may be at any time reduced to the state of wort, only by adding a sufficient quantity of warm water. See **SUGAR**.

TREASON, **PRODITIO**, in its very name (which is borrowed from the French) imports a betraying, treachery, or breach of faith. It therefore happens only between allies, saith the Mirror of Justice: for treason indeed is a general appellation, made use of by the law to denote not only offences against the king and government; but also that accumulation of guilt which arises whenever a superior reposes a confidence in a subject or inferior, between whom and himself there subsists a natural, a civil, or even a spiritual relation: and the inferior so abuses that confidence, so forgets the obligations of duty, subjection, and allegiance, as to destroy the life of any such superior or lord. This is looked upon as proceeding upon the same principle of treachery in private life, as would have urged him who harbours it to have conspired in public against his liege lord and sovereign: and therefore for a wife to kill her lord or husband, a servant his lord or master, and an ecclesiastic his lord or ordinary; these being breaches of the lower allegiance, of private and domestic faith, are denominated *petit-treasons*. But when disloyalty so tears its crest, as to attack even majesty itself, it is called, by way of eminent distinction, *high-treason*, *alta proditio*; being equivalent to the *crimen laesa majestatis* of the Romans; as Glanvil denominates it also in our English law.

High-TREASON. As this is the highest civil crime which, considered as a member of the community, any man can possibly commit, it ought therefore to be the most precisely ascertained. For if the crime of high-treason be indeterminate, this alone, says the president Montesquieu, is sufficient to make any government degenerate into arbitrary power. And yet, by the ancient common law, there was a great latitude left in the breast of the judges to determine what was treason, or not so: whereby the creatures of tyrannical princes had opportunity to create abundance of constructive treasons; that is, to raise, by forced and arbitrary constructions, offences into the crime and punishment of treason, which never were suspected to be such. But to prevent the inconveniences which began to arise in England from this multitude of constructive treasons, the statute 25 Edw. III. c. 2, was made; which defines what offences only for the future should be held to be treason: in like manner as the *lex Julia majestatis* among the Romans, promulgated by Augustus Cæsar, comprehended all the ancient laws that had before been enacted to punish transgressions against the state. This statute must therefore be our guide, in order to examine into the several kinds of high-treason.

When a man both compass or imagine the death of our lord the king, of our lady his queen, or of their eldest son and heir. Under this description it is held that a queen-regnant (such as Queen Elizabeth and Queen Anne) is within the words of the act, being invested with royal power, and entitled to the allegiance of her subjects: but the husband of such a queen is not comprised within these words; and therefore no treason can be committed against him.

If a man do violate the king's companion, or the king's eldest daughter unmarried, or the wife of the king's eldest son and heir. By the king's companion is meant his wife; and by violation is understood carnal knowledge, as well without force as with it: and this is high-treason in both parties, if both be consenting; as some of the wives of Henry VIII. by fatal experience, evinced. The plain intention of this law is guard the blood-royal from any suspicion of bastardy, whereby the succession to the crown might be rendered dubious: and therefore, when this treason ceases, the law ceases with it: for to violate a queen or princess dowager is held to be no treason: in like manner as, by the feudal law, it was a felony, and attended with a forfeiture of the fief, if the vassal violated the wife or daughter of his lord; but not so if he only violated his widow.

The punishment of high-treason, in general, is very solemn and terrible. That the offender be drawn to the gallows, and not

be carried or walk; though usually (by connivance, at length ripened by humanity into law) a sledge or hurdle is allowed, to preserve the offender from the extreme torment of being dragged on the ground or pavement. 2. That he be hanged by the neck, and then cut down alive. 3. That his entrails be taken out, and burned while he is yet alive. 4. That his head be cut off. 5. That his body be divided into four parts. 6. That his head and quarters be at the king's disposal. The king may and often doth, discharge all the punishment except beheading, especially where any of noble blood are attained. For beheading being part of the judgment, that may be executed, though all the rest be omitted, by the king's command. But where beheading is no part of the judgment, as in murder or other felonies, it hath been said that the king cannot change the judgment, although at the request of the party, from one species of death to another. In the case of coining, which is a treason of a different complexion from the rest, the punishment is milder for male offenders: being only to be drawn and hanged by the neck till dead. But in treasons of every kind, the punishment of women is the same, and different from that of men. For as the natural modesty of the sex forbids the exposing and publicly mangling their bodies, their sentence (which is to the full as terrible to sense as the other) is to be drawn to the gallows, and there to be burned alive. For the consequences of this judgment, see **ATTAINDER**.

Petit-TREASON, according to the statute 25 Edward III. c. 2, may happen three ways; by a servant killing his master, a wife her husband, or an ecclesiastical person (either secular or regular) his superior, to whom he owes faith and obedience. See **TREASON**. A servant who kills his master whom he has left, upon a grudge conceived against him during his service, is guilty of petit-treason: for the traitorous intention was hatched while the relation subsisted between them, and this is only an execution of that intention. So if a wife be divorced *à mensa et thoro*, still the *vinculum matrimonii* subsists; and if she kills such divorced husband she is a traitress. As to the rest, whatever has been said with respect to wilful **MURDER**, is also applicable to the crime of petit-treason, which is no other than murder in its most odious degree; except that the trial shall be, as in cases of high-treason, before the improvements therein made by the statutes of William III. But a person indicted of petit-treason may be acquitted thereof, and found guilty of manslaughter or murder; and in such case it should seem that two witnesses are not necessary, as in case of petit-treason they are; which crime is also distinguished from murder in its punishment. The punishment of petit-treason in a man, is to be drawn and hanged, and in a woman to be drawn and burned; the idea of which latter punishment seems to have been handed down to us from the laws of the ancient Druids, which condemned a woman to be burned for murdering her husband; and was long since the punishment for all sorts of treasons committed by those of the female sex. Persons guilty of petit-treason were first debarred the benefit of clergy by statute 12 Henry VII. c. 7, which has since been extended to their aiders, abettors, and counsellors, by statutes 23 Henry VIII. c. 1, & 4; and 5 Pl. & M. c. 4.

TREASURE, in general, denotes a store or stock of money in reserve.

TREASURE, *Trove*, in law, derived from the French word *trouver*, to find, called in Latin, *thesaurus inventus*, is where any money or coin, gold, silver, plate, or bullion, is found hidden in the earth, or other private place, the owner thereof being unknown; in which case, the treasure belongs to the king; but if he that hid it be known, or afterwards found out, the owner and not the king is entitled to it. When the Romans, and other inhabitants of the respective countries which composed their empire, were driven out by the northern nations, they concealed their money under ground, with a view of resorting to it again when the heat of the irruption should be over, and the invaders driven back to their deserts. But as this never happened, the treasures were never claimed; and on the death of the owners the secret also died along with them. The conquering generals being aware of the value of these hidden mines, made it highly penal to secrete them from the public service. In England therefore, as among the feudists, the punishment of such as concealed from the king the finding of hidden treasure was formerly no less than death; but now it is only fine and imprisonment.

TREASURE, an officer to whom the treasure of the prince, or corporation, is committed to be kept, and duly disposed of, in payment of officers, and other expenses, see **TREASURY**. Of these there is a great variety. His majesty of Great Britain, in quality of elector of Brunswick, is Arch-treasurer of the Roman empire. In the states of Poland were two grand-treasurers, that of the kingdom of Poland, and that of the duchy of Lithuania. In England, the principal officers under this denomination are, the lord high-treasurer, the treasurer of the household, treasurer of the navy, of the king's chamber, &c. Anciently we had likewise a treasurer of the exchequer, treasurer of war, &c.

Lord High TREASURER of England, is the principal officer of the crown; under whose charge and government is all the king's revenue kept in the exchequer. He receives the office by delivery of a white staff to him from the king, and holds it during the king's pleasure; anciently he received it by delivery of the golden keys of the treasury. He has the cheque of all the officers any way employed in

in collecting imposts, customs, tributes, or other revenues of the crown. He has the gift of all the customers, comptrollers, and searchers' places, in all the ports of London; and the nomination of the escheators in every county. He alone (or others in commission with him) lets leases of all the crown-lands, gives warrants to certain persons of quality to have their wine custom-free, &c. Killing the lord-treasurer in the execution of his office, is high-treason. The office of lord-treasurer is now in commission. The number of lords commissioners is five; one of whom is the first lord, whose annual salary was formerly 383*l.* but is now 4000*l.* and who, unless he be a peer, is also chancellor of the exchequer, and prime minister in the government of this country: the other lords-commissioners have an annual salary of 1600*l.* each.

TREASURER of the Household, is an officer who, in the absence of the lord-steward, has power, with the comptrollers, and other officers of the green-cloth, and the steward of the marshall's, to hear and determine treasons, felonies, and other crimes committed within the king's palace. There is also a treasurer belonging to the establishment of her majesty's household, &c.

TREASURER of the Navy, is an officer who receives money out of the exchequer, by warrant from the lord high-treasurer, or the lords commissioners executing that place: and pays all charges of the navy, by warrant from the principal officers of the navy.

TREASURY, the place wherein the revenues of a prince are received, preserved, and disbursed. In England the treasury is a part of the exchequer: by some called the *lower-exchequer*. The officers of his majesty's treasury, or the lower exchequer, are the lords commissioners, one of whom is chancellor, two joint secretaries, private secretary to the first lord, two chamberlains, an auditor, four tellers, a clerk of the pells, usher of the receipt, a tally-cutter, &c.

TREATY, a covenant between several nations; or the several articles or conditions stipulated and agreed upon between sovereign powers. There are treaties of peace, of marriage, of confederacy, of neutrality, of capitulation, and of commerce and navigation. Treaties of commerce are usually followed by various tariffs, to adjust the duties of exportation and importation of merchandizes into the respective dominions of the contracting powers. It is the king's prerogative to make treaties, leagues, and alliances, with foreign princes and states; and yet, lest this plenitude of authority should be abused to the detriment of the public, the constitution has interposed a check, by the means of parliamentary impeachment, for the punishment of such ministers as from criminal motives advise or conclude any treaty, which will afterwards be judged to derogate from the honour and interest of the nation.

TREE, ARBOR, the first and largest of the vegetable kind, consisting of a single trunk, out of which spring forth branches and leaves. For the arrangement of trees, as they relate to the ornaments of gardening, see the *System*, Part II. Art. 3.

TREES (Timber), are those whose trunks are tall and straight, whereof beams, masts, &c. are used to be made. Trees that are nine inches girth about a yard from the ground, are commonly reckoned timber-trees, but none under this size. See **TIMBER**.

TREFOIL, in botany, the English name of the genus *Trifolium*, see **TRIFOLIUM**. For the cultivation, see the *System* of **AGRICULTURE**, Sect. VIII.

TREMOR, TREMBLING, in medicine, a disease near akin to a convulsion, wherein there is something of a convulsive motion or shaking, accompanying a voluntary or natural motion. A tremor is frequently found to arise from the more violent passions, particularly anger, gluttony, venery, &c. but this is accidental and transitory. A tremor is sometimes apt to degenerate into other worse diseases, viz. palsy, apoplexy, lethargy, spasmus, &c. Medical writers distinguish this tremor into the active and passive: the active is that which happens in violent passions of terror, anger, joy, &c. or in intermittent fevers, and is to be referred to the semi-convulsive motions: the passive are owing to a privative cause, and are allied to the semi-paralytic affections. The passive tremors of the limbs, when considered as a disease, are to be distinguished from those which are caused by external accidents, such as the being plunged into cold water, the drinking tea, coffee, or other warm liquors, in many constitutions, and other such accidental causes. The persons subject to tremors of the limbs are principally old people, in whom the vital principle is weak and languid. The internal causes are a flaccidity of the nerves, and remission of the tone of the parts; the external and accidental ones are the omission of accustomed evacuations, a diaphoretic regimen, and an abuse of spirituous liquors. The medicine commonly made use of in tremors, and other nervous distempers, by the name of *palsy drops*, is no other than the compound spirit of lavender. The most successful way of using it, is by taking thirty or forty drops twice or thrice a day, drop on loaf-sugar or a little bread. It is supposed, that, by this way, the most spirituous and efficacious parts make their way directly by the nerves of the palate, &c. without undergoing the course of the circulation, as it must do when taken in a liquid vehicle.

TRENCH, a ditch cut or dug in the ground, to drain off the waters in a meadow, or morafs, or the like. See the *System* of **AGRICULTURE**, Sect. XIX.

TRENCHES, in fortification, are ditches which the besiegers cut to approach more securely to the place attacked, whence they are also

called *lines of APPROACH*. See the *Treatise*, article **DEFINITIONS**.

TRIAL, in law, the examination of a cause according to the laws of the land, before a proper judge: or it is the manner and order observed in the hearing and determining of causes. Trials are either civil or criminal.

Civil TRIALS. The species of trials in civil cases are seven: by record, by inspection or examination, by certificate, by witnesses, by wager or battle, by wager of law, and by jury. The first six are only had in certain special or excentric cases, where the trial by jury would not be so proper or effectual. The nature of the last, that principal criterion of truth in the law of England, shall be explained in this article. The method of trial by jury, called also the trial *per pais*, or by the country, hath been used, time out of mind, in this nation, and seems to have been coeval with the first civil government thereof. Its use, though for a time greatly impaired and shaken by the introduction of the Norman trial by battle, was always so highly esteemed and valued by the people, that no conquest, no change of government, could ever prevail to abolish it; and in *magna charta* it is more than once insisted on as the principal bulwark of our liberties. Trials by jury in civil causes are of two kinds: extraordinary and ordinary.

1. The first species of extraordinary trial by jury is that of the general assize, which was instituted by king Henry II. in parliament, by way of alternative offered to the choice of the tenant or defendant in a writ of right, instead of the barbarous and unchristian custom of duelling. For this purpose a writ *de magna assisa eligenda* is directed to the sheriff, to return four knights, who are to elect and choose 12 others to be joined with them; and these altogether form the grand assize, or great jury, which is to try the matter of right, and must now consist of 16 jurors. Another species of extraordinary juries, is the jury to try an attain; which is a process commenced against a former jury for bringing a false verdict. See the article **ATTAIN**.

2. With regard to the ordinary trial by jury in civil cases, the most clear and perspicuous way of treating it will be by following the order and course of the proceedings themselves. When therefore an issue is joined by these words, "And this the said A prays may be enquired of by the country;" or, "And of this he puts himself upon the country, and the said B does the like:" the court awards a writ of *venire facias* upon the roll or record, commanding the sheriff "that he cause to come here, on such a day, twelve free and lawful men, *liberes et legales homines*, of the body of his country, by whom the truth of the matter may be better known, and who are neither of kin to the aforesaid A, nor the aforesaid B, to recognize the truth of the issue between the said parties."

A trial by jury, ever has been, and it is hoped ever will be, looked upon as the glory of the English law. It is certainly the most transcendent privilege which any subject can enjoy or wish for, that he cannot be effected either in his property, his liberty, or in his person, but by the unanimous consent of 12 of his neighbours and equals. The impartial administration of justice, which secures both our persons and our properties, is the great end of civil society. But if that be entirely entrusted to the magistracy, a select body of men, and those generally selected by the prince, or such as enjoy the highest offices in the state, their decisions, in spite of their own natural integrity, will have frequently an involuntary bias towards those of their own rank and dignity: it is not to be expected from human nature, that the few should always be attentive to the interests and good of the many. On the other hand, if the power of judicature were placed at random in the hands of the multitude, their decisions would be wild and capricious, and a new rule of action would be every day established in our courts. It is wisely therefore ordered, that the principles and axioms of law, which are general propositions flowing from abstracted reason, and not accommodated to times or to men, should be deposited in the breasts of the judges, to be occasionally applied to such facts as come properly ascertained before them. For here partiality can have little scope; the law is well known, and is the same for all ranks and degrees; it follows as a regular conclusion from the premises of a fact pre-established. But in setting and adjusting a question of fact, when intrusted to any single magistrate, partiality and injustice have an ample field to range in, either by boldly asserting that to be proved which is not so, or more artfully by suppressing some circumstances, stretching and warping others, and distinguishing away the remainder. Here therefore a competent number of sensible and upright jurymen, chosen by lot from among those of the middle rank, will be found the best investigators of truth, and the surest guardians of public justice. For the most powerful individual in the state will be cautious of committing any flagrant invasion of another's right, when he knows that the fact of his oppression must be examined and decided by 12 indifferent men, not appointed till the hour of trial; and that when once the fact is ascertained, the law must of course redress it: this therefore preserves in the hands of the people that share which they ought to have in the administration of the public justice, and prevents the encroachments of the more powerful and wealthy citizens.

Criminal TRIALS. The several methods of trial and conviction of offenders, established by the laws of England, were formerly more numerous than at present, through the superstition and ignorance of

our Saxon ancestors; who, like other northern nations, were extremely addicted to divination; a character which Tacitus observes of the ancient Germans: they therefore invented a considerable number of methods of purgation or trial, to preserve innocence from the danger of false witnesses, and in consequence of a notion that God would always interpose miraculously to vindicate the guiltless: as, 1. By ordeal; 2. By confined; 3. By battle.

A fourth method is that by the *peers of Great Britain*, in the *Court of PARLIAMENT*; or the *Court of the Lord High STEWARD*, when a peer is capitally indicted; for in case of an appeal, a peer shall be tried by jury. This differs little from the trial *per patriam*, or by jury: except that the peers need not all agree in their verdict; and except also, that no special verdict can be given in the trial of a peer; because the lords of parliament, or the lord high steward (if the trial be had in his court) are judges sufficiently competent of the law that may arise from the fact: but the greater number, consisting of twelve at least, will conclude, and bind the minority. The trial by jury, or the country, *per patriam*, is also that trial by the peers of every Briton, which, as the great bulwark of his liberties, is secured to him by the great charter: *nullus liber homo capiatur, vel imprisonetur, aut exulet, aut aliquo alio modo detineatur nisi per legale iudicium parium suorum vel per legem terræ.*

TRIANDRIA, in botany, the third class of plants which have hermaphrodite flowers, with three stamina or male parts in each. For the representation of the several orders appertaining to this class, see the *System*, Sect. III. and Plate IV.

TRIANGLE, in geometry, a figure comprehended under three lines, or sides, and which of consequence has three angles. See the *System*, Part I. Sect. I.

TRICEPS, in anatomy, a muscle of the thigh, having three originations, and as many insertions; and which may therefore be divided into three muscles, all arising from the os pubis, and inserted into the linea aspera of the thigh-bone, whereof they possess the greatest part. For their names, origin, insertions, and uses, see the *System*, Part II. Sect. II. and Table of Muscles, Art. 25, and Plate I. Fig. 3, letter c.

TRICHECUS, the **WALRUS**; a genus of quadrupeds, belonging to the order *Bruta*. The characters are these: two great tusks in the upper jaw, pointing downwards; four grinders on both sides, above and below; no cutting teeth: five palmated toes on each foot: there are two species.

1. The *rosmarinus*, morse, or sea-horse, has a round head; small mouth; very thick lips, covered above and below with pullucid bristles, as thick as straw; the tail is very short; penis long; the length of the animal, from nose to tail, sometimes eighteen feet, and ten or twelve round in the thickest part: the teeth have been sometimes found of the weight of 20lb. each. The teeth of this size are only found on the coast of the Ice Sea, where the animals are seldom molested, and have time to attain their full growth: we need not enter into a further description of the proportions of the different parts of these animals, as the representations in Plate II. will afford a better idea than our description. They inhabit the coast of Spitzbergen, Nova Zembla, Hudson's Bay, and the gulf of St. Laurence; and the Ice Sea, as far as Cape Tschuktchi. They are gregarious; in some places appearing in herds of hundreds. They are shy animals, and avoid places which are much haunted by mankind; but are very fierce. If wounded in the water, they attempt to sink the boat, either by rising under it, or by striking their great teeth into the sides; they roar very loud, and will follow the boat till it gets out of sight. Numbers of them are often seen sleeping on an island of ice; if awoken, they fling themselves with great impetuosity into the sea; at which time it is dangerous to approach the ice, lest they should tumble into the boat, and overthrow it. They do not go upon the land till the coast is clear of ice. At particular times, they land in amazing numbers. The method of killing them on the Magdalen isles, in the gulf of St. Laurence, according to Mr. Pennant, is thus: The hunters watch their landing; and as soon as they find a sufficient number for what they call a cut, they go on shore, each armed with a spear, sharp on one side like a knife, with which they cut their throats. Great care must be taken not to stand in the way of those which attempt to get again to sea, which they do with great agility by tumbling headlong; for they would crush a person to death by their vast weight. They are killed for the sake of their oil, one walrus producing about half a tun. They bring one, or at most two, young at a time: they feed on sea-herbs and fish; also on shells, which they dig out of the sand with their teeth: they are said also to make use of their teeth to ascend rocks or pieces of ice, fastening them to the cracks, and drawing their bodies up by that means. Besides mankind, they seem to have no other enemy than the white bear, with whom they have terrible combats; but generally come off victorious, by means of their great teeth. For representation, see Plate II. Genus 6. Species 1.

2. The *manatus*, manati, or sea-cow. This animal, in nature, so nearly approaches the cetaceous tribe, that it scarce deserves the name of a biped: what are called feet are little more than pectoral fins; they serve only for swimming: they are never used to assist the animal in walking or landing; for it never goes ashore, nor ever attempts to climb the rocks, like the sea-horse and seal. It brings forth in the water, and, like the whale, suckles its young in

that element: like the whale, it has no voice; and, like that animal, has an horizontal broad tail, without even the rudiments of hind feet. It inhabits the shores of Kamtschatka, those of the opposite coast of America, and of the intervening islands. It is found again on that of Mindanao, one of the Philippine islands, and on that of Senegal; on the Mosquito shore, in the river Oronoque, and the lakes formed by it: and lastly, in the river of Amazons; but in no other part of the Atlantic Ocean. They live perpetually in the water, and frequent the edges of the shores; and in calm weather swim in great droves near the mouths of rivers: in the time of flood they come so near the land, that a person may stroke them with his hand: if hurt they swim out to sea; but presently return again. They live in families, one near another; each consists of a male, a female, a half-grown young one, and a very small one. The females oblige the young to swim before them, while the other old ones surround and as it were guard them on all sides. The affection between the male and female is very great; for if she is attacked, he will defend her to the utmost; and if she is killed, will follow her corpse to the very shore, and swim for some days near the place it has been landed at. They copulate in the spring, in the same manner as the human kind, especially in calm weather, towards the evening. The female swims gently about; the male pursues; till, tired with wantoning, she flings herself on her back, and admits his embraces. Steller thinks they go with young about a year: it is certain that they bring about one young at a time, which they suckle by two teats placed between the breasts. They are vastly voracious and gluttonous; and feed not only on the fuci that grow in the sea, but such as are flung on the edges of the shore. When they are filled, they fall asleep on their backs. During their meals, they are so intent on their food, that any one may go among them and choose which he likes best. Their back and their sides are generally above water; and as their skin is filled with a species of louse peculiar to them, numbers of gulls are continually perching on their backs, and picking out the insects. They continue in the Kamtschatkan and American seas the whole year; but in winter are very lean, so that you may count their ribs. They are taken by harpoons fastened to a strong cord; and after they are struck, it requires the united force of thirty men to draw them on shore. Sometimes when they are transfixed, they will lay hold of the rocks with their paws, and stick so fast as to leave the skin behind before they can be forced off. They have not any voice; but make a noise by hard breathing, like the snorting of a horse. They are of an enormous size; some are 28 feet long, and 8000lb. in weight. Those of the West Indies and other hot climates do not exceed 1200lb. in weight, and few arrive at that size. Probably they are not suffered to live their full time in those countries, being perpetually persecuted by the Mosquito and other Indians, who are very dexterous in striking them. The head, in proportion to the bulk of the animal, is small, oblong, and almost square; the nostrils are filled with short bristles: the gape, or rectus, is small: the lips are double; near the junction of the two jaws the mouth is full of white tubular bristles, which serve the same use as the liminae in the wales, to prevent the food running out with the water: the lips are also full of bristles, which serve instead of teeth to cut the strong roots of the sea-plants, which floating ashore are a sign of the vicinity of these animals. In the mouth are no teeth, only two flat white bones, one in each jaw; one above, another below, with undulated surfaces, which serve instead of grinders. The females have, between the pectoral fins, two large round and fair breasts: and both sexes have the parts of generation, and the navel, perfectly resembling those of the human species: there is no doubt, Mr. Pennant thinks, but all the fables concerning mermaids, mermen, and syrens, took their rise from an imperfect view of this animal. The skin is very thick, black, and full of inequalities like the bark of oak, and so hard as scarce to be cut with an axe, and has no hair on it; beneath the skin is a thick blubber, which tastes like oil of almonds. The flesh is coarser than beef, and will not soon putrify. The young ones taste like veal. The skin is used for shoes, and for covering the sides of boats. For representation, see Plate II. Genus 6. Species 2.

TRIENNIAL, an epithet applied chiefly to offices or employments which last for three years. In 1695, an act was made for triennial parliaments, i. e. for parliaments which should be dissolved, and the members be elected anew, every three years. Till that time, the king had it in his power to prorogue and continue his parliament as long as he pleased. This opened a door to corruption, which the triennial bill was intended to prevent. The triennial act has, from some other views, been since repealed; for the great struggles used at elections, the great ferment it usually put the nation into, the great expences upon that occasion, with other considerations, determined the legislature, in 1717, to change triennial parliaments for septennial ones.

TRIFOLIUM, **TREFOIL**, denotes several three-leaved plants: For cultivation of the several species of this plant, see the *System of AGRICULTURE*, Sect. VII.

TRIGLYPHS, in architecture, sorts of ornaments repeated at equal intervals in the Doric frieze. Each triglyph consists of two entire gutters or channels, cut to a right-angle called glyphes, and separated by three interstices. See the *System*, Plate VI.

TRIGONOMETRY.

TRIGONOMETRY teaches how to measure the sides and angles of triangles, and is either plane or spherical, according as the triangles are plane or spherical; of each whereof we shall treat in order.

PLANE TRIGONOMETRY.

PLANE TRIGONOMETRY, or that which treats of plane triangles, is commonly divided into *rectangular* and *oblique-angular*.
OF RECTANGULAR PLANE TRIGONOMETRY.

DEFINITIONS.

1. The periphery of every circle is supposed to be divided into 360 equal parts, called degrees; each degree into 60 equal parts, called minutes; and each minute into 60 equal parts, called seconds, &c. 2. Any part AB (Fig. 51.) Plate Miscellaneous Mathematics of the periphery of a circle is named an arch, and is said to be the measure of the angle ACB at the centre, which it subtends. N.B. Degrees, minutes, seconds &c. are written in this manner, viz. $50^{\circ} 18' 35''$; which signify that the arch or angle thereby expressed, contains 52 degrees, 18 minutes, and 35 seconds. 3. The complement of an arch is what it wants of a quadrant or 90° ; thus, BH is the complement of AB. 4. The supplement of an arch is what it wants of a semicircle; BD is the supplement of AB. 5. The chord or subtense of an arch is a right-line drawn from one extremity of the arch to the other; the right-line BFE is the chord or subtense of the arch BAE. 6. The sine or right-sine of an arch is a right-line drawn from one extremity of the arch, perpendicular to the diameter, passing through the other extremity thereof; BF is the sine of the arch AB, or DB. 7. The cosine or sine complement of an arch is the distance between the centre and the sine; CF is the cosine of the arch AB, which is also equal to BI, the sine of HB, the complement of BA. 8. The versed sine of an arch is the part of the diameter intercepted between the sine and the periphery; AF is the versed sine of the arch AB, and DF of DB. 9. The covered sine of the arch AB is the distance HI, between the end of the quadrant AH, and BI perpendicular to HC. 10. The tangent of an arch is a right-line touching the circle in one extremity of that arch produced from thence, till it meets a right-line passing through the centre, and the other extremity of the arch; AG is the tangent of the arch AB, and HK is the tangent of the arch BH. 11. The secant of the arch is a right-line reaching without the circle, from the centre to the extremity of the tangent; thus CG, is the secant of the arch AB; and CK is the secant of the arch BH. 12. The cotangent and cosecant of an arch are the tangent and secant of the complement of that arch; HK and CK are the cotangent and cosecant of AB respectively. 13. The sine of an arch, AB, greater than 90° , is equal to the sine of another arch AB, as much below 90° degrees; thus, $bf=BF$; and its cosine, tangent, and secant, are also respectively equal to the cosine, tangent, and secant of its supplement, AB, only they are negative, or fall on contrary sides of the points C and A, from whence they have their original. 14. A natural trigonometrical canon is a table exhibiting the length of the sine-tangent and secant to every degree and minute of the quadrant with respect to the radius, which is supposed unity, and conceived to be divided into 100000, or more decimal parts. An artificial trigonometrical canon, is a table exhibiting the logarithms of the numbers in the natural canon, the index of the radius being usually made 10, and the rest according to their proper proportion. This artificial table, on account of its dispatch, is commonly made use of in operation. Note, that the three angles of every plane triangle make 180 degrees, or are equal to two right-angles. Therefore in a right-angled plane triangle, the two acute angles make 90° , or are equal to one right-angle. And, consequently, the acute angles of a plane right-angled triangle are complements to one another.

LEMMA I. If the hypotenuse of any right-angled plane triangle be made the radius of a circle, then each leg will be the sine of its opposite angle: thus, if in the right-angled plane triangle ABC, Fig. 52, the hypotenuse AC be made radius, then, by definition 6, BC will be the sine of the arch CD, which is the measure of its opposite angle CAB; also AB will be the cosine of the said angle; and the angle CAB being the complement of the angle ACB; therefore, by definition 7, AB, the cosine of angle A, is equal to the sine of its opposite angle C; consequently, when the hypotenuse is radius, each leg becomes the sine of its opposite angle.

LEMMA II. If either of the legs of a right-angled plane triangle be made radius, the hypotenuse becomes the secant of the angle contained between it and the leg made radius, and the other leg becomes the tangent of the same angle, or they are respectively the cosecant or cotangent of the other acute angle, contained between the hypotenuse, and the other leg. Thus, in the triangle ABC, Fig. 53, if AB be radius, then, by definition 10, BC is the tangent of the arch BD (which is the measure of the angle A) and by definition 11, AC is the secant thereof. Also the angle C being the complement of the angle A, it follows, by definition 12, that BC and AC are respective cotangents, and cosecant of the angle C. In like manner, if the leg BC was made radius, it might be shewn that AB and AC are the tangent and secant of the angle C, and the cotangent and cosecant of the angle A.

SOLUTION OF RIGHT-ANGLED PLANE TRIANGLES.

In order to explain the nature of resolving the different cases of right-angled plane triangles, it is necessary to observe that some one

of the sides must be supposed the radius of a circle, agreeably to the foregoing lemmas; and if the side so made radius, were actually an unit, or 10, or 100, &c. then the table of natural sines, tangents, &c. would shew the lengths of the other sides by inspection, care being had to point off truly the decimal places. When the side made radius is not an unit, as represented in the table of natural sines, &c. then in whatever proportion the side made radius is greater or less than an unit, in the same proportion will the other sides be greater or less than the natural sine, tangent, secant, &c. which they respectively denote; and which is found in the table of natural sines, tangents, &c. by inspection; the degrees and minutes of the angle, of which the said respective sides are the natural sines, tangents, &c. being supposed to be known. Thus, suppose the side made radius was 12, then the other sides would be respectively 12 times greater than the natural sine, tangent, &c. which they respectively represent: and which natural sine, tangent, &c. would be had by inspection from the table of natural sines, &c. in the proper columns, and corresponding to the degrees and minutes of the angle. In short, in the solution of right-angled triangles there is nothing more to do than to reduce one kind or denomination of measure to that of another. For if the side made radius, when measured by one kind of scale or rule of measure, be supposed 1, but when measured or compared by another scale of a different magnitude or kind of measure, be any other number, as 12, 15, 20, &c. then if either of the other sides of the triangle be measured or compared by these two different scales or rules of measure, its length or measure, by one scale, will differ from that by the other in the same ratio or proportion as did the side made ratio, when so measured or compared. From these ideas we gather the following theorems:

THEOREM I. As radius (or 1) is to the real length of the side made radius, so is the sine, tangent, or secant, denoted by the side sought, (and which will be found in the table corresponding to the degrees, &c. of the angle, of which such side is the sine, tangent, or secant, &c.) to the length of the side sought. It is evident this theorem is to find a side, when one side and an acute angle is given, and when the given side is made radius. By reversing the theorem, it will stand as follows; and then, instead of finding a side, it will find an angle.

THEOREM II. As the real length of the side made radius is to radius (or 1) so is the length of the other given side to the sine, tangent, &c. of the angle which it represents, according as the same shall denote sine, tangent, &c. This theorem, which is the reverse of the former, is calculated to find an angle when two sides are given. Either of the given sides being made radius.

N.B. When one side and an angle is given to find another side, the same might be performed by making any side radius, but the proportion would not be so simple and easy as that by the first theorem. And as one good rule is preferable to a multitude of others that are not so good, we shall not in this work insist upon more. The above theorems will be equally applicable to the artificial canon, as to that of the table of natural sines, &c. only observing that the artificial canon being logarithms, the first term of the proportion must be subtracted from the sum of the second and third terms, in order to obtain the fourth term, or answer. And the logarithm of radius in that canon is 10.

CASE I. In the right-angled triangle, ABC (Fig. 54) let there be given the hypotenuse AC=121 miles, and the angle BAC= $54^{\circ} 30'$; to find the legs AB and BC. By the first theorem, the hypotenuse being made radius, we shall have, as under.

As radius	-	-	-	-	log. 10.000000
Is to AC (121 miles)	-	-	-	-	2.082785
So is sine of angle BAC ($54^{\circ} 30'$)	-	-	-	-	9.010686
To log. of BC=98.51 miles	-	-	-	-	1.993471

As radius	-	-	-	-	10.000000
Is to AC (121)	-	-	-	-	2.082785
So is cosine A ($54^{\circ} 30'$)	-	-	-	-	9.763954
To AB=70.26 miles	-	-	-	-	1.840739

In the first of these proportions, BC, which is sought, is by the first lemma the sine of the angle A, and therefore the sine of the angle A, must be the third term: In the second proportion where AB is sought, the third term of the proportion is the cosine of the angle A (or, which would have been the sine of the angle C) for AB by the said lemma denotes the sine of angle C, or cosine of angle A, seeing that the angles A and C are complements to one another. The proportions are wrought according to the artificial canon, by subtracting radius or 10, from the sum of the second and third terms; and by looking in the table for the number answering to the logarithm so obtained.

CASE II. There being given the angle ABC= $35^{\circ} 30'$; and the leg BC=to 98.5 miles: to find the hypotenuse and the leg AB. Here the given side BC being the radius, we have this proportion for finding AC, viz. as radius is to BC (98.5) so is the secant of the angle C ($35^{\circ} 30'$) to AC, which, wrought out as before, will be found equal to 121. In finding AB; the tangent of the angle C must be the third term of the proportion; for AB denotes such tangent.

CASE

TRIGONOMETRY.

CASE III. The hypotenuse $AC=121$ and the leg $AB=70$ being given to find the angles A and C , and the other leg BC . Here either of the given sides may be made radius. Suppose AC . Then we shall have this proportion by the second theorem. As side AC (121) is to radius, so is the leg AB (70) to the sine of angle $C=35^{\circ} 30'$: or, which is the same, to the cosine of angle $A=54^{\circ} 30'$. The acute angles being thus known; the other leg BC will be found by theorem 1, as in case 1.

CASE IV. The legs AB and BC being given, $=98$ and 70 respectively to find the hypotenuse, and the acute angles. Here either of the given legs may be made radius; suppose AB radius.

Then by theorem 2, we have this proportion. As AB is to radius, so is BC to the tangent of the angle A ; the angles being found, AC will be found thus, by theorem 1. (continuing AB radius) as radius is to AB , so is secant of angle A to the hypotenuse AC , which the reader may work at his leisure; it is sufficient for us to shew in what manner the operations are wrought.

OBLIQUE ANGLED PLANE TRIANGLES.

The solution of the several cases of oblique angled plane triangles depends on the following theorems.

THEOREM I. In any plane triangle the sides are proportional to the sines of the opposite angles, viz. as any one side is to the sine of its opposite angle, so is any other side to the sine of its opposite angle, and vice versa.

THEOREM II. In any plane triangle, as the sum of any two sides is to their difference, so is the co-tangent of half the included angle, to the tangent of half the difference of the other two; then this half difference added to half the supplement of the included angle, gives the greater of the other two angles: but subtracted therefrom gives the less. Also the greater angle is opposite the greater side, and the less angle is opposite the less side.

THEOREM III. In any plane triangle, having let fall a perpendicular upon the greatest side, or base from its opposite angle, dividing the base into two segments, and the whole triangle into two right-angled triangles, it will be, as the base or sum of the segments is to the sum of the other two sides, so is the difference of these sides to the difference of the segments of the base. The half of this difference added to half the base gives the greater segment; but subtracted therefrom gives the less. Also the greater segment of the base is adjoining to the greater of the two other sides; and the less segment is adjoining to the less of them.

By the first of the above theorems, when two sides and an angle opposite to one of them is given, the angle opposite to the other may be found; or when two angles, and a side opposite to one of them is given, the side opposite to the other angle may be found. When a side is to be found, the proportion must begin with the angle opposite the given side; and when an angle is to be found, the proportion must begin with the side opposite the given angle.

By the second theorem, when two sides and an included angle is given, the other angles may be found.

And by the third theorem, when the three sides are given, the angles may be found, which theorems are sufficient for resolving all the common cases of oblique plane triangles. The theorems being universally known, we think it unnecessary to demonstrate them. But we shall illustrate them by the following cases.

CASE I. In the triangle, ABC (Fig. 55) let there be given the angles $CAB=31^{\circ} 07'$, the angle $ABC=115^{\circ} 24'$, and the side BC opposite to the former angle $CAB=97$ feet, to find the sides AC and AB . 1st. To find AC , we have by the first axiom this proportion, as the sine of the angle $CAB:BC::$ sine of the angle $CBA:AC$. The proportion wrought by logarithms is as under.

As sine of angle A ($31^{\circ} 37'$)	-	-	-	log. 9.7133077
Is to BC (97)				1.9867717
So is sine angle B ($115^{\circ} 24'$)	-	-	-	9.9558490
				11.9426207
To $AC=169.6$ feet				2.2293130

Since two of the angles are given, the refore the other angle ACB is also given, it being the supplement of the other two to 180° ; to wit, $33^{\circ} 29'$; and therefore AB will be found by this proportion, viz. as sine of angle CAB ($31^{\circ} 07'$) is to BC (97) so is sine of angle ACB ($33^{\circ} 29'$) to $AB=103.6$; the operation of which being similar to the former we shall not insist on.

CASE II. Given $AC=169.6$, and $BC=97$; also the angle CAB opposite to the latter $=31^{\circ} 07'$ to find the angles ACB, ABC , and the side AB . Here we have these proportions, viz.

By theorem 1. As 97 (BC); sine $31^{\circ} 07'$ (angle A) :: 169.6 (AC); sine of angle B ; which, as CB is less than AC , will be greater than the angle A , but may be either acute or obtuse, viz. it may be either $64^{\circ} 36'$, or the supplement thereof $115^{\circ} 24'$. When the given angle is obtuse, or when its opposite side is greater than the other side, then the angle sought is acute: otherwise it is doubtful, as in this case. But if it is known that the side which is not given is longer than either of the others, then the angle sought is acute: but if the side adjacent to the given angle be the longest, then the angle found as above is obtuse; but if the side opposite the given angle be the longest, it is acute: supposing therefore in this case, that the side adjacent to the given angle is the longest, then the angle B will be $115^{\circ} 24'$: this added to the other angle $51^{\circ} 07'$ makes

$146^{\circ} 31'$ which subtracted from 180° leaves the other angle $C=33^{\circ} 29'$: then the side AB will be found $=103.6$, as shewn in the first case.

CASE III. Given $AB=103.6$, $BC=97$, and $AC=169.6$ to find the angles.

1st. Let a perpendicular be let fall from angle C upon AB , as directed in theorem 3: then, by the said theorem, we shall have this proportion; as AC (169.6) is to $AB+BC$ ($=200.6$) so is $AB-BC$ (6.6) to $AD-DE$ ($=7.8$) = the difference of the segments of the base: then half this difference (3.9) added to half the base (84.8) = the greater segment $AD=88.7$; but subtracted therefrom gives the less segment $DE=80.9$; then in the right-angled triangle ADB , there is given the hypotenuse $AB=103.9$, and the leg $AD=88.7$ to find the angle BAD ; for which, by theorem 2. of right-angled triangles, and making AD radius, we have this proportion, viz. as AD (88.7) is to radius, so is AB (103.6) to secant of angle BAD or $BAC=31^{\circ} 07'$. And in the right-angled triangle BDC , there is given the hypotenuse $BC=97$, and the leg $DC=80.9$; to find the angle BCD or BCA ; and by making DC radius, we have this proportion: as BC (80.9) is to radius, so is BC (97) to the secant of angle BCD or $BCA=33^{\circ} 29'$: then adding the angles at A and C together, and subtracting the sum from 180° , there remains $115^{\circ} 24'$ for the angle ABC .

The operations of plain trigonometry may be also performed by actually drawing the triangles according to the rules of plane geometry, from a proper scale of equal parts, and a scale of chords, and then measuring the sides which you want to find, on the same scale of equal parts that the given side or sides were drawn from: and, in like manner, the angles that you want to find must be measured from the same line of chords that was used in drawing the triangle. This will be easy to those who have a thorough knowledge of geometry; to the system of which we refer our readers.

Also, all the cases in trigonometry may be solved by Gunter's Scale; which is nothing but a scale, or rather scales, of logarithmic lines, tangents, &c. The method of using it is by extending a pair of compasses from the first term of the proportion on the proper line or scale to which it belongs, to the second or third term of the proportion, according as either of them shall happen to be of the same kind or denomination with the first: then that extent applied the same way from the other term, on its proper line or scale, will reach to the fourth term or answer.

THE METHOD OF APPLYING PLANE TRIGONOMETRY TO ALTIMETRY AND LONGIMETRY.

DEFINITIONS.

1st. Altimetry is the art of determining the height of an object by means of an angle or angles of altitude taken with a quadrant or other instrument, and some certain measured distance or distances on the ground corresponding therewith.

2d. Longimetry is the art of determining the distance of a remote object by means of certain measured distances on the ground, and the angles or bearings which the object makes at the different stations you measured from.

Thus in altimetry. Suppose it were required to find the height of an obelisk, or other object, as AB (Fig. 56) and suppose you take an angle of altitude ADC at the point D ; then if you can measure from D to the foot of the spire, you will have one leg CD of a right-angled triangle, and the angle B given, to find the other leg AC ; and making CD radius, the proportion will be, as radius is to the distance CD , so is the tangent of the angle of altitude taken at D to the height AC ; to which add the height of the instrument at D above the foot of the obelisk at B , and you will have the whole height of the spire AB . The height of the instrument may be ascertained by means of a spirit level, or other contrivance used by surveyors. But if the object is inaccessible, then measure only the accessible part FD , and take angles of altitude at F , and D . Then the supplement of the altitude at F , will give the angle AFD . Wherefore you will have the angles AFD and ADF of the oblique triangle AFD , and also the side FD , to find either of the sides AF or AD , which may be performed by theorem 1, of oblique plane trigonometry. For two of the angles being known, the other is known also, being their supplement to 180° . This done, there will be the hypotenuse AF or FD , with the corresponding angle AFC , or ADC , to find the leg AC ; which found, add to it the height of the instrument as before, and you will have the whole height AB .

In longimetry, the bearings or angles which objects make with one another are taken by proper instruments, and as many contiguous lines are measured as are found necessary, so as to form complete triangles, of which the objects, whose distances you want to find, are so many angular points, and taking care to have either two angles and a side, or two sides and an angle given: and then the required sides will be found according to the respective theorems already given in the system. The whole of which is so easily understood, that it will be only taking up space and time, to no valuable purpose, to enter farther into it.

SPHERICAL TRIGONOMETRY.

NATURE AND PROPERTIES OF SPHERICAL TRIANGLES.

1. Every side of a spheric triangle, is an arc of a great circle, and is less than a semicircle. 2. Every great circle divides the sphere or globe into two equal parts, called hemispheres. 3. Any two great circles cutting each other, make the angles which are opposite

TRIGONOMETRY.

fit and contrary, equal to each other. 4. The sum of any two sides of a spheric triangle is greater than the third side. 5. The sum of the three sides of a spheric triangle is less than 360 degrees, and the sum of the three angles is less than 540 degrees, but more than 180 degrees. 6. The sum of any two sides is less than the difference between the third side and 180 degrees. 7. The sum of any two angles is more than the difference between the third side and 180 degrees. 8. In any rectangular spheric triangle, the legs and their opposite angles, are of the same affection; that is, if a leg be more or less than a quadrant, its opposite angle is likewise more or less than a right angle. 9. In a rectangular spheric triangle, if one leg be a quadrant, the hypotenuse will be a quadrant, but if both legs be of the same affection, viz. both either more or less than 90 degrees, the hypotenuse will be less than a quadrant; if of different affections, viz. one more and the other less than 90 degrees, it is more. 10. If the hypotenuse be less than 90 degrees, one leg and its opposite angle will be less than 90 degrees, but the other leg and its opposite angle may be either less or more. 11. In every spheric triangle the greatest sides are opposite to the greatest angles. 12. In every oblique spheric triangle, if two acute angles be equal, their opposite sides will be equal, and less than quadrants. Also the opposite sides of equal obtuse angles are equal, and greater than quadrants. 13. If two acute angles are unequal, the side opposite to the less angle will be less than a quadrant. If two obtuse angles are unequal, the side opposite the greater angle will be more than a quadrant. 14. If all the angles be acute, each side will be less than a quadrant.

SOLUTION OF THE DIFFERENT CASES OF RECTANGULAR, SPHERIC TRIANGLES, ACCORDING TO LORD NAPIER'S PROPOSITION.

1st. It must be observed that in a rectangular spheric triangle, there are, besides the right angle, 5 things; to which Lord Napier gave the name of the 5 circular parts; that is, the three sides, and the two acute angles, and, the right angle not being reckoned or taken into the account, the two legs are supposed to be adjoining parts.

2. Any one of these five parts may be made a middle part, and then the two circular parts, which are next to such middle part, are named the extremes conjunct, and the other two circular parts, remote from the middle part, are called the extremes disjunct.

3. In every case two of the aforesaid circular parts are always given; from which a third is to be found. One of these three parts must be a middle part; and it must be so ordered that the other two parts must be both of the same name, viz. both extremes conjunct, or extremes disjunct.

This being premised, observe this general theorem, viz. the sine of the middle part and radius are reciprocally proportional with the tangents of the extremes conjunct, and with the fine complements of the extremes disjunct; that is, 1st, When the middle part is sought, then it will be, when the extremes are conjunct, as radius is to the tangent of one extreme, so is the tangent of the other to the sine of the middle part; but when the extremes are disjunct, this is the proportion; as radius is to the fine complement of one extreme, so is the fine complement of the other to the sine of the middle part.

2. When either of the extremes are sought, then if the extremes are conjunct, use the following proportion, viz. As the tangent of one given extreme is to radius, so is the sine of the middle part, to tangent of the required extreme; but if the extremes are disjunct, then this is the proportion, as the fine complement of the given extreme is to radius, so is the sine of the middle part to the fine complement of the required extreme.

EXCEPTIONS TO THE FOREGOING PROPORTIONS.

1. If the middle part, or either of the extremes conjunct, be the hypotenuse, or either of the oblique angles, then instead of sine, and of tangent, you must use fine complement, and tangent complement. 2. If either of the extremes disjunct, be the hypotenuse or either of the oblique angles, then instead of fine complement, you must use the sine.

TABLE

OF ALL THE VARIETIES OF EXTREMES, CONJUNCT AND DISJUNCT. (See Plate Miscellaneous Mathematics, fig. 57.)

Number	Middle Part	Extr. Conjunct	Extr. Disjunct
1	Sine AB	Tang. BC Tang. c. BAC	Sine ACB Sine AC
2	Sine c. BAC	Tang. c. AC Tang. AB	Sine c. BC Sine ACB
3	Sine c. AC	Tang. c. BAC Tang. c. ACB	Sine c. BC Sine c. AB
4	Sine c. ACB	Tang. c. AC Tang. BC	Sine BAC Sine AB
5	Sine BC	Tang. AB Tang. c. ACB	Sine BAC Sine AC

CASE I. In the rectangular spheric triangle ABC, there is given the hypotenuse AC $54^{\circ} 25'$, and the leg BC $23^{\circ} 29'$: required the angles ACB, BAC, and the side AB.

Here the angle ACB (which is to be found) must be the middle part, and then the given sides AC and BC will be extremes con-

junct, consequently to find the angle ACB, the proportion will be as radius is to the tangent of the given leg BC ($23^{\circ} 29'$) so is the tangent complement of the hypotenuse AC ($54^{\circ} 25'$) to the fine complement of the adjacent angle ACB, which by actually working the proportion will be found to be $71^{\circ} 53'$.

Then to find the angle BAC opposite to the given leg, the proportion is thus; BC in this case, being the middle part, and AC and the angle BAC, being extremes disjunct; as the sine of the hypotenuse AC ($54^{\circ} 25'$) is to radius, so is the sine of the given leg BC ($23^{\circ} 29'$) to the sine of the angle BAC $29^{\circ} 20'$.

Also for the leg AB we have this proportion; AC, being the middle part, and BC and AB extremes disjunct; as the fine complement of the given leg BC ($23^{\circ} 29'$) is to radius, so is the fine complement of the hypotenuse AC ($50^{\circ} 25'$) to the fine complement of the leg AB $= 50^{\circ} 37'$.

CASE II. In the rectangular spheric triangle ABC, (fig. 57) there is given the hypotenuse AC $= (54^{\circ} 25')$, and the angle BAC $= (29^{\circ} 20')$ to find the legs BC and AB: and the angle ACB.

1. For the leg BC; BC being the middle part, and BAC and AC disjuncts; as radius is to the sine of the hypotenuse, AC $54^{\circ} 25'$ so is the sine of the given angle BAC, ($29^{\circ} 20'$) to the sine of the leg BC $23^{\circ} 29'$. 2. For the leg AB, BAC being the middle part, and AC and AB the conjunct extremes; as the tangent complement of the hypotenuse AC ($54^{\circ} 25'$) is to radius, so is the fine complement BAC ($23^{\circ} 20'$) to the tangent of the adjacent leg AB $= 50^{\circ} 37'$. 3. For the angle ACB, AC being the middle part; and BAC and ACB extremes conjunct; as the tangent complement of the given angle BAC ($29^{\circ} 20'$) is to radius, so is the fine complement of the hypotenuse AC ($54^{\circ} 25'$) to the tangent complement of the other angle ACB $= 71^{\circ} 53'$.

CASE III. In the rectangular triangle ABC, (right angled at B) there is given the leg AB $= 50^{\circ} 37'$; and the angle BAC $= 29^{\circ} 20'$; to find the leg BC, the angle ACB, and the hypotenuse AC;

1. For the leg BC; AB being the middle part. As the tangent complement of the given angle BAC, ($29^{\circ} 20'$) is to radius, so is the sine of its adjacent leg AB ($50^{\circ} 37'$) to the tangent of its opposite leg BC $= 23^{\circ} 29'$. 2. For the angle ACB; ACB being the middle part. As radius is to the fine complement of the given leg AB ($50^{\circ} 37'$) so is the sine of its adjacent angle to the fine complement of its opposite angle ACB $71^{\circ} 53'$. 3. For the hypotenuse AC, it is, as the tangent of the given leg AB, ($50^{\circ} 37'$) is to radius, so is the fine complement of its adjacent angle BAC, ($29^{\circ} 20'$) to the tangent complement of the required hypotenuse AC $= 54^{\circ} 25'$.

CASE IV. In the rectangular spheric triangle ABC, there is given the leg BC $= 23^{\circ} 29'$; and the angle BAC $= 29^{\circ} 20'$, to find the leg AB, the angle ACB, and the hypotenuse AC.

1. For the leg AB. As radius is to the tangent of the given leg BC, ($23^{\circ} 29'$) so is the tangent complement of the angle BAC ($29^{\circ} 20'$) to the sine of the leg AB $50^{\circ} 37'$. 2. For the angle ACB. As the fine complement of the given leg, $23^{\circ} 29'$ is to radius; so is the fine complement of its opposite angle BAC ($29^{\circ} 20'$) to the sine of its adjacent angle ACB $71^{\circ} 53'$. 3. For the hypotenuse AC. As the fine complement of the given angle is to radius, so is the sine of its opposite leg, to the sine of the hypotenuse required $= 54^{\circ} 25'$.

CASE V. Suppose AB and BC are given to find the angles BAC, ACB, and the hypotenuse AC. The proportions will be as under. As radius is to sine of leg AB, so is tangent complement of leg BC to tangent complement of angle BAC: and, as radius is to sine of leg BC, so is tangent complement of leg AB to tangent complement of angle ACB: also as radius is to fine complement of leg AB, so is fine complement of leg BC, to fine complement of the hypotenuse AC.

CASE VI. Let there be given the angle BAC, and the angle ACB: to find the three sides.

We shall have the following proportions. As sine of angle A is to radius; so is the fine complement of angle C, to the fine complement of leg AB; and as sine of angle C is to radius, so is the fine complement of angle A to the leg BC; also, as radius is to tangent complement of one angle, so is the tangent complement of the other angle to the sine of the hypotenuse.

Note. In the solutions of all spheric triangles, particular attention must be paid to the properties and affections already mentioned, in order to determine whether the sides or angles be more or less than quadrants, if the data and knowledge of the question does not clear this point, which is generally the case.

SOLUTION OF OBLIQUE ANGLED SPHERIC TRIANGLES.

AXIOMS.

In all spheric triangles whatever, the sines of the sides are proportional to the sines of their opposite angles, viz. as the sine of any one side is to the sine of its opposite angle, so is the sine of any other side to the sine of its opposite angle; and as the sine of any one angle is to its opposite side; so is the sine of any other angle to its opposite side.

2. As the sine of half the sum of two sides (containing an angle) is to the sine of half their difference, so is the tangent complement of half the contained angle, to the tangent of half the difference of the other two angles: also as the fine complement of half the sum

TRIGONOMETRY.

of two sides is to the sine complement of half their contained angle, so is the tangent complement of half their contained angle to the tangent of half the sum of the other two angles. The half difference added to the half sum gives the greater of the said angles, but subtracted therefrom, gives the less. Also the greater angle is opposite the greater of the given sides, and the contrary: also this axiom is equally true when reversed or taken backwards.

3d. As the sine of half the sum of two angles is to the sine of half their difference, so is the tangent of half their interjacent side to the tangent of half the difference of the other two sides: also as the sine complement of half the sum of two angles is to the sine complement of half their difference, so is the tangent of half the interjacent side to the tangent of half the sum of the other two sides; the half difference added to the half sum, gives the greatest side, but subtracted from it gives the less; this axiom is also used reversed.

4th. As the rectangle of the sines of the two containing sides is to the square of radius, so is the rectangle of the sine of the half sum of the three sides, and of the sine of the difference between the said half sum and the side opposite the angle to the square of the sine complement of half the contained angle sought.

CASE I. In the oblique spheric triangle, ACD, fig. 58, let there be given the side $ACD = 34^\circ 7'$; the side $AD = 65^\circ 20'$, and the angle $ADC = 27^\circ 30'$ to find the angles ACD and CAD, and the side CD. By the first axiom we have, as sine of the side $AC = 34^\circ 7'$ is to the sine of the angle $ADC (27^\circ 30')$ so is the sine of side $AD (65^\circ 20')$ to the sine of the angle ACD , $48^\circ 25'$, which, being subtracted from 180° , leaves $131^\circ 35'$ for the same angle ACD, when it is required to be obtuse: but when the side opposite the given angle is less than the other given side, as in this case, the angle opposite the said other given side will be ambiguous or doubtful, unless there be something else in the nature of the question from whence it can be determined. For the contained angle CAD, the proportion by axiom 2, reversed, is thus; as the sine of half the difference of the sides AD and AC ($15^\circ 36'$) is to the sine of half their sum ($49^\circ 43'$) so is the tangent of half the difference of the angles ACD and $ADC = 52^\circ 2'$ (ACD being obtuse) to the tangent complement of half the angle CAD ($15^\circ 23'$); which doubled, gives $30^\circ 46'$, the angle CAD required. Also for the third side CD, we have, by axiom 3, reversed, this proportion: as sine of half the difference of the angles ACD and $ADC (52^\circ 2')$ is to the sine of half their sum ($79^\circ 32'$) so is the tangent of half the difference of the sides AD and AC ($15^\circ 36'$) to the tangent of half the side $CD = 19^\circ 12'$, which doubled, gives $CD = 38^\circ 24'$.

CASE II. Let there be given the angle CAD (preceding figure) $= 30^\circ 48'$; the angle $ADC = 27^\circ 30'$; and the side $CD = 38^\circ 28'$: to find the side AC, when less than 90° , the side AD, and angle ACD.

By Axiom I. As sine $\angle CAD (30^\circ 48')$: sine $CD (38^\circ 28')$:: sine $\angle ADC (27^\circ 30')$: sine $AC = 34^\circ 7'$.—Second, by Axiom III. (reversed) as sine of $\frac{1}{2}$ difference of $\angle$'s CAD and $ADC (1^\circ 39')$: sine of $\frac{1}{2}$ their sum ($29^\circ 9'$): tangent of $\frac{1}{2}$ difference of sides CD and AC ($2^\circ 10'$): tangent of $\frac{1}{2}$ side $AD = 32^\circ 37'$, which doubled, gives $AD = 65^\circ 14'$.—Third, by Axiom II. reversed. As sine of $\frac{1}{2}$ difference of sides CD and AC ($2^\circ 10'$): sine $\frac{1}{2}$ their sum ($36^\circ 17'$): tangent of half the difference of angles CAD and $ADC (1^\circ 39')$: tangent complement of $\frac{1}{2}$ the angle ACD $65^\circ 44'$, which doubled, gives $131^\circ 28'$, the angle ACD required.

In the preceding cases, the three given terms without the quality of a fourth, are not sufficient; and the quality of the fourth is not always discoverable by the given terms; therefore they are called doubtful cases, but such doubts may often be removed by delineating the triangle according to the principles of stereographic projection treated of in the System of Astronomy, Sect. IX.

CASE III. Let the sides AC and AD, and the angle CAD be given to find the angles ACD and ADC, and the side CD.

1st. By axiom 2d, as sine $\frac{1}{2}$ sum AD and AC: sine of half their difference:: tangent complement $\frac{1}{2} \angle CAD$: tangent of $\frac{1}{2}$ the difference of the remaining angles: and as sine complement of half sum of AD and AC: sine complement of $\frac{1}{2}$ their difference:: tangent complement $\frac{1}{2} CAD$: tangent of $\frac{1}{2}$ sum of the remaining angles, the above $\frac{1}{2}$ difference added to the $\frac{1}{2}$ sum gives the greater angle ACD, but subtracted therefrom gives the less angle $27^\circ 20'$.

N. B. If the sum of the two containing sides exceeds 180° , then subtract each side from 180° and proceed with those remainders as with the given sides, and the proportion will produce the supplement of the required angle. The third side CD may be found by axiom 1; but CD may be found first, without finding the angles, thus: say, as radius is to the sine complement of the contained angle, so is the tangent of the less given side to a fourth arc; then if the contained angle be acute, subtract the fourth arc from the greater given side; but when it is obtuse from the supplement thereof, call the remainder the fifth arc. Then as the sine complement of the 4th arc is to the sine complement of the 5th arc, so is the sine complement of the less given side, to the sine complement of the side required.

Note. When the contained angle and the fifth arc are each more or less than 90° , the side sought is less than a quadrant; but when one is more and the other less than 90° the side sought is more than a quadrant.

CASE IV. When the angle ACD; angle ADC and sides CD are given, to find the sides AC and AD and the angle CAD.

1. By axiom 3. As $\frac{1}{2}$ sum of the angles ACD and ADC: sine of $\frac{1}{2}$ their difference:: tangent $\frac{1}{2}$ side CD: tangent $\frac{1}{2}$ difference of the remaining sides: and as sine complement $\frac{1}{2}$ sum of angles ACD and ADC: sine complement $\frac{1}{2}$ their difference:: tangent $\frac{1}{2}$ CD: tangent of $\frac{1}{2}$ sum of remaining sides: the sum of these gives the greater side AD; but their difference, gives the less side AC. Note, If the sum of the two given angles exceed 180° , then subtract each given angle from 180° , and proceed with the remainders as with the given angles, and you will obtain the supplement of the required side. The angle CAD will then be found by the first axiom, or it may be had without finding the sides, thus; as radius is to the sine complement of the interjacent side, so is the tangent of the less given angle to the tangent of a fourth arc; now if the interjacent side be more than a quadrant, subtract the fourth arc from the greater given angle, but when it is less from the supplement thereof, and the remainder is the 5th arc; then as the sine complement of the 4th arc, is to the sine complement of 5th arc, so is the sine complement of the less given angle, to the sine complement of the required angle. Note, when the adjacent side and 5th arc are each more or less than 90° , the angle sought is acute; but when one is more and the other less it is obtuse.

CASE V. The three sides AD, CD, and AD, being supposed given to find the three angles. This case is performed by the 4th axiom: which axiom by logarithms is as follows.

1. Add the three sides together, and from their half sum subtract the side opposite the required angle, nothing the remainder.

2. To the complement of arithmetic of the logarithm sines of the containing sides, add the logarithm sines of the half sum, and the remainder; half the total of these four logarithms, is logarithm sine of half the required angles supplement to 180° .

Note. If either of the containing sides, or the half sum exceed 90° , then the sine, or sine complement, arithmetic, must be taken of the supplement to 180° . N. B. The complement arithmetic of any logarithm is what it wants of 10,000000.

CASE VI. The angles given to find the sides. This is performed in the same manner as the last, putting angles for sides, and sides for angles.

Having gone through all the ordinary cases in plain and spherical trigonometry, we shall conclude the treatise with some other useful theorems relative to spherical triangles, and which are not so commonly known.

THEOREM I. If from the versed sine of the sum of two given sides, containing a given angle, there be subtracted the versed sine of their difference, and if half the remainder be multiplied by the versed sine of the given angle, and the product be added to the versed sine of the difference of the sides, the sum will be the versed sine of the third side.

THEOREM II. If from the versed sine of the side opposite to the angle sought (all the sides being given) there be subtracted the versed sine of the difference of the other two sides, and the remainder be divided by the excess of the versed sine of the sum of the two sides, (including the required angle) above the versed sine of their difference, the quotient will be double the versed sine of the required angle. N. B. There is no ambiguity in the two last theorems.

THEOREM III. If two sides and their contained angle be given, multiply together the sine of the side opposite to the required angle, the cosine of that adjacent thereto, and the versed sine of the known angle. Then when the side adjacent to the given angle is acute, add this product to the sine of the difference; but when obtuse, take the difference between this product, and the sine of the difference of the known sides: and divide this sum or difference by the rectangle, under the sines of the given angle, and of the sine opposite to that required; so will the quotient be the cotangent of the angle sought.

THEOREM IV. In any spheric triangle, where there are three angles given to find a side, multiply together the cosines of the angles adjacent to the required side; then if these two angles are of like affection, and the third angle acute; or if, of unlike affection and the third obtuse, add to this product the cosine of the third angle; but if the said two adjacent angles be of the same affection, and the third angle obtuse; or if of different affections, and the third angle acute; take the difference between the said product and the cosine of the third angle: so will the sum or difference (as the case shall be) divided by the product of the sines of the adjacent angles, give the cosine of the required side.

THEOREM V. Useful in finding a side, having two sides and the included angle given. Add the log. sines of the two sides, and the log. cosine of the included angle together; and find the natural number of the sum. Also add the log. cosines of the sides together, and find the natural number of the sum. Then the sum of these two natural numbers will be the natural cosine of the side sought.

THEOREM VI. As 90° is to the angle intercepted between two great circles, so is the area of one whole great circle of the sphere to the lunular area, between the great circles.

THEOREM VII. In any spheric triangle, as 180° is to the excess of the three angles above two right angles, so is the area of a great circle of the sphere, (constituting the triangle) to the area of the triangle. For the application of spherical trigonometry, see the Problems of the sphere in the System of Astronomy.

TRI

TRIGYNIA, in Botany, the third order in the first thirteen classes in the sexual System of Linnæus. See the System, Sect. III. and Plate 4 and 5.

TRINGA, the **SANDPIPER**, in Ornithology, a genus of birds, belonging to the order of gallæ. The beak is somewhat cylindrical, and as long as the head; the nostrils are linear; there are four toes on the feet, the hind one consisting of one joint, and elevated above the ground. The most remarkable species are the two following.

1. The *vanellus*, or lapwing, inhabits most of the heaths and marshy grounds of the island. The bill is black, the crown of the head of a shining blackness; the crest of the same colour. The lapwing lays four eggs, making a slight nest with a few bents. The eggs have an olive cast, and are spotted with black. The young, as soon as hatched, run like chickens; the parents shew remarkable solicitude for them, flying with great anxiety and clamour near them, striking at either man or dogs that approach, and often flutter along the ground like a wounded bird to a considerable distance from their nest, to delude their pursuers; and to aid the deceit, become more clamorous when most remote from it. In winter, lapwings join in vast flocks; but at that season are very wild: their flesh is very good, their food being insects and worms. During October and November, they are taken in the fens in nets, in the same manner that ruffs are; but are not preferred for fattening, being killed as soon as caught. 2. The *squatarola*, or grey sandpiper, is in length 12 inches; in breadth 24: the bill black, about an inch long, strong and thick; the head, black, and coverts of the wings are black, edged with greenish ash-colour and some white; cheeks and throat white; marked with oblong dusky spots; the belly and thighs white; the exterior webs of the quill feathers black, the lower parts of the interior webs of the four first white; the rump white: the tail marked with transverse bars of black and white; the legs of a dirty green; the back too very small. These appear in small flocks in the winter-time, but are not very common; their flesh is very delicate. For representation, see Plate IV. Genus 69.

TRINITARIANS, a term used very variously, and arbitrarily: frequently it stands as a common name for all persons who have sentiments on the mystery of the Trinity, different from those of the catholic church. Sometimes it is more immediately restrained to some one or other particular class of such persons. It is now applied in contradistinction to the others who are then called Antitrinitarians, who deny and impugn the doctrine of the Trinity. Thus the Socinians and others called the Athanasians Trinitarians. The Trinitarians of the present age, and especially those, who, in England, have written on the subject of the Trinity, are far from being agreed in their opinion, and therefore ought to be classed very differently from one another. A late writer (Priestley's Hist. Corrupt. of Christianity, vol. i. p. 147.) thinks that they are all reducible to two classes, viz. that of those who believe, that there is no proper divinity in Christ, besides that of the Father; and the class of Trinitheists, who maintain that there are three equal and distinct Gods. Dr. Waterland and the rest of the Athanasians assert three proper distinct persons, entirely equal to and dependent upon each other, yet making up one and the same being. Mr. Howe (Works, vol. ii. p. 560—568) seems to suppose that there are three distinct eternal spirits, or distinct intelligent hypostases; each having his own distinct, singular, intelligent nature, united in such an inexplicable manner, as that upon account of their perfect harmony, consent and affection, to which he adds their natural self-consciousness, they may be called the one God, as properly as the different corporeal, sensitive, and intellectual natures united may be called one man. Bishop Pearson (on the Creed, p. 134, &c. 322, &c.) Bishop Bull (Serm. vol. iv. p. 829,) and Dr. Owen (on the Heb. i. 3. p. 53, &c.) are of opinion, that though God the Father is the fountain of the Deity, the whole divine nature is communicated from the Father to the Son, and from both to the Spirit; yet so as that the Father and Son are not separate, or separable from the divinity, but do still exist in it, and are most intimately united to it. Dr. Thomas Burnet (Script. Doctr. p. 173.) maintains one self-existent and two dependant beings; but asserts, that the two latter are so united to and inhabited by the former, that by virtue of that union, divine perfections may be ascribed and divine worship paid to them. In this opinion Dr. Doddridge is said to have concurred. Dr. Wallis (Lett. on the Trin.) thought, that the distinction between the three persons was only modal; which seems, says Dr. Doddridge, to have been the opinion of archbishop Tillotson. Tillotson, Serm. vol. i. p. 492—494. Dr. Watts (Diff. No. 7.) maintained one supreme God dwelling in the human nature of Christ, which he supposes to have existed the first of all creatures; and speaks of the divine Logos, as the wisdom of God, and the Holy Spirit, as the divine power, or the influence and effect of it; which he says, is a scriptural person, i. e. spoken of figuratively in scripture under personal characters. Doddridge's Lectures, p. 402, &c.

TRINITY, **TRINITAS**, **TRIAS**, **TRIAD**, in Theology, the ineffable mystery of three persons in one God, Father, Son, and Holy Spirit. It is an article in some systems of theology, that there is one God, an unity in nature and essence, and a Trinity of persons: the term Trinity implies the unity of three divine persons really different, and the identity of an indivisible nature: the Trinity is a ternary of divine persons of the same essence, na-

TRO

ture, and substance. Person is defined an individual, reasonable, or intellectual substance; or an intellectual and incommunicable substance: the hypostasis, or substance, is what constitutes the person: there are then in the Holy Trinity three persons, Father, Son, and Holy Spirit, which have all things in common, except their relations: whence that axiom in theology comes to have place, in the divine persons there is no distinction where there is no opposition of relation: the Father is the first person in the Holy Trinity, by reason the Father alone produces the Word, by the way of *understanding*; and with the word produces the Holy Spirit, by way of *will*. Here is to be observed, that the Holy Spirit is not thus called from his spirituality, that being common and essential to all the three persons; but from the passive spiration (as some popish schoolmen express the manner in which the personality of the Holy Spirit is derived from the Father and Son,) which is peculiar to him alone. Add, that when one person in the Holy Trinity is called *first*, another *second*, and another *third*, it must not be understood of a priority of time, or of nature, which would imply some dependence; but of a priority of origin and emanation, which consists in this, that one person produces the other, in such a manner, as that the person which produces cannot be, or be conceived, without that produced. Those who maintain the doctrine of the Trinity alledge, that the same titles, attributes, works and worship, are ascribed by the sacred writers to the Father, Son, and Holy Spirit: nevertheless they contend, in different ways, for the proper unity of the divine nature. For the sentiments of some of the chief modern Trinitarians, see **TRINITARIANS**: and for the sentiments of others, who have rejected what has been usually denominated the orthodox doctrine of the Trinity, see **ARIANS**, **SOCINIANS**, and **UNITARIANS**. It is observed by Dr. Waterland, and many other writers, that the term Trinity first occurs in the works of Theophilus, bishop of Antioch, about the year 180. Theoph. ad Autolyc. lib. ii. cap. 14. p. 148, 150, ed. Wolfii. But at this time the words, persons and substance, were not in use; however, they were introduced on occasion of the disputes with Praxeas, Noëtus, and Sabellius, either by Clemens of Alexandria, or by Tertullian.

TRIPLICATE Ratio, is the ratio which cubes bear to each other. This ratio is to be distinguished from triple ratio, and may be thus conceived. In the geometrical proportionals 2, 4, 8, 16, 32, as the ratio of the first term (2) is to the third (8) duplicate of that of the first to the second, or of the second to the third; so the ratio of the first to the fourth is said to be triplicate of the ratio of the first to the second, or of that of the second to the third, or that of the third to the fourth, as being compounded of three equal ratios. See the System of GEOMETRY, Sect. I.

TRITHEISM, the opinion of the tritheists, or the heresy of believing three Gods. Tritheism consists in admitting not only of three persons in the Godhead; but of three substances, three essences, or hypostases, and indeed three Gods. Several people, out of fear of giving into Tritheism, have become Sabellians; and several others, to avoid Sabellianism, have commenced Tritheists; so delicate and subtle is the distinction. In the famous controversy between Dr. South and Dr. Sherlock, the first is judged to have run into Sabellianism, by a too rigorous asserting the unity of a Godhead, and the latter into Tritheism, by a too absolute maintaining the Trinity.

TROCHANTER, in Anatomy, a name given to two apophyses situate in the upper part of the thigh-bone. The largest which is above, is called the *great trochanter*; and the smaller, beneath, the *less trochanter*. See the System, Part I. Sect. IV. and Plate I. Art. 4. fig. 1. letters *b*; *c*.

TROCHILUS, the **HUMMING-BIRD**; a genus belonging to the order of picæ. There are 60 species; all of them remarkable for the beauty of their colours, and most of them for the smallness of their size, though some are eight or nine inches in length.—They are divided into two families, viz. those with crooked bills, and those with straight bills. Of these we shall describe the three following species, from Mr. Latham's Synopsis of birds.

1. The little humming-bird has a crooked bill, is an inch and an half in length; frequently weighing less than 50 grains. The bill is black, and half an inch in length; the body greenish-brown, with a red shining inimitable gloss; the head is crested with a small tuft, green at bottom, but with a sparkling gold-colour at top: quills and tail fine black. It is a native of Guiana; and the velocity of it in flying is so great, that the eye can scarce keep pace with its motion. 2. The molchitus, or ruby-necked humming-bird, according to Maregrave, is the most beautiful of the whole genus. Its length is three inches four lines; the bill straight. This species is found in Brasil, Curassoa, Guiana, and Surinam. 3. The minimus, or least humming-bird, is exceeded, both in weight and dimensions, by several species of bees. The total length is one inch and a quarter; and when killed, weighs no more, according to Sir Hans Sloane, than 20 grains. The bill is straight and black, three lines and a half in length; the upper parts of the head and body are of a greenish gilded brown, in some lights appearing reddish; the under parts are of a greyish white; the wings are violet-brown; the tail of a blueish black, with a gloss of polished metal; but the outer feather, except one on each side, is grey from the middle to the tip, and the outer one wholly grey; legs and claws brown. The female is less than the male; the whole upper side of a dirty brown, with a slight

flight glofs of green; the under parts of a dirty white. These birds are found in various parts of South America and the adjacent islands. Our author received it from Jamaica. These birds subsist on the nectar or sweet juice of flowers; they frequent those most which have a long tube; particularly the *impatiens noli me tangere*, the *monarda* with crimson flowers, and those of the convolvulus tribe. They never settle on the flower during the action of extracting the juice, but flutter continually, like bees, moving their wings very quick, and making a humming noise; whence they are named. They are not very shy, suffering people to come within a foot or two of the place where they are, but on approaching nearer fly off like an arrow out of a bow. They often meet and fight for the right to a flower, and this all on the wing: they do not feed on insects nor fruit; nor can they be kept long in cages, though they have been preserved alive for several weeks together by feeding them with water by which sugar had been dissolved: they lay two eggs of the size of a pea, which are white, and not bigger at one end than the other. For representation of the male and female, see Plate II. Genus 29.

The above account of the manners will in general suit all the birds of this genus: for as their tongues are made for suction, it is by this method alone that they can gain nourishment; no wonder, therefore, they can scarcely be kept alive by human artifice. Captain Davies, however, informed our author, that he kept these birds alive for four months by the following method. He made an exact imitation of some of the tubular flowers with paper, fastened round a tobacco pipe, and painted them of a proper colour; these were placed in the order of nature, in the cage wherein these little creatures were confined; the bottoms of the tubes were filled with a mixture of brown sugar and water as often as emptied; and he had the pleasure of seeing them perform every action; for they soon grew familiar, and took the nourishment in the same manner as when ranging at large, though close under his eye.

TROCHUS, in Conchology, a genus of shells. For description and classification, see the System, Order III. Genus 27.

TROPE, in Rhetoric and Oratory, a word or expression used in a different sense from what it properly signifies. Or, a word changed from its proper and natural signification to another, with some advantage. For a description of the various tropes and their respective uses, see the Treatise on ORATORY, Part III. Sect. I. Art. III.

TROPICS, in Astronomy, two immoveable circles of the sphere, drawn through the solstitial points, parallel to the equator. See the System, Sect. IX. and Plate VI.

TROPIC Bird, in Ornithology, the English name of the Genus *phaeton*. See PHAETON. For representation, see Plate V. Genus 95.

TRUNCATED Leaf, in Botany. See the System, Sect. I. For representation, see Plate I.

TUBEROUS, or **TUBEROSE**, an epithet given to such roots as are round, and consist of an uniform fleshy substance, having neither skins nor shells, as bulbous roots have.

TUMEFACATION, the act of swelling, or rising into a tumor. Inflammations and tumefactions of the testes frequently happen in the gonorrhoea; either from the weakness of the vessels, violent motion, unseasonable use of astringents, a neglect of purging, or the like.

TUMOR, or **TUMOUR**, in Medicine, &c. a preternatural rising or eminence on any part of the body. Tumor is defined by the physicians, a solution of continuity, arising from some humour collected in a certain part of the body, which disjoins the continuous parts, insinuates itself between them, and destroys their proper form. When a tumor is resolved by induration, the swelling of the part, and pain, decrease as the hardness comes on. When it terminates in putrefaction or mortification, the part grows senseless, and turns black and fetid. See MORTIFICATION. But when a tumor goes off by repulsion, or a return of the matter into the blood, it disappears at once; upon which a fever or some other acute disease, usually ensues. See INFLAMMATION.

TUMORS of the Breasts, tumors and inflammations of the breasts are a disorder that very frequently afflicts child-bearing women, and almost constantly happens, in some degree, a few days after their delivery. For the method of treatment, see the System of MIDWIFERY, Part X. Sect. VI.

TUNICA, or **TUNIC**, in Anatomy, is applied to the membranes which invest the vessels, and divers others of the less solid parts of the body. The eye consists principally of a number of humours contained in tunics ranged over one another: as the *tunica albuginea*, the *tunica cornea*, the *tunica retiformis*, &c. See the System, Part VII. Sect. V. and Plate X. fig. 11. Letters A, B, C, D.

TURBO, the *screw-shell*, in Conchology. For description and classification, see the System, Order III. Genus 28.

TURBOT, in Ichthyology, a species of the genus *pleuronectes*. For description of the Genus, see PLEURONECTES.

TURDUS, the *THRUSH*; a Genus of birds belonging to the order of passerines. The bill is somewhat cylindrical and cultrated; the nostrils are naked; the fauces is ciliated; and the tongue is lacinated. There are 28 species, the most remarkable of which are,

1. The viscerivorous, or the mistle, the largest of the genus. Its length is 11 inches; its breadth 16½. The bill is shorter and thicker than that of other thrushes; and dusky; except the base of the

lower mandible which is yellow. Its song is very fine; which it begins very early in the spring, often with the new year, in blowing showery weather, which makes the inhabitants of Hampshire call it the *storm cock*. It feeds on insects, holly and mistletoe berries, which are the food of all the thrush kind: in severe snowy weather, when there is a failure of their usual diet, they are observed to scratch out of the banks of hedges, the root of arum, or the cuckoo pint; this is remarkably warm and pungent, and a provision suitable to the season. For representation, see Plate, V. Genus 32.

2. The *pilaris*, or field-fare, is in length 10 inches, in breadth 17. This bird passes the summer in the northern parts of Europe; also in lower Austria. It breeds in the largest trees; feeds on berries of all kinds, and is very fond of those of the juniper. Field-fares visit our islands in great flocks about Michaelmas, and leave us at the latter end of February or the beginning of March.

3. The *musicus*, or thrush, is in length 9 inches, in breadth 13½. In colours it so nearly resembles the mistle-thrush, that no other remark need to be added, but that it is less, and that the inner coverts of the wings are yellow. The thrush is the finest of our singing birds, not only for the sweetness and variety of its notes, but for the long continuance of its harmony; for it obliges us with its song for near three parts of the year. Like the mistle-bird, it delivers its music from the top of some high tree.

4. The *iliacus*, or red wing, has a very near resemblance to the thrush; but is less. These birds appear in Great Britain a few days before the field-fare; they come in vast flocks, and from the same countries as the latter. With us they have only a disagreeable piping note; but in Sweden during spring, they sing very finely, perching on the top of some tree among the forests of maples. They build their nests in hedges, and lay six blueish-green eggs, spotted with black.

5. The *merula*, or black-bird, when it has attained its full age, is of a fine deep black, and the bill of a bright yellow; the edges of the eye-lids yellow. When young, the bill is dusky, and the plumage of a rusty black, so that they are not to be distinguished from the females; but at the age of one year they attain their proper colour. This bird is of a very retired and solitary nature; frequents hedges and thickets, in which it builds earlier than any other bird: the nest is formed of moss, dead grass, fibres, &c. lined and plastered with clay, and that again covered with hay or small straw. It lays four or five eggs of a blueish green colour, marked with irregular dusky spots. The note of the male is extremely fine, but too loud for any place except the woods; it begins to sing early in the spring, continues its music part of the summer, desists in the moulting season, but resumes it for some time in September and the first winter months.

6. The *polyglottus*, or mocking-bird, is a native of America. It is about the size of a thrush, of a white and grey colour, and a reddish bill. It is possessed not only of its own natural notes, which are musical and solemn, but it can assume the tone of every other animal in the wood, from the wolf to the raven. It seems even to sport itself in leading them astray. It will at one time allure the lesser birds with the call of their males, and then terrify them when they have come near with the screams of the eagle. There is no bird in the forest but it can mimic; and there is none that it has not at times deceived by its call. But, unlike such as we usually see famed for mimicking with us, and who have no particular merit of their own, the mock-bird is ever surest to please when it is most itself. At those times it usually frequents the houses of the American planters; and sitting all night on the chimney top, pours forth the sweetest and the most various notes of any bird whatever. It would seem, if accounts be true, that the deficiency of most other song-birds in that country is made up by this bird alone. They often build their nests in the fruit-trees about houses, feed upon berries and other fruits, and are easily rendered domestic.

TURF, *peat*, a blackish sulphureous earth, used in several parts of England, Scotland, Ireland, Holland, and Flanders, as fuel. Turf, as distinguished from *peat*, consists of mould interwoven with the roots of vegetables; when those roots are of the bulbous kind, or in a large proportion, they form the looser and worse kind of turf; but when mixed with a considerable proportion of *peat*, they form what is called *stone-turf*; it at first hardens, but at last crumbles by long exposure to the air. Of *peat* or *geanthrax*, there are two sorts: the first and principal is of a brown, yellowish brown, or black colour, found in moory grounds, and when fresh, of a viscid consistence, but hardens by exposure to the air; it consists of clay mixed with calcareous earth and pyrites, and sometimes contains common salt; when distilled, it affords water and oil and volatile alkali, and its ashes contain a small proportion of fixed alkali. They are either white or red, according as it contains more or less ochree or pyrites. This sort of *peat* is found in Scotland, Holland, and Germany. Another sort is found near Newbury, in Berkshire; it contains but little earth, and consists chiefly of wood-branches, twigs, roots of trees, with leaves, grass, straw and weeds. Phil. Transl. for 1757, p. 110. Kirwan's Elem. of Miner. p. 219. In Flanders their turf is dug or pared from off the surface of the earth, and cut in form of bricks. The sedge, or species of grass, growing very thick on the turf earth, contributes greatly, when dry, to the maintenance of the fire. The Dutch take their turf from the bottom of the dykes or canals which run across most of their

their lands; by which means they not only supply the defect of wood, which is very great in most of the united Provinces, but also keep their dykes clear and navigable: this turf-earth is very black. In the north of England, Scotland, &c. turf or peat is dug out of soft, moist, rotten earth, called peat-mofs: for the formation whereof see Bog. They dig horizontally from the surface, to the depth of about four feet, with a spade, which at once fashions and takes them out in parallelopipeds, nine or ten inches long, and three square, which are spread on the ground to drain as fast as dug, and then set up on end three or four against each other, for the wind to blow through them, and at last they are stacked or housed. The pits or dykes in a few years fill up again, and afford a fresh crop.

TURKEY, in Ornithology, the English name of the genus *Meleagris*. For description of the Genus, See MELEAGRIS.

TURNAMENTS, or TOURNAMENTS, in Chivalry, were honourable exercises formerly used by all persons of note that desired to signalize themselves by their dexterity, &c. They were first instituted in Germany, according to historians, towards the beginning of the 10th century, and became afterwards a general practice: they derived their name from the French word *tourner*, i. e. "to turn round," because to be expert in these exercises, much agility both of horse and man was requisite, they riding round a ring in imitation of the ancient Circi. They were the principal diversion of the 13th and 14th century. The following account of English tournaments, extracted from Harrison's History of London, will not, it is presumed, be disagreeable to the reader.—In the reign of Edward IV. Roch, who was better known by the appellation of the *Bastard of Burgundy*, being greatly celebrated for the acts of chivalry, came over and challenged the Lord Scales, brother to the queen, to fight with him; which Scales readily accepting, the king commanded lifts to be prepared in Smithfield (wherein to perform combat), of the length of 370 feet, and breadth of 260, with magnificent galleries for the reception of the illustrious spectators; where assembled the King, the nobility, and the principal gentry of both sexes. The first day they fought with spears, without a visible advantage on either side. The second they tourneyed on horseback, when the Lord Scales having a long pike fixed on his chafron (pommel of his saddle) which, as they closed, ran into the nostrils of the Bastard's horse, by the anguish whereof he reared himself with that violence, that he stumbled backwards, whereby his rider was unfortunately unhorsed: which occasioned him to cry out, "That he could not hold by the clouds;" and that though his horse had failed him, he would not fail to meet his adversary the next day. This being accordingly performed, they fought on foot with pole-axes: when Scales soon penetrating the Bastard's helmet, the king threw down his warder, whereupon they were immediately parted by the marshal. But the Bastard insinuating upon fighting out that weapon, a council was held to deliberate thereon. The result was, that if he persisted in renewing the combat, he must, according to the law of arms, be delivered to his adversary in the same condition he was in at his horse's misfortune: but rather than submit to those terms, he waved his pretension.

King Richard II. designing to hold a tournament at London on the Sunday after Michaelmas, sent divers heralds to make proclamations of it in all the principal courts of Europe; and accordingly not a few princes, and great numbers of the prime nobility, resorted hither from France, Germany, the Netherlands, &c. This solemnity began on Sunday afternoon, from the Tower of London, with a pompous cavalcade of 60 ladies, each leading an armed knight, by a silver chain, being attended by their squires of honour; and, passing through Cheapside, rode to Smithfield, where the jousts and tournaments continued several days with magnificent variety of entertainments; on which occasion the king kept open house at the bishop of London's Palace for all persons of distinction; and every night concluded with a ball.

Not long after this, three Scotch champions challenged three English to fight, which was performed in Smithfield with the greatest solemnity; the Earl of Mar against the Lord Nottingham; Sir William Dorrel the king of Scotland's banner-bearer, against Sir Pierce Courtney, the king of England's standard-bearer; Cockburne, Esq. against Sir Nicholas Hawkirke. Mar and Cockburne were unhorsed; but the two standard-bearers were so well matched, that betwixt them it was a drawn battle. Voltaire, in his Essay upon the Civil Wars of France, p. 4, observes, that this romantic and dangerous sport was put an end to by the death of Henry II. king of France, who was killed at Paris in a tournament, which was the last in Europe.

One Chiaoux, who had assisted at a tournament under Ch. VIII. said very wisely, *If it be in earnest, it is too little; if in jest, too much.* It is to the exercise of tournaments that we owe the first use of armories; of which the name blazonry, the form of the escutcheons, the colours, principal figures, the mantlings, labels, supporters, &c. are undeniable evidences.

TURNEP, or TURNIP, in Botany, a species of the genus *brassica*. For a copious account of the culture of turneps, and their several uses, see the System of AGRICULTURE, Sect. XII.

TURPENTINE, *terebinthina*, a transparent sort of resinous juice, flowing either naturally, or by incision, from several unctuous and resinous trees; as the terebinthus, larch, pine, fir, &c. Medical writers distinguish four kinds of turpentine; as that of

Chio, or Cyprus, that of Venice, that of Strasburg, and the common turpentine. All the turpentine are hot stimulating corroborants and detergents. They are given, where inflammatory symptoms do not forbid the use of them, from half a scruple to half a dram and upwards, for cleansing the urinary passages, and internal ulcerations in general, and in laxities of the femoral and uterine vessels; they seem to act in a peculiar manner on the urinary organs, impregnating the water with a violent smell, even when applied externally, particularly the Venice sort: this last is accounted the most powerful as a diuretic and detergent, and the Chio and Strasburg as corroborants. They all loosen the belly, but the Venice most; and on this account they are supposed by Reverius and others to be less hurtful than such irritating diuretics as are not accompanied with that advantage. Dr. Cullen remarks, that terebinthinate glysters in obstinate costiveness, are most preferable to saline, as being more certain and durable. The common turpentine, as being the most offensive, is rarely given internally; its principal use is in some external applications, among the farriers, and for the distillation of the oil.

This oil is a most potent, stimulating, detergent diuretic. It is sometimes given in doses of a few drops, in rheumatisms and fixed pains of the joints; and some have ventured on much larger quantities. Cheyne recommends (Ess. on the Gout, p. 119. ed. 10.) as a perfect cure for sciatics, though of many years standing, from one to four drams of the ethereal oil, to be taken with thrice its quantity of honey, in a morning fasting, with large draughts of sack-whey after it, and an opiate at bed-time; this medicine is to be repeated, with the occasional intermission of a day, if daily repetitions cannot be bore, for four or five days, or eight at farthest. In appears, however, says Dr. Lewis, highly imprudent to venture on such large doses at once of a medicine so very hot and stimulating. Boerhaave, after recounting, not without some exaggeration, its styptic, anodyne, healing, antiseptic, and discutient virtues, when applied hot externally; and its aperient, warming, sudorific, and diuretic qualities, when taken internally, adds, that it must be used with great caution; that when taken too freely, it affects the head, excites heat and pain therein, and, violently urges a diabetes, brings on a flux of the semen and of the liquor of the prostrates; and that in venereal runnings in which it has by some been commended, it tends to inflame the parts, and increase the disorder. The oil of turpentine, taken in too large a dose, hath often very bad consequences; such as strangury, bloody urine, and its total suppression, with a fever, violent thirst, and vomiting. In the Medic. Ess. Edinb. vol. ii. article 5. we have an account of such symptoms, produced by the taken of two drams of this oil in warm ale. The patient was cured by a warm bath, and drinking plentifully of Fuller's *emulso Arabica*. This oil is generally used as a drier, to mix with other oils; for which purpose it has greatly the advantage of drying oil, with regard to colour, as it is perfectly transparent and white. It is used without any other preparation than mixing it, either alone or together with drying oil, with the other oils and colours. Turpentine is sometimes used with other bodies, to render spirit of wine a fit vehicle for colours. The balsam and the inspissated resins are used chiefly externally: the balsam is less purgent than the oil, and the resins much less so than the turpentine in substance: the common yellow resin, in taste considerably bitter, is sometimes given as an internal corroborant, in preference to the turpentine themselves, as being divested of the stimulating oil. Lewis's Mat. Med.

TURTLE, in Amphibiology, a species of the Genus *Testudo*, called also the Sea Tortoise, which supplies a well known delicious food. For description See the System.

TUSCAN, in Architecture, the first, simplest, and most massive of the orders. For a general description of the characters, proportions, &c. of this order, see the System under the orders of ARCHITECTURE in general, and Plate I. For Sir William Chambers's proportions, see Plate VI.

TUTENAG, a name given in India to the semi metal ZINC. It is also sometimes applied to denote a white metallic compound, brought from China, called also Chinese, or white copper, the art of making which is not known in Europe. It is the best imitation of silver which has been made; it is very tough, strong, malleable, may be easily cast, hammered, and polished; and the better kinds of it when well manufactured, are very white, and not more disposed to tarnish than silver is. Three ingredients of this composition may be discovered by analysis, viz. copper, zinc, and iron.

TWINS, two young ones delivered at a birth by an animal which ordinarily brings forth but one. It has been greatly disputed, which of two twins is to be esteemed the elder? The faculty of Montpellier have given it, that the latter born is to be reputed the elder; because first conceived: but by all the laws which now obtain, the first-born enjoys the privilege of seniority: and the custom is confirmed by the Scripture instance of Esau and Jacob. But if two twins be born so intermixed, that one cannot distinguish which of the two appeared first, it should seem that neither the one nor the other can pretend to the right of primogeniture, which ought to remain in suspense by reason of their mutual consourse. In such case some would have the decision left to the father, and others to the chance of a lot. For the method of delivery in cases of twins, see the System of MIDWIFERY, Part VIII. Sect. I. and Plate II. fig. 15.

TYMPANUM, in Anatomy. *Membrana TYMPANI*, is a thin

TYR

tender skin or membrane, stretched upon a bone or circle in the meatus auditorius of the ear, which it shuts, and supposed to be the immediate organ of hearing. See the *Systém*, Part IV. Sect VI. and Plate X. fig. 6.

TYMPANY, in Medicine, a flatulent tumor, or swelling of the abdomen or belly, very hard, equable and permanent; whereby the skin is stretched so tight, that, when struck, it gives a sound like that of a drum. For description, causes, and cure, see the *Systém*, Genus 56, and 57.

TYPE, *form, figure*, a copy, image, or resemblance, of some mode. The term type is less in use than its compounds **PROTOTYPE** and **ARCHETYPE**, which are the originals that are made without model.

TYPE is also a scholastic term, much used among divines, signifying a symbol, sign, or figure, of something to come. In this sense the word is commonly used with relation to **ANTITYPE**, which is the thing itself, whereof the other is a type or figure. Thus Abraham's sacrifice, the paschal lamb, &c. where types or figures of our redemption; and the brazen serpent was a type of the cross, &c. The ancient fathers, as well as the modern critics, have been greatly divided about the nature and use of types and typical representations in the Old Testament; and it is this makes one of the greatest difficulties in understanding the ancient prophecies, and in reconciling the New and Old Testament together.

TYRANNY, in Political Government, is the exercise of power beyond right, which no one can have a right to; and thus it is distinguished from **USURPATION**, or the exercise of power which another hath a right to: and it is the use of power which any one possesses, not for the good of those who are subject to it, but for his own private separate advantage: when the governor, however intitled, makes not the law, but his will the rule; and his command and actions are not directed to the preservation of the property of his people, but the satisfaction of his own ambition, revenge, covetousness, or any other irregular passion. It is a mistake to think this fault peculiar to monarchies; other forms of government are liable to it as well as that. For, wherever the power that is put in any hands for the government of the people, and the preservation of their property, is applied to their ends, and made use of to impoverish, harass, or seduce them to the arbitrary irregular

TYR

commands of those that have it, there it becomes tyranny, whether those who thus use it are one or many. Accordingly we read of the thirty tyrants at Athens, as well as one at Syracuse; and the intolerable dominion of the decemviri at Rome was nothing better. Every wanton and causeless restraint of the will of the subject, whether practised by a monarch, a nobility, or popular assembly, is a degree of tyranny. Whenever the constitution of a state vests in any man, or body of men, a power of destroying at pleasure, without the direction of laws, the lives or members of the subject, or of alienating their property, or of depriving them of their liberty at pleasure, such constitution is tyrannical. In a word, wherever law ends, tyranny begins, if the law be transgressed to another's harm. And whosoever in authority exceeds the power given him by the law, and makes use of the force he has under his command, to compass that upon the subject which the law allows not, ceases in that to be a magistrate, and, acting without authority, may be opposed as any other man, who by force invades the right of another. The end of government, whatever be its name or nature, is the good of mankind: and upon this principle, whosoever uses force without right, as every one does in society who does it without law, puts himself into a state of war with those against whom he uses it; and in that state all former ties are cancelled, all other rights cease, and every one has a right to defend himself, and to resist the aggressor. If it be asked, who shall be judge; whether the prince or legislature act contrary to their trust? The answer is obvious, the people shall be judge; for who shall be judge whether the trustee or deputy acts well, and according to the trust reposed in him, but he who deposes him, and must, by having deposed him, have still a power to discard him when he fails in his trust? If this be reasonable in particular cases of private men, why should it be otherwise in that of the greatest moment, where the welfare of millions is concerned; and also, where the evil, if not prevented, is greater, and the redress very difficult, dear, and dangerous?

TYRANT, **TYRANNUS**, among the ancients, denoted simply a king or monarch. But the ill use several persons invell with the character made of it, has altered the import of the word, and tyrant now carries with it the idea of an unjust and cruel prince, who invades the people's liberty; and rules in a more despotic manner than the laws of nature, or the country do allow of.

VAC U VAC

U or u, the 20th letter, and 5th vowel of our alphabet. The sound is short in *curst, must, tun, tub*; but is lengthened by a final e, as in *tune, tube*, &c. In some words it is rather acute than long; as in *brute, flute, lute*, &c. It is mostly long in polysyllables; as in *union, curious*, &c. but in some words it is obscure, as in *nature, venture*, &c. This letter in the form of V, or v, is properly a consonant, and as such is placed before all vowels; as in *vacant, venal, vibrate*, &c. Though the letters v and u had always two sounds, they had only the form v till the beginning of the fourth century, when the other form was introduced, the inconvenience of expressing two different sounds by the same letter having been observed long before. In numerals V stands for five; and with a dash added to the top, thus *v*, it signifies 5000.

VACUUM, **VACUITY**, in Physics, a space empty or devoid of all matter, or body. Whether there be any such thing in nature as an absolute vacuum; or whether the universe be completely full, and there be an absolute plenum; is a thing that has been controverted by the philosophers of all ages. The ancients, in their controversies, distinguished two kinds, a *vacuum coarctatum*, and a *vacuum interspersum*, or *disseminatum*.

VACUUM Coarctatum, is conceived as a place destitute of matter: such, e. gr. as there would be, should God annihilate all the air, and other bodies within the walls of a chamber. The existence of such a vacuum is maintained by the Pythagoreans, Epicureans, and the Atomists, or Corpuscularians; most of whom assert such a vacuum actually to exist without the limits of the sensible world. But the modern Corpuscularians, who hold a vacuum coarctatum, deny that appellation; as conceiving, that such a vacuum must be infinite, eternal, and uncreated. According, then, to the later philosophers, there is no vacuum coarctatum without the bounds of the sensible world; nor would there be any other vacuum provided God should annihilate divers contiguous bodies, than what amounts to a mere privation, or nothing; the dimensions of such a space, which the ancients held to be real, being by these held to be mere negations; that is, in such a place, there is so much length, breadth, and depth wanting, as a body must have to fill it. To suppose, that when all the matter in a chamber is annihilated, there should be real dimensions, is to suppose corporeal dimensions without body; which is absurd. The Cartesians, however, deny any vacuum coarctatum at all; and assert, that if God should immediately annihilate all the matter, i. e. in a chamber, and prevent the ingress of any other matter, the consequence would be, that the walls would become contiguous, and include no space at all. They add, that if there be no matter in a chamber, the walls can be conceived no otherwise than as contiguous: those things being said to be contiguous, between which there is not any thing intermediate;

but if there be no body between, there is no extension between; extension and body being the same thing; and if there be no extension between, then the walls are contiguous; and where is the vacuum? But this reasoning is founded on a mistake, viz. that body and extension is the same thing.

VACUUM Disseminatum, or *interspersum*, is that supposed to be naturally interspersed in and among bodies, in the pores of the same body and in the interstices between different bodies. It is this kind of vacuum which is chiefly disputed among the modern philosophers; the Corpuscularians strenuously asserting it; and the Peripatetics, and Cartesians, as tenaciously impugning it. See **CORPUSCULAR** and **CARTESIAN PHILOSOPHY**; see also **PERIPATETICS**.

The great argument the Peripatetics urge against a vacuum interspersum, is, that there are divers bodies frequently seen to move contrary to their own nature and inclination; and that for no other apparent reason, but to avoid a vacuum; whence they conclude, that nature abhors a vacuum; and give us a new class of motions ascribed to the *fuga vacui*, or nature's flying a vacuum. Such, they say, is the rise of water in a syringe, upon the drawing up of the piston; such also is the ascent of water in pumps, and the swelling of the flesh in a cupping-glass, &c. But since the weight, elasticity, &c. of the air have been ascertained by sure experiments, those motions and effects are universally ascribed to the gravity and pressure of the atmosphere. The Cartesians deny not only the actual existence, but even the possibility of a vacuum; and that on this principle, that extension being the essence of matter, or body, wherever extension is, there is matter: but mere space, or vacuity, is supposed to be extended; therefore it is material. Whoever asserts an empty space, they say, conceives dimensions in that space, i. e. he conceives an extended substance in it; and therefore he denies a vacuum, at the same time that he admits it. Descartes, if we may believe some accounts, rejected a vacuum from a complaisance to the taste which prevailed in his time, against his own first sentiments: and among his familiar friends used to call his system his philosophical romance. On the other hand, the corpuscular authors prove, not only the possibility, but the actual existence of a vacuum, from divers considerations: particularly from the consideration of motion in general: and that of the planets, comets, &c. in particular; from the fall of bodies; from the vibration of pendulums; from rarefaction and condensation; from the different specific gravities of bodies: and from the divisibility of matter into parts.

1^o. It is argued, that motion could not be effected without a vacuum. This is what Lucretius urged long ago. *Principium quoniam cedenis nulla daret res—undique materies quoniam stipata fuisset.* The force of this argument will be increased from the two following

ing considerations, viz. first that all motion is either in a straight line, or in a curve, which returns into itself, as the circle, and ellipsis; or in a curve that does not return into itself, as the parabola, &c. And, secondly, that the moving force must always be greater than the resistance. For hence it follows, that no force, even though infinite, can produce motion where the resistance is infinite; consequently there can be no motion either in a straight line, or a non-returning curve; because, in either of those cases, the protrusion, and consequently the resistance, would be infinite. There remains therefore only the motion of a revolving curve practicable; this must either be a revolution upon an axis, or an annular motion round a quiescent body; both which are again impossible in an elliptic curve; and consequently, all motion must be in circles geometrically true; and the revolving bodies must either be spheres, spheroids, cylinders, or portions of them, exactly geometrical; otherwise, the revolutions in a plenum would be impossible: but such motions, or such figured bodies, we do not know in nature. Therefore there is a vacuum.

2°. The motions of the planets and comets demonstrate a vacuum: thus Sir Isaac Newton—"That there is no such fluid medium as æther," (to fill up the porous parts of all sensible bodies, as the air and interstellar parts, and so make a plenum) "seems probable; because the planets and comets proceed with so regular and lasting a motion through the celestial spaces both from and to all parts; for hence it appears, that those celestial spaces are void of all sensible resistance, and consequently of all sensible matter. For the resisting force of fluid mediums arises partly from the attrition of the parts of the medium, and partly from the inactivity of matter. Now that part of the resistance of any medium, which arises from the tenacity or attrition of its parts, may be lessened by dividing the matter into smaller parts, and rendering those parts more smooth and slippery: but that part of the resistance which arises from the inactivity of matter, is always in proportion to the density of the matter: nor can it be diminished by dividing the matter, nor by any other means, except by diminishing the density thereof. Consequently, if the celestial regions were as dense as water, or as quicksilver, they would resist almost as much as water or quicksilver; but if they were perfectly dense, without any interspersed vacuity, though the matter were ever so fluid and subtle, they would resist more than quicksilver does: a perfectly solid globe, in such a medium, would lose above half its motion, in moving three lengths of its diameter; and a globe not perfectly solid, such as the bodies of the planets and comets are, would be stopped still sooner. Therefore that the motion of the planets and comets may be regular and lasting, it is necessary the celestial spaces be void of all matter, except perhaps some few, and much rarefied effluvia of the planets and comets, and the passing rays of light.

3°. The same great author deduces a vacuum also from the consideration of the weights of bodies; thus; "All bodies about the earth gravitate towards the earth; and the weights of all bodies, equally distant from the earth's centre, are as the quantities of matter in those bodies. If the æther, therefore, or any other subtle matter, were altogether destitute of gravity or did gravitate less than in proportion to the quantity of its matter; because (as Aristotle, Descartes, and others, argue) it differs from other bodies only in the form of matter; the same body might, by the change of its form, gradually be converted into a body of the same constitution with those which gravitate most in proportion to the quantity of matter; and, on the other hand, the most heavy bodies might gradually lose their gravity, by gradually changing their form; and therefore the weights would depend upon the forms of bodies; and might be changed with them; which is contrary to all experiment.

4°. The descent of bodies proves, that all space is not equally full; for the same author goes on, "If all spaces were equally full, the specific gravity of that fluid with which the region of the air would in that case be filled, would not be less than the specific gravity of quicksilver or gold, or any other the most dense body; and therefore neither gold, nor any other body, could descend therein. For bodies do not descend in a fluid, unless that fluid be specifically lighter than the body. But by the air pump, we can exhaust a vessel, till even a feather shall fall with a velocity equal to that of gold in the open air: the medium, therefore, through which this feather falls, must be much rarer than that through which the gold falls in the other case. The quantity of matter, therefore, in a given space, may be diminished by rarefaction; and why may not it be diminished in infinitum? Add, that we conceive the solid particles of all bodies to be of the same density, and that they are only rarefiable by means of their pores: and hence a vacuum evidently follows.

5°. That there is a vacuum, is evident from the vibrations of pendulums: for since those bodies, in places out of which the air is exhausted, meet with more resistance to retard their motion, or shorten their vibrations; it is evident there is no sensible matter in those spaces, or in the occult pores of those bodies." As to what Descartes urges of his materia subtilis, that its tenuity prevents its resistance from being sensible; and that a small body, striking against a greater, cannot in the least move, or resist the motion of that other, but is reflected back again with all its momentum; it is contrary to all experience. For Sir Isaac Newton proves, that the density of fluid mediums is proportionable to their resistances, very nearly; and that they are exceedingly mistaken who suppose

the resistance of projectiles to be infinitely diminished by dividing the parts of the fluid, even in infinitum (Princip. lib. ii. prop. 38) when on the contrary, it is clear the resistance is but little diminished by the subdivision of the parts, (ibid. Prop. 40) and that the resisting forces of all fluids are nearly as their densities: for why should not the same quantity of matter, whether divided into a great number of subtle parts, or into a few larger ones, have the same resisting force? If then there were no vacuum, it would follow, that a projectile, moving in the air, or even in a space whence the air is exhausted, should move with as much difficulty as it would in quicksilver, which is contrary to all experience. Nor will it avail to suppose the particles of the subtle fluid, constituting a plenum, to move constantly and equally in all directions; and by favour of this hypothesis, to imagine that they act but do not resist. Because the motion of a fluid favours the motion of a body in it, only as far as it is in the same direction; and an intestine motion of the parts of the fluid, equal in all directions, cannot make the resistance less than if there was no motion of the parts. It is supposed by many, that the particles of common fluids, e. g. water or air, are in a constant intestine motion; but this does not hinder those fluids from resisting in proportion to their density. If it should be alledged, that by supposing this dense fluid which replenishes space to penetrate the pores of bodies with the utmost freedom, (as light passes through transparent bodies, and the magnetic and electric effluvia through most kinds of bodies) its resistance will then be incomparably less than in proportion to its density; the resistance in this case not being measured by the density of the fluid, because the greater part passes through the pores of the body in motion freely, without resistance: yet even on this hypothesis, the resistance of a golden ball in a plenum would be still very great. For this subtle fluid, how penetrating soever it be, must resist the solid parts of the ball; which cannot move in the fluid without displacing its parts, and losing as much motion as must be communicated to those parts; and this resistance depends on the quantity of the solid parts in the ball; whereas the resistance which the same ball meets with in quicksilver (which we suppose to have no passage through the ball,) depends on the quantity of the solid parts in an equal bulk of the quicksilver, which must be moved to make way for the ball. And this being less than the quantity of solid parts in an equal bulk of the golden ball, in proportion as the specific gravity of quicksilver is less than that of gold, it follows that the resistance of a golden ball moving in such a subtle penetrating plenum, would still be greater than its resistance in quicksilver. The resistance of a golden ball in a plenum (how freely soever the matter constituting it pass through the pores of the ball, and how large and numerous soever these pores may be) must correspond to the solid matter in the ball; which is greater than the solid matter in any equal bulk of any of our fluids, upon which their resistance depends.

6°. That there are interspersed vacuities, appears from matter being actually divided into parts, and from the figures of those parts: for, on supposition of an absolute plenitude, we do not conceive how any part of matter could be actually divided from that next adjoining, any more than it is possible to divide actually the parts of absolute space from one another: for by the actual division of the parts of a continuum from one another, we conceive nothing else understood, but the placing of those parts at a distance from one another; which, in the continuum, were at no distance from one another: but such divisions between the parts of matter must imply vacuities between them.

7°. As for the figures of the parts of bodies, upon the supposition of a plenum, they must either be all rectilinear, or all concavo-convex; otherwise they would not adequately fill space: which we do not find to be true in fact.

8°. The denying a vacuum supposes what it is impossible for any one to prove to be true; viz. that the material world has no limits. However, we are told by some, that it is impossible to conceive a vacuum. But this surely must proceed from their having imbibed Descartes' doctrine, that the essence of body is constituted by extension; as it would be contradictory to suppose space without extension. To suppose that there are fluids penetrating all bodies and replenishing space, which neither resist nor act upon bodies, merely in order to avoid admitting a vacuum, is feigning two sorts of matter, without any necessity or foundation; or is tacitly giving up the question. Since then the essence of matter does not consist in extension, but in solidity, or impenetrability, the universe may be said to consist of solid bodies moving in a vacuum: nor need we at all fear, lest the phenomena of nature, most of which are plausibly accounted for from a plenitude, should become inexplicable when the plenum is set aside. The principal ones, such as the tides; the suspension of the mercury in the barometer; the motion of the heavenly bodies, and of lights, &c. are more easily and satisfactorily accounted for from other principles.

VACUUM, *vacuum* or *Boyleanum*, is also used to express the approach to a real vacuum, which we arrive at by means of the air-pump. Thus, any thing put in a receiver so exhausted, is said to be put in *vacuo*: and thus, most of the experiments with the air-pump are said to be performed in *vacuo*, or in *vacuo Boyleano*. Some of the principal phenomena; observed of bodies in *vacuo*, are: that the heaviest and lightest bodies, as a guinea and a feather,

fall here with equal velocity: that fruits, as grapes, cherries, peaches, apples, &c. kept for any time *in vacuo*, retain their nature, freshness, colour, &c. and those withered in the open air recover their plumpness *in vacuo*: all light and fire become immediately extinct *in vacuo*: the collision of flint and steel *in vacuo*, produces no sparks: no sound is heard, even from a bell rung *in vacuo*: a square phial, full of common air, well closed, breaks *in vacuo*: a round one does not: a bladder half full of air will heave up forty pound weight *in vacuo*: cats, and most other animals, soon expire *in vacuo*. By experiments made in 1704, Dr. Derham found, that animals which have two ventricles, and no foramen ovale, as birds, dogs, cats, mice, &c. die in less than half a minute; counting from the first exsuction; a mole died in one minute, a bat lived seven or eight. Insects, as wasps, bees, grasshoppers, &c. seemed dead in two minutes; but after being left *in vacuo* twenty-four hours, they came to life again in the open air: snails continued twenty-four hours *in vacuo*, without appearing much incommoded. Seeds planted *in vacuo* do not grow: Small beer dies, and loses all its taste, *in vacuo*: lukewarm water boils very vehemently *in vacuo*: and air, rushing through mercury into a vacuum, throws the mercury in a kind of shower upon the receiver, and produces a great light in a dark room. The air-pump can never produce a perfect vacuum; as is evident from its structure, and the manner of its working: in effect, every exsuction only takes away a part of the air: so that there will still be some left after any finite number of exsuctions. Add, that the air-pump has no longer any effect than while the spring of the air remaining in the receiver is able to lift up the valves: when the rarefaction is come to that degree, you can come no nearer to a vacuum. Sir Isaac Newton, observing, that a thermometer suspended *in vacuo*, and in that state removed to a warm or a cold room, receives the heat or cold, and rises, or falls, almost as soon as another in open air; takes thence occasion to suspect, that the heat of the warm room is conveyed through the vacuum, by the vibrations of a much subtler medium than air, which remained in the vacuum after the air was drawn out.

VAGABOND, a person that wanders about, having no certain dwelling; or a sturdy beggar, &c. mentioned in divers statutes. All itinerant beggars, fortune-tellers, collectors for gaols, fencers, bearwards, players of interludes, minstrels, jugglers, gypsies, &c. shall be reputed vagabonds, rogues, and sturdy beggars, 39 Eliz. c. 4. The court of Areopagus at Athens punished idleness, and exercised a right of examining every citizen in what manner he spent his time. The civil law expelled all sturdy beggars from the city; and, in our own law, all idle persons or vagabonds, (whom our ancient statutes describe to be, "such as wake in the night, and sleep in the day, and haunt customable taverns, or alehouses, and routs about; and no man wot from whence they come or whither they go:" or such as are more particularly described by statute 17 Geo. II. c. 5. called the vagrant act, and divided into three classes, (idle and disorderly persons, rogues and vagabonds, and incorrigible rogues;) are offenders against the good order, and blemishes in the government of any kingdom. They are all punished by the statute last mentioned.

VAGINA, in Anatomy, denotes a canal, or cavity, leading from the pudendum to the uterus of women. The vagina, called also *cervix-uteri*, is a membranous passage, extended from the rima, or aperture of the labia, to the neck of the womb. See the System, Part III. Sect. XV. Art. 2, and Plate IX. fig. 1. letter H. See also Plate II. and III. and its description.

VAIR, in heraldry, a kind of fur, or doubling, consisting of divers little pieces, argent and azure, resembling a Dutch U, or a bell-glass. See the System, Sect. IV. and Plate II.

VALERIANA, VALERIAN; a genus of the monogynia order, belonging to the triandria class of plants. There are 20 species; the most remarkable of which is the officinalis, or great wild valerian, growing naturally in Britain, in ditches, marshy places, and sometimes in dry mountainous pastures. The root is much used in medicine, and consists of a number of strings or fibres matted together, issuing from one common head; of a whitish or pale brownish colour: its smell is strong, like a mixture of aromatics with fetids; the taste unpleasantly warm, bitterish, and subacid. The London college have restrained the shops to that which grows in dry places, and is considerably the strongest, and loses of its quality if transplanted into such soils as the other naturally delights in. The roots produced in low watery grounds have a remarkably faint smell in comparison of the others, and sometimes scarce any at all.

Wild valerian is a medicine of great use in nervous disorders; and is particularly serviceable in epilepsies proceeding from a debility of the nervous system. It was first brought into esteem in these cases by Fabius Columna, who by taking the powdered root in the dose of half a spoonful, was cured of an inveterate epilepsy after many other medicines had been tried in vain. Repeated experience has since confirmed its efficacy in this disorder; and the present practice lays considerable stress upon it. The common dose is from a scruple to a dram: in infusion from one to two drams. Its unpleasant flavour is most effectually concealed by a suitable addition of mace. Cats are very fond of the smell of this root, and seem to be intoxicated by it.

VALETUDINARY, a term sometimes used by the writers of medicine, for a person of a weak, sickly constitution, who is

very frequently out of order, &c. Dr. Cheyne, by all means, directs the weakly, the studious, the sedentary, and valetudinary, to a low spare regimen.

VALID, a term applied to acts, transactions, expeditions, &c. which are clothed in all the formalities requisite to the being put into execution, and to their being admitted to a court of justice. A contract by a minor is not valid, or is invalid: a marriage is not valid, unless performed with the solemnities enjoined.

VALVE, in Anatomy, a thin membrane, applied, like a door or shutter, on divers cavities and vessels of the body; to afford a passage to some humour, or other matter, going one way, and prevent its reflux towards the part whence it came. The veins and lymphatics have valves, situate from space to space, which open towards the heart, but keep close on that side towards the extremities; i. e. they let the blood and lymph pass towards the heart, but prevent their returning to the extreme parts, whence they came. See the System, Part III. Sect. XIV. and Plate VI.

VAPOUR, in Philosophy, the particles of bodies rarefied by heat, and thus rendered specifically lighter than the atmosphere, in which they rise to a considerable height. See EVAPORATION, DAMP, GAS, &c. Many kinds of vapours are unfriendly to animal life, but the most noxious are those which arise from metallic substances. In the smelting and refining of lead, a white vapour arises, which, falling upon the grass in the neighbourhood, imparts a poisonous quality to it, so that the cattle which feed there will die; and in like manner stagnant waters impregnated with this vapour will kill fish. Phlogistic vapours are also extremely noxious; and hence painters, and others who are exposed to these vapours, are generally unhealthy. In some places the earth exhales vapours of a very noxious quality; such as the Grotto del Cani, and other places in Italy, where a mephitic vapour constantly hovers over the surface of the ground, proving instantly fatal to such animals as are immersed in it. But the most formidable kind of vapours are those which issue from the mouths of volcanoes, and which seem to be a combination of all others, joined to such a quantity of electric matter as to produce the greatest mischiefs. In some parts of the world there have been instances of people killed, and almost torn to pieces, by a vapour suddenly bursting out of the earth under their feet. Of the aqueous vapour raised from the earth by the sun's heat are formed the clouds; but though these are commonly at no great height from the earth, we cannot from thence dertermine the height to which the vapours ascend. Indeed, considering the great propensity of water, and even quicksilver, to evaporate in the most perfect vacuum we can make, it is by no means probable that any limit can be fixed for this ascent. For the formation of Vapour, see the article EVAPORATION, under that head.

The vapour-bath is very commodious for the distilling of odorous waters, and the drawing of spirit of wine. We also use the term vapour-bath, when a sick person is made to receive the vapours arising from some liquid matter placed over a fire. Many contrivances have been proposed for this purpose: and their expediency and utility are best known to those who are conversant in this business. A late writer has suggested a new construction of vapour-baths: and the whole apparatus is reduced to a tin boiler, tin pipes wrapped in flannel, and a deal box with a cotton cover, for the reception of the body, and circulation of the vapour. See Playfair's Method of constructing vapour-baths, at a small expence, for the use of Private Families, 8vo. 1783.

VAPOURS, in Medicine, a disease properly called *hys*, or the *hypochondriacal disease*; and in men, particularly the *splen*. For description, causes, prognosis and cure, see the System, Genus 17.

Fiery VAPOURS, *balitus ignei*, a term used by some to express those exhalations from the earth, which either take fire of themselves on their bursting forth into the air, or are readily inflammable on the bringing of a candle to them. See DAMPS, and AIR Inflammable. Many of the supposed burning lakes are owing to these fumes bursting up through the water, and not to any quality of the water itself. Our famous burning well at Wigan, in Lancashire, is of this kind. The common people affirm, that the water of this spring burns like oil; but there is nothing of truth in this. There bursts up a vapour through the earth in this place, which keeps the water bubbling, as if boiling over the fire, though it is not warm, and the steam of this breath may be felt issuing up in these places like a strong wind. This breath alone is inflammable, and takes fire at the approach of a candle, burning with considerable violence for some time. There are coal-pits in the neighbourhood, and the air is certainly of the same kind with that inflammable vapour, often met with in those places, and which may also be prepared from iron dissolved in a proper menstruum. The water itself, taken from the place, does not burn; and if the bottom be made dry, the vapour which ascends from it will burn as strongly as if the water were there. The flame is not discoloured like that of sulphureous bodies, nor has it any bad scent; and the fumes, as they are felt bursting out of the earth, by the hand held over the place, are hot. Phil. Trans. Nov. 20. 1721.

VARIABLE, in Geometry, is a term applied by mathematicians, to such quantities as either increase or diminish, according as some other quantity either increases or diminishes. Thus, the semiordinates and abscissas of an ellipsis, &c. are variable quantities; because, if the one increase, the others increase likewise. See the System, Part II. Sect. II.

The infinitely small quantity whereby a variable quantity is continually increasing, or diminishing, is called the increment or decrement, or difference; and the velocity with which it increases or decreases at any given point, is called its *fluxion*; the calculation whereof is the subject of the new *methodus differentialis*, or *doctrine of fluxions*. See *FLUXIONS*, Sect. I.

VARIATION of Quantities, in Algebra. See the System, Article XX.

VARIATION, in Navigation, &c. a term applied to the deviation of the magnetic needle, or compass, from the true north point, towards either east or west; called also the *declination*. For description of the variation of the compass, see the System of NAVIGATION, Part I. Sect. I. No. 7; to find the variation of the compass, see Sect. IV. of the same part.

VARIATION of Curvature, in Geometry, is used for that inequality, or change, which happens in the curvature of all curves, except the circle. And this variation or inequability, constitutes the quality of the curvature of any line. See *CONIC SECTIONS*.

VARICOCELE, in Surgery, a name given to one of the spurious *hernia*, which consists in a dilatation of the blood vessels of the scrotum. These are of different sizes, in different people, and like the vessels in other parts of the body, are liable to become varicose; but are seldom so much enlarged as to be troublesome, unless such enlargement is the consequence of a disease, either of the testicle, or of the spermatic chord. When this is the case, the original disease should engage the attention of the surgeon, and not this simple effect of it; and therefore, considered abstractedly, the varicocele is a disease of no importance. Pott's *Chirurgical Works*, vol. ii. p. 423, 1779.

VARICOMPHALUS, in Surgery, a kind of umbilical rupture, or *exomphalus*, so denominated from the nature of the particular humour of which it is formed.

VARIETIES, in Natural History, a word used to express an accidental change in some body which is not essential to it, and therefore does not constitute a different species. The naturalists of former ages have run into great errors, in mistaking the accidental varieties of plants, animals, and minerals, for distinct species. Many of them have called a plant a new species, because its flower, which should have been blue or red, is white, on account of the poorness of the soil, or some other such reason. Mr. Ray has established a very good test for varieties in botany; he allows every thing to be a distinct plant which will propagate itself in its own form by its seeds; but such as when sown, lose their difference, and run back to the old standard, he accounts varieties, however great their distinctions may appear. In the history of fish as much confusion has been introduced, by mistaking varieties for distinct species, as in botany. Artedi was the first author who has rationally attempted to bring this part of natural history into order in this respect, and to settle regularly the rules by which to distinguish real and essential, from accidental differences. The principal grounds of the error of supposing varieties distinct species of fish, have been these: the variable and inconstant colour of fish have been mistaken for a specific difference; in this manner Rondeletius has described many varieties of the turbot, labrid, and other fish, under the names of distinct genera. Of the same kind are the mistakes of those who esteem size or magnitude a specific character; and thus, out of the varieties of the same fish, occasioned by scarcity or plenty of food, or other such occasions, make larger or smaller species.

The place, where fish are caught, is also another cause of making new species with these authors: thus, though the *perca fluviatilis* of Bellonius, and the *perca marina* of other authors be the same fish, yet they are pretended to be different species. All these differences are false and frivolous, and the utmost they can do, is to make what are properly called varieties, though few of them are sufficient even for that. A salmon caught at sea, is not different from one of the same brood caught in a river; and if the *perca marina*, falsely so called, be a little different from the *perca fluviatilis*, yet if its spawn will produce regular *perca fluviatilis*, its difference can only amount to a variety, not a distinct species.

VARIOLÆ, or **VARIOLI**, a contagious disease, popularly called the *small-pox*. It is called variolæ, as shewing itself in pustules, or little tumors, like varices; or as variegating the skin. For description, causes, prognosis and cure, see the System of MEDICINE, Genus 26.

VARIORUM, in matters of literature, a term or phrase of abbreviation, used for an edition of a classic author, printed in Holland, with the notes of divers authors thereupon: *Cum notis variorum*, or *cum selectis variorum observationibus*.

VASCULAR, *vascularis*, in Anatomy, is applied to any thing consisting of divers vessels, veins, arteries, &c. We say, the vascular and valvular texture of the lungs. All the flesh, in an animal body, is found to be vascular, none of it parenchymous, as the ancients imagined. For the vascular system, see the System of ANATOMY, Part V. throughout, and Plate 6.

VASSAL, *vassalus*, in our ancient customs, a person who vowed fidelity and homage to a lord, on account of some land, &c. which he held of him, in fee. The vassal was also called *piratus*, *lord's-man* and *fee-man*; but now the denomination is changed into that of *tenant in fee*. Accordingly the vassal, or feudatory, was only

No. 145.

another name for the tenant or holder of the lands; though, on account of the prejudices we have justly conceived against the doctrines that were afterwards grafted on this system, we now use the word vassal opprobriously, as synonymous to slave or bondman. The manner of the grant, on the part of the proprietor or lord, who retained the dominion of ultimate property of the feud or fee, was by words of gratuitous and pure donation, *dedi et concessi*; which are still the operative words in our modern infeodations, or deeds of feoffment. This was perfected by the ceremony of corporal investiture, or open and notorious delivery of possession, in the presence of other vassals, which perpetuated among them the æra of the new acquisition, at a time when the art of writing was very little known; and, therefore, the evidence of property was reposed in the memory of the neighbourhood; who in case of a disputed title were afterwards called upon to decide the difference, not only according to external proofs adduced by the parties litigant, but also by the internal testimony of their own private knowledge. If a vassal offended his lord grievously, either in person, or in honour, he committed the crime of felony: which carried with it a confiscation of his fee.

VASTUS, in Anatomy, a name common to two muscles of the leg distinguished into internal and external; both of them serving to extend the leg. See the System, Sect. II. Table of Muscles, Art. 25, and Plate III. fig. 1, letters *b, i*.

VATICAN, *Vaticanus* is properly the name of one of the seven hills whereon Rome stands: on the foot hereof is the famous church of St. Peter, hence called the Vatican; and a magnificent palace of the pope, which has the same denomination. Hence arise divers figurative expressions: as the *thunderbolt of the Vatican*, q. d. the pope's anathema, &c.

The library of the VATICAN is one of the most celebrated in the world: it is particularly remarkable for its manuscripts. It was first erected, according to Petavium (Rat. Temp. lib. ix. c. 9.) by pope Nicholas V. who succeeded to the papal chair, in 1447. Towards the beginning of the last century, it was greatly augmented by the addition of that of the elector Palatine. It is open to all the world, three or four times a week. In it are shewn a Virgil, Terence, &c. above a thousand years old; as also the manuscript whereon the edition of the Septuagint was made; and abundance of rabbinical manuscripts.

VATICAN Manuscript, is one of the most celebrated manuscripts of the Greek version of the Bible now extant in the world. It was published at Rome, by Cardinal Carafa, at the command of Sixtus Quintus, in 1587; and in the preface, it is said to have been written *ante millesimum ducentisimum annum*, i. e. before 1200; but Blanchini supposes it a few years later. A latin edition from his manuscript, with notes, was printed at Rome in 1588, by Flam. Nobilius, and an edition, with the Greek and Latin, with the division of the verses, according to the Vulgate, and Nobilius's Latin notes, and the Greek scholia of Carafa, by J. Morinus, at Paris, in 1628. This manuscript is written in large or text letters, and has no distinguishing chapters, verses, words, nor any marks of accents. It is mutilated both at the beginning and end; and wants the first forty-six chapters of Genesis, thirty-two Psalms, viz. from the 105th to the 137th, and the latter part of the Epistle to the Hebrews, from chap. ix. ver. 14. with the other Epistles of Paul to Timothy, Titus, and Philemon, and the whole book of Revelation. It appears also, that the whole manuscript has been repaired with fresh ink laid over the letters, which were disappearing through age. In the edition of Carafa the mutilated passages have been supplied from other copies. It has been asserted, by two eye-witnesses, that this manuscript has undergone some alterations by a later hand. See Le Long's Biblioth. Sacra. cap. 3. sect. 4; and Wettstein's Prolegomena, Nov. Test. p. 24. It is difficult to estimate the comparative value of this and the Alexandrian manuscript, in which thirty psalms, a few chapters, and a few verses, are now lost, as well as parts of verses in different places; and in which there have been some erasures and insertions, as Grabe allows. If, as Grabe states it, that manuscript be the most respectable, which comes the nearest to the Hexaplar copy, the Alexandrian manuscript seems to claim that merit in preference to its rival. But if it be thought a matter of superior honour, to come nearer the old Greek version unaltered by Origen, that merit seems to belong to the Vatican. For further particulars, see the Prolegomena of Walton, Grabe, Wettstein, Mills, and Le Long.

VAULT, *fernix*, in Architecture, an arched roof, so contrived, as that the several stones whereof it consists, do, by their disposition sustain each other. Vaults are to be preferred, on many occasions to soffits, or flat ceilings, they give a greater rise and elevation; and, besides, are more firm and durable. See the System, on the Principles of the Art.

UBIQUITY, *omnipresence*; an attribute of the Godhead, whereby he is always intimately present to all things; gives the *esse* to all things; and knows, preserves, and does all in all things. For since God cannot be said to exist in all places, as placed therein (because, then, he would need something to his existence, viz. place; and would have extension, parts, &c.) he must be conceived to be every where, or in all things, as a first, universal, efficient cause in all his effects. He is present, therefore, to all his creatures, as a pure act, or an exercise of an active virtue, which knows,

*

5 D

preserves

VEG

preserves, governs, &c. every thing. Nor are even finite minds present otherwise than by operation. See GOD.

VEGETABLE, VEGETABLE, in Physiology, a term applied to all plants, considered as capable of growth, i. e. to all natural bodies which have parts organical, formed for generation and accretion, but not sensation. See PLANT. In vegetables, there is supposed to be a principle of life, commonly called the vegetative soul; see also **VEGETATIVE**. The vascular structure of vegetables is rendered very apparent by an experiment of Mr. Willoughby. Cutting off some pretty large branches of birch, and making a sort of bafon, or reservoir, on the end thereof, with soft wax; upon filling this with water, and holding the branch upright, the water in a few minutes, sunk into the vessels of the wood, and running quite through the length, dropped out considerably fast at the other end; continuing so to do as long as the water was poured on. The same succeeds in a sycamore, walnut-tree, &c. though the flux here is not so copious. Phil. Transf. No. 70. In a dietetical view, it is to be observed, that greens as well as fruit are but a flatulent diet, and therefore ought to be eaten with moderation in bilious disorders. However, on account of their antiseptic quality, they are esteemed good for preventing putrid and contagious diseases. Pringle, Obser. on the Diseases of the Army, p. 210, 294. Vegetables, according to the analyses made of them by chymistry, are distinguishable into two grand tribes, the acid and the alkaline: the first affording a volatile acid, and the second a volatile alkali, upon a dry distillation: thus guaiacum, cedar, box, cinnamon, cloves, sorrel, mint, baum, &c. afford an acid; but garlick, leeks, onions, horse-radish, scurvy-grass, mustard, &c. afford an alkali, which, when rectified, is hardly distinguishable from that of animal substances, so as nearly to resemble the spirit and salt of hartshorn. For the analogy between the animal and vegetable world, see PLANTS, and **VEGETATION** *infra*. Also see the System of BOTANY, Sect. III. and the System of CHYMISTRY, Part IV.

VEGETABLE Salt. In the Philosophical Transactions we have some very curious processes and observations, by Redi, on the subject of the salt of vegetables. Burn any wood, herb, fruit, or flower to ashes; make a ley with these ashes with common water, not heated; filtre this through paper till it is clear as rock water; then evaporate this ley to a proper degree in a balneum Mariæ, in a glass vessel. This degree of evaporation must be carefully observed, according as the congelation of the salt is intended to be hastened or retarded. In the common way of evaporating lixiviums of this kind in earthen vessels over a naked fire, a great quantity of the salt is always lost; part of this is carried off with the vapours raised too hastily in this manner, and part penetrates the sides and bottom of the vessel, though it be ever so well glazed. The quantity of water necessary, is, in most cases, about five pints to two pounds weight of the ashes. After all the salt that can be got is extracted by this operation, the ashes, being calcined again in the kiln, will afford more salt of the same kind, but in a much smaller quantity.

VEGETATION, VEGETATIO, the act whereby plants and other living bodies, receive nourishment, and grow. Plants, we learn from the microscope, consist of different parts, vessels, &c. analogous to those of animals: and each kind of vessel is supposed to be the vehicle of a different humour, or juice, secreted from the mass of sap; which is considered as the blood, or common fund of them all. Dr. Grew assigns the offices of the several vessels: those placed on the inner verge of the bark, he calls lympheducts, and supposes them destined for the conveyance of the most aqueous or watery liquor: these Mr. Bradley calls the new forming vessels, which are annually produced, and help to increase the bulk of the tree. Those in the middle of the bark, Dr. Grew calls lactiferous, or resiniferous vessels; their use, according to Bradley, is to return the superfluous sap; these vessels, Grew observes, are the principal viscera of plants; and adds, that as the viscera of animals are but such vessels conglomerated, so the vessels of a plant are viscera drawn out at length. The process of nature in the vegetation of plants is very accurately delivered by the excellent Malpighi, and others, to the effect following. The seed of the plant, after it has dropt from the ovium, called the pod or husk, may be considered as an impregnated ovum, within which the embryo plant is securely lodged. The egg or seed of the plant being excluded out of the ovary, and requiring further fostering and brooding, is committed to the earth; which having received it into her fertile bosom, not only does the office of incubation by her own warm vapours and exhalation, joined with the heat of the sun, but by degrees supplies what the seed requires for its further growth; as abounding every where with canals and sinuses, wherein the dew, and rain-water, impregnated with fertile salts, glide, like the chyle and blood in the arteries, &c. of animals. In a few days after it has been committed to the earth, we may discern the rudiments of the future plant. Every part appears to exist in miniature. The nutritive juices of the soil insinuate themselves between the original particles of the plant, and bring about an extension of its parts; and this is called the growth of the vegetable body; with regard to this increase by addition and extension, there seems to be a great analogy between the animal and vegetable kingdoms. Every one knows that animals, instead of being strengthened, are enfeebled by a supply of improper nourishment. The case is the same with regard to vegetables; but with this difference, that animals refuse whatever

VEG

is improper; while vegetables, from their passive nature, must be content with what we give them. The impregnated ovum of every animal, after it has passed down the Fallopian tube, and fixed itself to the bottom of the uterus, is found to contain the tender embryo within two membranes called chorion and amnion. In this situation the embryo could not long subsist without a supply of nourishment. Nature, has, therefore, bestowed upon it a placenta and umbilical chord, through which the blood and juices of the mother are transmitted, for its preservation and increase. Seeds are disposed by providence nearly in the same manner; they have two coverings, answering to the chorion and amnion, and two lobes, which perform the office of the placenta. These lobes constitute the body of the seed, and in the farinaceous kinds, they are the flower of the grain. Innumerable small vessels run through the substance of the lobes, which, uniting as they approach the seminal plant, form a small chord to be inserted into the body of the grain. Through this the nutriment supplied by the placenta or lobes is conveyed for the preservation and increase of the embryo plant. Here it may be observed, that the lobes of farinaceous grains are fixed in the earth; they are, therefore, improperly termed **SEMINAL leaves**, being rather the placenta or cotyledons of the plants. On the contrary, vegetables that have an oily seed, as rape, hemp, line, and turnip, carry their lobes upward, and spread them upon the surface in the form of broad leaves. These, though they perform the office of a placenta, are properly seminal leaves. See the article SEED.

To illustrate the subject of vegetation, let us take a view of what happens to a bean, after it has been committed to the earth. In a few days, sooner or later, according to the temperature of the weather and disposition of the soil, the external coverings open at one end, and disclose to the naked eye part of the placenta or body of the grain. This substance consists of two lobes, between which the seminal plant is securely lodged. Soon after the opening of the membrane, a sharp pointed body appears, which is the root. By a kind of principle which seems to bear some appearance of instinct, it seeks a passage downward, and fixes itself into the soil. At this period the root is a smooth and polished body and has, perhaps, but little power to absorb any thing from the earth, for the nutriment of the germ. The two lobes now begin to separate, and the germ, with its leaves, may be plainly discovered. As the germ increases in size, the lobes are farther separated, and the tender leaves, being closely joined, push themselves forward in the form of a wedge. These leaves take a contrary direction to the root. They seek a passage upward; which having obtained, they lay aside their wedge-like form, and spread themselves in an horizontal direction, as being best adapted for receiving the rains and dew. The radicle, every hour increasing in size and vigour, pushes itself deeper into the earth, from which it now draws some nutritive particles. At the same time the leaves of the germ, being of a succulent nature, assist the plant by attracting from the atmosphere such particles as the tender vessels are fit to convey. These particles, however, are of a watery kind, and have not in their own nature a sufficiency of nutriment for the increasing plant. Vegetables, as well as animals, during their tender state, require a large share of balmy nourishment. As soon as an animal is brought into life, the milk of its mother is supplied in a liberal stream, while the tender germ seems only to have the crude and watery juices of the earth for its support. This, however, is not the case: for the vegetable lives upon a similar fluid, though differently supplied. For its use the farinaceous lobes are melted down into a milky juice, which, as long as it lasts, is conveyed to the tender plant by means of innumerable small vessels, which are spread through the substance of the lobes. These vessels uniting into one common trunk, enter the body of the germ, and perform the office of an umbilical chord. Without this supply of balmy liquor, the plant must inevitably have perished, its roots being then too small to absorb a sufficiency of food, and its body too weak to assimilate it into nourishment.

Turnips, and all the tribe of brassicas, in opposition to the leguminous and farinaceous plants, spread their seminal leaves upon the surface; these leaves contain all the oil of the seed, which when diluted with the moisture of the atmosphere, forms an emulsion of the most nourishing quality; and on account of its sweetness, the seminal leaves are greedily devoured by the fly. A grain of wheat, as soon as the germ has made its appearance, shews the milky liquor to the naked eye; but the umbilical chord with its ramifications, can only be discovered by the nicest glasses. As the plant increases in size, the balmy juice diminishes, till at last it is quite exhausted. The umbilical chord then dries up, and the external covering of the grain appears connected with the root in the form of a shrivelled rag. In the process of vegetation, there is no mortality; from the moment that the seed is lodged in its parent earth, the vegetative soul begins its operations, and in the whole successive gradation of them illustrates the wisdom, power, and bounty of providence. It is worthy of observation, that farinaceous vegetables and oviparous animals are nourished in their tender state, nearly in the same manner. The embryo plant is supported by the farina melted down into a milky liquor, and conveyed into its body by means of an umbilical chord, at a time when the radicle was unable to supply a sufficiency of nutriment. An oviparous animal from the time that it is brought into light,

seems

VEN

seems to receive all its nourishment from without; but this is only in appearance. The yolk of the egg remaining entire during incubation, is received into the body of the animal, and in a manner similar to the passage of the milky juice of the vegetable, is slowly conveyed into the vessels of the tender chick: and thus a sweet nourishment is prepared at a time when neither the industry of the animal, nor the attention of its mother, could have procured a sufficient supply. Evelyn's Sylva, by Dr. Hunter, p. 33, &c. note. Hales's Statics, vol. i. and Miller's Gard. Dict. art. VEGETATION. For other particulars respecting the vegetation of plants, such as their nature, anatomy, economy, generation, nutrition, &c. see the System of Botany, Sect. II.

As to the manner in which vegetation is effected, very little can be said. That heat, air, and light are necessary for this purpose, is known to every one; but in what manner they act, seems to be totally undiscoverable by us. The lowest degree of vegetation seems to be that of the crystallization of salts. This indeed has scarce been allowed really to be a vegetation, though it certainly is owing to the same causes. Whether crystallization will succeed *in vacuo*, indeed, has not been determined; but it certainly may go on without light, and in much lower degrees of heat than those in which any vegetable will grow. Light, indeed, seems not absolutely necessary to vegetation; for the roots of all plants grow below ground, where they are very much deprived of light. This element seems only necessary for giving a green colour to the upper part of vegetables, and perhaps strengthening them, so that they can better bear the inclemency and changes of the weather. But whatever may be the differences between the powers which produce vegetation and those of crystallization, water is the medium by which only both can act: for if a salt is perfectly dry, it will not crystallize, more than a seed will grow in dry sand or dust. Some kinds of crystallization indeed resemble vegetation so much, that we scarce avoid ascribing them to the same cause. Of these the most remarkable is the arbor Diane, or compound of nitrous acid and silver. Several curious crystallizations, or vegetations, as they are called, may also be formed with other metals; but that which most of all resembles a true vegetation, is the *caput mortuum* of Glauber's spirit of nitre. This is a combination of very pure vegetable fixed alkali with vitriolic acid. If the latter has been employed in the distillation, and the mass is exposed to a moist air, a great number of crystallizations will take place on the surface, exactly resembling the vegetations of some kinds of shrubs. See CRYSTALLIZATION, PLANT, &c.

VEGETATIVE, a term applied to that principle, or part, in plants, by virtue whereof they receive nourishment, and grow, or vegetate. The philosophers speak of three kinds of souls, the *vegetative, sensible, and rational*. See SOUL.

The vegetative soul is that principle whereby trees and plants live, grow, and produce their kinds. This vegetative principle is differently seated, in different plants: an ingenious author observes, that, generally speaking, its place is exactly between the trunk and root; at least this appears to be the place in most of the annual tribe; which if cut down near this place, rarely shoot again. In other vegetables, as the elm, and many edible plants, it seems to reside wholly in the roots; which, if cut into ever so many parts, yet those being planted in the ground, soon grow. In others, as the willow kinds, it seems to be diffused all over the root, trunk, and branches; inasmuch, that if cut into a thousand pieces, there is no destroying them without splitting them in the middle; and scarcely then. Lastly, in others as the ceruses, ficuses, &c. it is seated in the body, branches, and leaves; any of which, being put into the ground, strike root immediately, and grow. The office of this vegetative principle is to concoct the nutritive matter which is imbibed by the roots and flowers, and to assimilate it to the nature of the plant.

VEIN, VENA, in Anatomy, a name given to several vessels or canals, which receive the blood from the divers parts of the body, to which the arteries had conveyed it from the heart; and carry it back to the heart again. For the particular description of the VASCULAR System, see the System of ANATOMY, Part V. throughout, and Plate V.

VELOCITY, in Mechanics, *swiftness*; that affection of motion, whereby a moveable is disposed to run over a certain space in a certain time. It is also called CELERITY, and is always proportional to the space moved. See the System, Sect. II. and IV. see also the articles ACCELERATION and MOTION. VELOCITY in Acoustics denotes the motion of sounds. For Sir Isaac Newton's calculation, see the System of ACOUSTICS, Sect. I.

VELOCITY, in Gunnery, denotes the velocity with which military projectiles issue from the piece by which they are discharged. This is now known to be much more considerable than was formerly apprehended. For the method of estimating it, and the result of a variety of experiments, see the System of PROJECTILES.

VENEREAL, something belonging to VENUS. VENEREAL disease, *lues VENEREA*, the French disease, *feul disease*, French pox, or great pox, is a contagious malady, contracted by some impure humour generally received in coition; and discovering itself in ulcers and pains about the genital, and other parts. For a copious description, with the prognosis, and cure, see the System of MEDICINE, Genus 59.

VENERY is used for the act of copulation, or coition, of the

VEN

two sexes. It takes its name from Venus, the supposed deity of the passion of love.

VENERY also denotes the arts or exercise of hunting wild beasts; which are also called *beasts of venery*, and *beasts of the forest*. Such are the hare, hart, hind, boar, &c.

VENTER, *belly*, in Anatomy, a cavity in the body of an animal, containing viscera, or other organs, necessary for the performance of divers functions. Physicians divide the human body into three venters, regions or cavities: the first, the HEAD, containing the brain, &c. The second, the BREAST, or THORAX, as far as the diaphragm, containing the organs of respiration. The third, which is what we more commonly call the *venter*, or *belly*, is that wherein the intestines and the organs of generation and digestion are contained; this is called, by anatomists, the ABDOMEN. For description of these several parts, see the System, Part III. and IV. with the Plates annexed.

VENTRICLE, *ventriculus*, q. d. *little belly*, in Anatomy, a diminutive of VENTER; signifying a cavity smaller than what we express by a venter; or, rather a division of a venter; or some smaller cavity contained in a larger. There are two cavities in the heart, adjoining to the auricles, and four in the brain, called ventricles. The right ventricle of the heart, relaxing, admits the blood, by the right auricle, from the cava; and, in contracting, drives it out into the pulmonary arteries; the left, receiving the blood by the left auricle, from the lungs, drives it out into the aorta. See the System, Part V. Sect. III. and Plate VII.

VENUS, in Astronomy, one of the inferior planets; denoted by the character ♀. Venus is easily distinguished by her brightness and whiteness, which exceed that of all the other planets; and which is so considerable, that in a dusky place, she projects a sensible shadow. Her place is between the earth and Mercury. For a particular description of this planet, see the System, Sect. VIII.

VENUS, in Mythology, the goddess of love, is represented by the poets, painters, and statuaries of antiquity, in a variety of alluring forms: with her hair sometimes waving over her naked shoulders, and sometimes negligently tied behind in golden tresses; with a mantle, exhibiting all the colours of the rainbow and glittering with diamonds, sometimes flowing loosely, and at other times bound with a girdle or belt, called CESTUS, of which it is said that, *in eo deliramenta omnia inclusa erant; ubi inerat amor, inerat desiderium, inerat et amantium colloquium, inerat et blanda loquentia que furtim mentem prudentium subripit*: accompanied by the two Cupids, the three Graces, and followed by the beautiful Adonis, who held up her train; and riding in a chariot of ivory, finely carved and beautifully painted and gilt, and drawn by swans, doves, or swallows. She is sometimes exhibited like a young virgin arising from the sea, and riding in a shell; at other times with a shell in her hand, and her head crowned with roses; sometimes with a mirror in her hand, and golden sandals and buckles on her feet; sometimes with poppy in one hand, and an apple in the other; and at Elis she was represented as treading on a tortoise; the tortoise being an emblem of reserve and modesty. We shall only add that, Venus is sometimes described by the poets of the third age under the character of the goddess of jealousy, rather than as the goddess of love; in which Valerius Flaccus (Argon. ii. v. 106.) and Statius (Theb. v. v. 69.) have drawn two very terrible pictures of her. Spence's Polymetis, p. 74.

VENUS de Medicis, in the history of ancient sculpture, a famous statue of white marble, about five feet high, brought from the Medicis palace at Rome to Florence, by order of Duke Cosmo III. and now standing in the great duke's palace. The hips, legs, and arms, were broken off by the removal of this statue; but they have been rejoined with an art, that renders their former separation imperceptible. The inscription on the base intimates that this was the work of Cleomenes, an Athenian, the son of Apollodorus; the pedestal is modern. The statue seems to bear a little forward; the right knee advances a little, the left-hand is placed before that part which distinguishes the sexes, and the right across her breasts: yet without touching the body. The head inclines a little to the left shoulder; so that her face seems to be turned away a little from the observer; and from this circumstance some have taken occasion to remark, that the air of the head of this Venus expresses three different passions: as you first approach her, you perceive aversion or denial in her look; as you advance a step or two nearer, she shews compliance; and one step more to the right, it is said, turns into a little insidious and insulting smile; but Mr. Spence does not allow that this account is justified by the statue itself. The attitude of the Venus de Medicis is peculiarly graceful: that attitude may be described in two verses of Ovid, Art. Am. v. 614.

The bloom of youth, the pleasing softness of her look, and her beauty and modesty, seem to rival each other in the charms of her countenance. Her person is somewhat plump, and the flesh is so admirably executed, that it seems so soft as if it would yield to the touch. Time has given to the white marble a yellowish hue, though still in the sun-shine it is almost transparent: her hair is brown, which may be no more than the faded gilding not unusual among the ancients. The head, which is said to be too small in proportion to the other parts, is suspected by some not to have been executed by the same artist who made the body: this will ever be the standard of female beauty and softness: the breasts

are

are also the finest that can be conceived, small, distinct, and delicate, suggesting an idea of softness which no copies can imitate, and also of firmness: from the breasts, her shape begins to diminish gradually down to her waist; but with an exquisite fineness of shape; the Venus of Medici has what the Romans call *corpus solidum*, and the French the *enbon-point*; and her waist in particular is not represented as stunted by art, but as exactly proportioned by nature to all the other parts of her body. There is also a tenderness and elegance in every other part of her form: so that she possesses all those lesser beauties which the poets have marked out in the female make; the *teretes surae* (Hor. lib. ii. od. iv. ver. 21) and the *pes candidus* (id. lib. iv. od. i. v. 27.) and *exiguus* (Ovid. Am. lib. ii. el. iii. v. 7.) And one may well say of this statue, what one of the persons in Plautus's *Epidicus* (act v. sc. i.) says of a complete beauty:

Ab unguicula ad capillum summum, est festivissima.

Though the Venus of Medici has not escaped censure, with regard to the smallness of her head and hips, the largeness of the nose, the depth of the partition along the vertebrae of the back, the length of her fingers, which, excepting the little finger on the right-hand, are without joints; and though in comparing the parts separate, as the head, nose, &c. of this statue, with those of others, the similar parts might be found, even of superior workmanship; yet for such a combination of beauties, the delicacy of shape and attitude, and symmetry of the whole, it is universally allowed that the world doth not afford its equal. This incomparable statue stands between two others, which in any other place would be esteemed admirable pieces: that on the right of the Venus de Medici is twice as big, with the golden apple in her hand, and is called Venus Victrix: the other by Hercules Ferrata, is distinguished by the name of Venus Urania. Spence's *Polymetis*, p. 6, &c. Keysser's *Travels*, vol. i. p. 434. For a representation of the Venus de Medicis, see Plate II. in the *Treatise of Drawing*; for its proportions and measurements in Drawing, according to Monsieur Audran, see the *Treatise*, Sect. III.

VENUS, in Conchology, a genus of shells, belonging to the second order *Bivalves*. For the characters of the genus and classification in general, see the *System*, Order II. Genus 10.

Mount of VENUS, *Mons VENERIS*, among Anatomists, is a little hairy protuberance in the middle of the pubes of women; occasioned by the collection of fat under the skin in that place. See the *System*, Part III. Sect. XV. Art. 2.

VERB, in Grammar, a word serving to express what we affirm of any subject, or attribute to it; or, it is that part of speech, by which one thing is attributed to another, as to its subject; as the words, *is*, *understands*, *bears*, *believes*, &c. see the *System*, Part I. Chap. II. Sect. I. and Part II. Chap. III. Art. 5, throughout.

VERDEGREASE, VERDIGREASE, VERDEGRIS, or VERDIGRIS, a kind of rust of copper, formed from the corrosion of copper by a fermented vegetable, and into a bluish green substance, of great use among painters for a green colour. The goodness of verdigrise is judged of from the deepness and brightness of its colour, its dryness, and its forming, when rubbed on the hand with a little water or saliva, smooth paste, free from grittiness. Verdigrise is employed externally for detaching foul ulcers, and as an escharotic. Hoffman recommends it particularly for destroying the callosities of old fistulae: tents of powdered verdigrise, made up with saliva, or other liquids, not fat or oily, consume, he says, the hardest callus in three or four days, so as to render it completely separable. A detergent ointment, called *mel Aegyptiacum*, is prepared by boiling five parts of verdigrise in fine powder with sixteen of honey, and seven of vinegar, till reduced to a clear consistence. The thinner matter which floats on the top of this mixture, after standing for some time, is generally used, unless it be required more acid, in which case the thick part which has subsided is shook up among it. In the Edinburgh dispensatory, an ointment called *unguentum ex aerugine*, is directed, composed of white wax and resin, each two ounces, olive oil one pint, and verdigrise half an ounce. When these kinds of applications are employed for venereal or other ulcerations in the mouth or tonsils, great caution is necessary, lest they should pass into the stomach, in which case dangerous and even fatal consequences may ensue. Verdigrise is rarely or never given internally. Some recommend it, in the dose of a grain or two, as an emetic, which produces almost instantaneous effect, where poisonous substances have been taken, for the immediate rejection of them. But warm water, milk, and oils, are much less dangerous, and more proper. Lewis's *Mat. Med.* M. Navier has lately evinced the salutary effects of liver of sulphur, and particularly of liver of sulphur of Mars, as an antidote against the poison of verdigrise. Verdigrise makes a blue green colour in paint; but is generally used in yellow, which, by a proper mixture, renders it a true green. It is bright when good; but soon flies when used in oil. When dissolved in vinegar, it is used in water painting, and is more durable; it may be also dissolved in the juice of rue, and thus produces a fine full green colour, equally fit for washing with that dissolved in vinegar. Verdigrise, with a decoction of logwood, strikes a deep black, which when diluted becomes a fine blue.

VERDICT, (*vere dictum*), is the answer of the jury given to the court concerning the matter of fact, in any case civil or criminal, committed by the court to their trial and examination. In the law of England, a verdict is either privy or public. A

privy verdict is either when the judge hath left or adjourned the court: and the jury, being agreed in order to be delivered from their confinement, obtain liberty to give their verdict privily to the judge out of court: which privy verdict is of no force, unless afterwards affirmed by a public verdict given openly in court; wherein the jury may if they please, vary from their privy verdict. So that the privy verdict is indeed a mere nullity: and yet it is a dangerous practice; allowing time for the parties to tamper with the jury, and therefore very seldom indulged. But the only effectual and legal verdict is the public verdict; in which they openly declare to have found the issue for the plaintiff, or for the defendant; and if for the plaintiff, they assess the damages also sustained by the plaintiff, in consequence of the injury upon which the action is brought. Sometimes, if there arises in the case any difficult matter of law, the jury, for the sake of better information, and to avoid the danger of having their verdict attained, will find a special verdict; which is grounded on the statute Westm. 2. 13 Edw. I. c. 30. § 2. And herein they state the naked facts, as they find them to be proved, and pray the advice of the court thereon; concluding conditionally, that if upon the whole matter the court shall be of opinion that the plaintiff had cause of action, they then find for the plaintiff; if otherwise, then for the defendant. This is entered at length in the record, and afterwards argued and determined in the court at Westminster, from whence the issue came to be tried.

Another method of finding a species of special verdict, is when the jury find a verdict generally for the plaintiff, but subject nevertheless to the opinion of the judge or the court above, on a special case stated by the counsel on both sides with regard to a matter of law: which has this advantage over a special verdict, that it is attended with much less expence, and obtains a much speedier decision; the postea being stayed in the hands of the officer of *nisi prius* till the question is determined, and the verdict is then entered for the plaintiff or defendant as the case may happen. But as nothing appears upon the record but the general verdict, the parties are precluded hereby from the benefit of a writ of error, if dissatisfied with the judgment of the court or judge, upon the point of law; which makes it a thing to be wished, that a method could be devised of either lessening the expence of special verdicts, or else of entering the case at length upon the *postea*. But in both these instances the jury may, if they think proper, take upon themselves to determine, at their own hazard, the complicated question of fact and law; and, without either special verdict or special case may find a verdict absolutely either for the plaintiff or defendant.

In criminal cases, the jury deliver in their verdict with the same forms as in civil cases: only they cannot in a criminal case which touches life or member, give a privy verdict. But an open verdict may be either general, guilty, or not guilty; or special, setting forth all the circumstances of the case, and praying the judgment of the court, whether, for instance, on the facts stated, it be murder, manslaughter, or no crime at all. This is where they doubt the matter of law, and therefore choose to leave it to the determination of the court; though they have an unquestionable right of determining upon all the circumstances, and finding a general verdict, if they think proper so to hazard a breach of their oaths: and, if their verdict be notoriously wrong they may be punished, and the verdict set aside by attain at the suit of the king; but not at the suit of the prisoner. But the practice, heretofore in use, of fining, imprisoning, or otherwise punishing jurors, merely at the discretion of the court, for finding their verdict contrary to the direction of the judge, was arbitrary, unconstitutional, and illegal; and was treated as such by Sir Thomas Smith 200 years ago; who accounted "such doings to be very violent, tyrannical and contrary to the liberty and custom of the realm of England." For, as Sir Matthew Hale well observes, it would be a most unhappy case for the judge himself, if the prisoner's fate depended upon his directions:—unhappy also for the prisoner; for if the judge's opinion must rule the verdict, the trial by jury must be useless. Yet in many instances, where, contrary to evidence, the jury have found the prisoner guilty, their verdict hath been mercifully set aside, and a new trial granted by the court of king's bench; for in such a case, as hath been said, it cannot be set right by attain. But there hath yet been no instance of granting a new trial, where the prisoner was acquitted upon the first. See JURY and TRIAL.

VERJUICE, a juice or liquor drawn from four grapes or wild apples, unfit for wine, or cyder, or from sweet ones, while yet acid, or unripe. Its chief use is in sauces, ragouts, &c. though it is also an ingredient in some medicinal compositions: and is used by the wax chandlers to purify their wax. It has its name from a large sort of grape, called *verjus*, or *bour delas*; which is said never to grow perfectly ripe; or rather, which in its utmost maturity is too austere and sour to be used in wine: whence it is commonly turned into verjuice; though in France all unripe grapes are denominated *verjus*. There is also a tolerable verjuice made of crabs, gathered and laid in a heap to sweat, the stalks, &c. separated; they are then stamped, or ground, and the crab mash put in a hair bag; the juice squeezed in a press, then barrelled up close, and set in a warm place to work for ten or twelve days.

VERMEOLOGY, or VERMES, in the Linnæan system, the sixth class in the animal kingdom. For its description and classification, see the Article VERMEOLOGY.

VERMEOLOGY.

INTRODUCTION.

THIS part of natural history forms the sixth and last class of animals in the first division of the system of nature, called *zoology*, or the *animal kingdom*. The class *vermes* comprises five orders, viz. 1. *Intestina*; 2. *Mollusca*; 3. *Testacea*; 4. *Lithophyta*; and 5. *Zoophyta*. These orders are divided into 80 genera, which are again subdivided into 1166 species; consequently to enter into a description of all the generic and specific characters of these numerous animals would lead us far beyond the limits of our plan. Indeed was the space allotted much more extensive, we should have persisted in our present plan, as this is one of the classes of animal nature so little known and studied; that to enter into a description beyond that which is here adopted, it is apprehended would prove unentertaining and tedious to the majority of our readers from the multiplicity of species that would require consideration as well as the uninteresting nature of many of them. Therefore under this head we shall introduce general observations on the class and orders, extracted from that valuable work of Mr. James Barbut entitled, *The Genera Vermium* exemplified by various specimens of the animals contained in the orders of Linnæus, which from its merits will be highly entertaining to the readers. Those who wish to pursue the subject further, we recommend to the perusal of the above work, as being the most judicious system, founded on the basis of Linnæus, and superior to any of the kind yet extant.

OBSERVATIONS ON THE CLASS, ORDERS, AND GENERA.

The animals of this class are distinguished by having the heart with one ventricle, and no auricle, and a cold, colourless sanies, and they are particularly distinguished from insects which are antennated, by being tentaculated. They are of a slow progressive motion, soft substance, able to encrease their volume; very tenacious of life; they renew their skin, are hermaphroditical, fond of moisture, have neither head nor feet, and may be known by their tentacula or feelers. By the ancients they were not improperly called imperfect animals, as being destitute of head, ears, nose, feet, and for the most part of eyes; therefore totally distinct from insects, between whom Linnæus has long since exploded the clandestine union of nature: they are intestine, soft, testaceous, lithophyte, and zoophyte. The intestine, formerly called earthy, by help of the great simplicity of their frame, bore holes through every thing. The gordius perforates clay, to make a passage for the water; the lumbricus the earth, lest it should be spoiled by inaction; the myxine dead bodies, to effect their dissolution; the terebrator wood, to its destruction; as the pholades and stone-penetrating mytili do in rocks, to bring on their dissolution. The mollusca or soft, are naked, provided with arms, for the most part inhabit the sea, shine in the open air, and being of a phosphorous nature, they, as so many lamps, illuminate the darksome deep, so that the nether parts resemble the vast expanse above. The testacea are soft worms that carry their habitations with them, being provided with a small house made of lime. They are opposed to insects by the number of their species, which sporting nature multiplies in great varieties.

Lithophytes, are soft composite animals affixed to and inhabiting shells. The ancients judged these corals to be plants petrified by the contact of the air; to the moderns, they appeared to be stones growing from their own proper seed; especially on account of their calcareous nature, till the industry of Marfiglius drew out of the sea corals vegetating with octandrous octopetalous flowers, which contracted when exposed to the air, and expanded again in the water: but at the same period Peysonel makes corals to consist of animalcules. Above a century after this opinion was received among the Sages of India. Tremblais first saw in them water snakes, in which he would have scarce been regarded, had he not discovered them to the admiration of every one, and brought to the shore a concourse of curious persons, whereby, with the help of Ellis's invention, a way was opened to the corals. Zoophytes, are composite animals placed in the medium between animals and vegetables, most of them taking root, grow in stalks, multiplying life in their branches, in their buds which decay, and in the metamorphose of their animated blossoms which move spontaneously, and turn to seminiferous bags, as if plants were zoophytes, destitute of sense and motion, and zoophytes were real plants but with a nervous system, and endowed with organs of sense and motion. My opinion, says Pliny, is that they have a sense which is neither that of animals nor of vegetables, but a third nature, compounded of the two, and that therefore vegetables by a natural transformation are to be changed into animals. For a description of these animals, as viewed by the microscope, see MICROSCOPIC OBJECTS, Plate I. and its explanation.

When we consider the station of animals which inhabit the deep, we need not wonder that this part of nature has not been thoroughly illustrated. Innumerable figures of their habitations have been correctly delineated, but many of the inhabitants are not sufficiently known. By this it may appear that our naturalists have been greater painters than philosophers; save the inimitable Argenville, whose knowledge and labour adorn the age and country which gave him birth. The immortal Linnæus, with infinite judgment, has exhibited an arrangement of the testaceous animals,

N^o 146.

not only generically analogous to the animals themselves, but has preserved the distinctive characters of their habitations likewise, which is certainly the most scientific method: and though certain persons have taken the liberty to criticise the works of this wonderful man, they are as much inferior to him in brilliancy of wit and solidity of judgment, as a glow-worm is to the evening star. The animals generally arranged under the order mollusca, may not be perhaps so numerous as is commonly imagined; for this reason; many of them may be inhabitants of shells, whose usual abode is in the depths of the ocean, and may have been forced from their hold in an hostile manner, by animals more powerful than themselves; and having escaped the enemy, have risen to the surface, and by the hardening nature of the air, may have acquired a toughness to their skin, and likewise strength sufficient to float or swim, according to the several properties with which nature may have endowed them; in short, their external appearance strongly enforces my opinion, and more especially when we consider, that the animals of the mollusca bear so strong a resemblance in form and generic character to those inhabiting shells, and that they all are capable of contraction and expansion. The animals arranged under this class, internally are endued with innumerable muscles, which give them the peculiar property of increasing or diminishing their volume.

The gordius, a genus of the first order, pieces through the clay, with the same facility as a fish does the water, and by which perforations are made for the water to pass through, and form springs; others of the same genus insinuate themselves in the muscles of the eastern traveller, while some infest the livers of the herring, and fresh water pike. The ascaris penetrates the putrefying roots of plants, and the human intestines. The lumbricus bores the earth and sands of the sea, and is an excellent bait for fishing. The fasciola feeds on the livers of sheep, and is often vomited up by them in brooks where they drink, and in all probability occasions the rot, or no doubt some disorder, not less fatal to these harmless useful animals; may they not be the occasion of the spots which we often see in their livers? The siphunculus lodges under the rocks, and through its tubular mouth, takes in with the sea water the minute animalcula, which constitute its nourishment, squirting out again the useless water. Leeches, though great plagues to fish and animals on which they fix, are yet productive of great good, when medicinally applied to draw off the inspissated blood. The myxine enters the mouth of the poor captive fish, when caught by a night line, devours its whole inside, and leaves the bare skin as the fishermen's prey. The slug, a genus of the second order, consumes the roots and leaves of plants, trees, &c. but affords food for many birds, as ravens, rooks, &c. and the amber slug has been recommended in consumptive cases. The lapylia, wrapped round as it were with a cloak, is protected by the qualities nature has endowed it with, both on account of its fetid smell, and the painful tingling which follows the touch, feeds on sea weeds, and is greedily devoured by the porpoise. Thus it plainly appears, that whatever poisonous qualities some animals may possess, with regard to mankind, they may nevertheless be harmless and even nourishing food to other creatures; for a sailor happening to take a lapylia in the Mediterranean, it gave him such instantaneous and excruciating pain, as to cause an inflammation, and the poor man lost his arm; and so sensible are the fishermen of the poisonous quality of the mucus, which oozes from its body, that they will not on any account touch it.

The doris is furnished with eyes in the manner of the land snail, trails among the rocks, feeds on weeds, corallines, &c. and falls a prey to crabs, star fish, the cuttle, &c. This genus accords with the limax in motion, and the animals belonging to it, folding themselves up, when at rest. The aphrodita, remarkable for the beauty of the velvety down, which adorns the whole genus, crawls among the rocks, by the assistance of its feet, similar in construction to those of the caterpillar tribes, exists upon small shell fish, and in its turn, becomes delicious food to many of its marine neighbours.

The nereis contains animals of various size, some invisibly minute, yet afford subsistence to many small marine animalcula; those lodge in the interstices of the scales of fishes, and perhaps exist on the mucous matter which oozes from their bodies; others of greater magnitude, enter the tubular lodging of the serpule and terebines, and destroy the inhabitants thereof; while the giant nereis, the largest of this tribe, bores holes in the piles driven down in the sea, and thereby undermining the work, effects its destruction. These animals bear a strong resemblance in form to the land Juli.

We now take a step rather remote from animals of a more active nature, when we enter upon a view of the Ascidia; an animal, whose functions are so extraordinary, as to appear only a few degrees removed from marine plants, constantly affixed to some body; its motion is imperceptibly slow, scarce making one inch in some hours, therefore never recedes far from its native spot; its life is taken up, in continually receiving in its body the sea water, and squirting it out again; the internal structure of the animal's mouth is furnished with a number of minute papillæ, by which means it preserves from escape, in the act of ejecting the water, those animalculæ, which constitute its nourishment. The ascidia affixes

*

5 E

itself

VERMEOLOGY.

itself by a kind of peduncle, to rocks, oysters, &c. and displays its florescent head, in such manner as more to resemble a flower than an animal; the radii which adorn the head, are so many tentacula, by which the animal assumes and conveys its prey to its mouth, which is the centre of the flower as it were; at times they assume such various forms, as to be mistaken for animals of a different genus.

The Tethys makes its abode in the depths of the ocean, affixing itself to the argillaceous bottom, or to rocks; lives upon sea weeds, is preyed upon by lobsters, &c. Little is known of this animal on account of its deep recess, and very few have been taken.

The Holothuria, beset with innumerable tentacula all over its belly, adheres by them to the bottom of the sea, at the same time agitating in search of food the branchy tentacula which adorn its head; and occasionally assumes many ludicrous and grotesque forms, which has caused naturalists to impose on them names not in the least analogous to their nature.

The Terebella, furnished as it were with an auger, pierces the rocks, and consigned by nature to its dark dwelling, rests in security, till the hungry crab, with its cheliferous claw, drags him from his lurking place, and devours him. The Triton, inserting its body in the holes of rocks, which lie concealed under water, throws out its head and cheliferous tentacula, whereby it seizes the unwary prey, which happens to crawl or swim within reach. But he has likewise many enemies to encounter, the crab, asterias, cuttle, &c.

The Lernæa affixes itself behind the gills of various fishes, and like the leech draws forth its nourishment by suction. The Scyllæa affixed by its back to the fucus floating in the ocean underneath, spreads out his foliate tentacula, and assumes such food as chance may throw in its way during the course of the voyage; but the shark, porpoise, and other fish riot in its destruction. The Clio, from its structure, seems more calculated as a prey, than to prey upon others. Nature therefore has provided it with a funnel-formed sheath, into which it withdraws itself when necessity urges.

The Cuttle, so frequently a prey to turbot, and many other marine animals, often escapes by blackening the water around with the liquor which Providence has furnished him with, and which he ejects as occasion requires. He is not less voracious in his kind, and is the destroyer of many weaker animals. Some of this genus are of an alarming magnitude; and with their strong tentacula will pull a boat under water, if they are not cut off with an axe; an instrument commonly carried by the Indians in those seas where they frequent.

The Medusa, a gelatinous substance, appearing like a lifeless lump of jelly, floating on the surface of the ocean, and plying underneath with its tentacula, embraces the small fry, and devours them: they are aggregate animals; and though they are said to occasion, when touched, the same alarming sensation as the lappet, the ravenous shark, with malignant eye, darts side-long at them, and devours many of them at a mouthful. These animals when dead soon dissolve to a thin lucid water, and nothing substantial of them remains which leaves any traces of their former animated state. To examine the nature and property of these beings, it is necessary to preserve them in a large glass filled with sea water, which should be changed daily. The Actinia, Ascidia, and many others, might be investigated by the same means, and much pleasure and improvement in the knowledge of the ways of these creatures are derived therefrom.

We are now come to the Asterias; an animal apparently possessing stronger animal functions and properties than the preceding genus, though its motion is slow, when we consider the number of fasciculi which surround its rays, and serve the animal as feet, by which means it moves either sideways, backward or forward, and in any direction the creature requires; with them it likewise clings to the rocks, and preserves itself from being dashed about by the tempestuous waves. They are likewise as tentacula to the animal with which it seizes its prey, and conveys it to the mouth; their rays are of so brittle a nature as easily to be broke off, but in time they grow again, as the claws of crabs and lobsters do, when lost. It subsists on young crabs, small shell-fish, &c.

The Echinus is an extraordinary creature, though common: armed with spines, which serve the animal as feet, it moves in every direction, and occasionally throws out tentacula, with which it grapples to the bottom of the sea, at the approach of a storm. Some of these animals have feet to the number of 2000, with which they move in every direction; between the feet issue 12 or 1500 small tentacula, the use of which seems to be that of reconnoitering the ground; and they are like to tackling, by the help of which they cast anchor during the violence of a tempest. As soon as these animals are seen to plunge and grapple at the bottom of the water, there is a certainty of foul weather to come.

The head of these animals is placed at the large aperture, and armed with small teeth. At Marseilles, Sea Urchins are sold in the markets the same as oysters, and the people do not open them but with gloves on. They are eaten when full of eggs, boiled like hens eggs. Custom must reconcile one to this kind of food, which at first seems very disgusting. When the animal is dead, the spines

with which it is set, fall off, and leave naked the avenues and numberless small points, set in compartments over the bony incrustation.

It has been warmly disputed by naturalists, whether the Echini Marini belonged properly to the crustaceous or the testaceous animals; the determination is easy, they belong to neither: their characteristics, the structure of their bodies, and even the form, use and intent of their several exterior parts, usually comprehended under the term shell, are wholly different from those of all other creatures; and, as such, are a distinct series of animals by themselves, and require to be arranged accordingly.

Klein, who has been at great pains to arrange these bodies, has divided them into several genera, but they may be all conveniently ranked under the two families of the Linnæan system.

But nature has ornamented this creature in a most surprising manner; the finest sculptor could not, with the most consummate skill and labour, imitate its ornaments, with such regularity, beauty, and numerous excrescences; which are the joints to which their spines are affixed, and made moveable by, all over the calcareous covering; some are as it were, laid out in avenues, like unto a parterre, others are reticulated, in the manner of the most beautiful and exact net-work, interspersed with excrescences of a minute globular form. Some have their habitation round, others oval; and again there are some that have them round, oblong, and flat: as various are the forms of their spines; round, quadrangular, octagonal; some formed like bristles, others like pillars belonging to a fine building. Their colour, when stripped of their spines, which soon fall off after the animal's decease, is beautifully various; some being green, yellow, purple, red, brown; and others blushing with the tinge of the Tyrian dye.

Observations on testaceous animals are far from being unenterprising, and possess great singularity in their endowment, every genus having qualities peculiar to it. The splendor and durability of their beautiful colours render them pleasing subjects of admiration in the cabinet. How are we struck with amazement, when, on traversing the shores of islands, we observe some closely affixed and cemented by means of a viscous humour, which agglutinates them to rocks, wrecks, &c. while the animal is sporting its tentacula from the opening at the top in quest of prey? Others we find buried in rocks, stones, and wood, enlarging their habitations according to their growth, whose nutriment is the minute animalcula contained in the sea-water, which they draw in by means of a tube, and reject it again at pleasure. Behold the Solen burying himself quickly in a directing perpendicular manner in the sand, to elude the pursuit of its enemy, or travelling in the same manner to the surface in quest of prey. View yon Tellina, how she embraces the greater circumference of her shells with her muscular foot, and striking the ground therewith, leaps to a certain distance. The Pectines likewise possess this quality.

Behold the splendour of the Pectines which rival the glowing colours of the papilionaceous tribe, as numerous as they are beautiful; flitting from place to place, and may well be called the Papiliones of the ocean. What superior qualities do not the Pectines enjoy above the Ostrea Edulis, which, constantly confined to its native bed, seems wholly destined to afford food to other creatures, not having any means of defence but its shelly castle, which is frequently attacked by its numerous enemies. This creature is not only useful to man as a dainty food, but the shell, being levigated into a subtle power, is employed as an absorbent in heart-burns and other like complaints arising from acidities in the first passages: the hollow shells are generally made choice of, as containing more than the thinner flat ones of the fine white earth, in proportion to the outer rougher coat; which last is found to be considerably impregnated with sea salt. The Pectines, by some, are esteemed as delicious a food as the oyster; but though the generic character of the hinge agrees in both, the animal inhabiting the Pectines is very different from that of the oyster; for which reason, Linnæus has divided the genus into sections.

The various endowments of these animals, complement of tentacula, ways of life, and manner of procuring their subsistence, are matters of entertainment; while they produce in the heart the sublime reflection of the infinite wisdom and power of the Most High, in enduing every animal with their necessary requisites, and fixing the places of their abode according to the task and function, he has been pleased to frame them for. Various are their pursuits; one preys on another; the most numerous fall a prey to those animals which are more rare. Their increase and decrease are proportioned to their hazards, and the full complement of every genus is kept up to complete every link in the chain of nature. Perhaps the first cause of our little acquaintance with this part of the work of God, is in a great measure due to our pride, by looking down with contempt or disregard on animals; vainly in our ideas deemed worthless, by being far removed from us in their nature and properties; but let us take a nearer view of them, and our admiration will increase as our ignorance wears away; and the mind will become illumined; so prolific indeed is nature in all her works, sporting with her amazing powers over all the creation, and proving the vast source of wisdom from whence her operations flow; that in the holy exultation of our hearts, we shall cry aloud, O God, how wondrous are thy works!

V E R

VERMICELLI, or **VERMICHELLY**, a kind of mixture prepared of flour, cheese, yolks of eggs, sugar, and saffron; and reduced into little long pieces or threads, like worms, by forcing it with a piston through a number of little holes in the end of a pipe made for the purpose. The word in the original Italian, signifies little worms; they also call it *tagliarini* and *millefanti*. It was first brought to us from Italy, where it is in great vogue. In effect, it is the great regale of the Italians. Other nations are not easily brought to relish the taste of it. It is chiefly used in soups and pottages, to warm, provoke venery, &c.

VERMICULAR an epithet given to any thing that bears a relation or resemblance to worms, *vermiculi*. Anatomists particularly apply it to the motion of the intestines and certain muscles of the body. The vermicular, or peristaltic motion of the intestines is performed by the contraction of the fibres thereof from above downward; as the unnatural, or antiperistaltic motion, is by their contraction from below upwards. The contraction happening in the peristaltic, which others call the vermicular motion, as resembling the motion of worms, does not affect all the parts of the intestines at once; but one part after another.

VERMIFORMIS, in anatomy, a term applied to various parts in the human body; bearing some resemblance to worms. Such are the *Processus*, or *Apophyses* **VERMIFORMES**, two extremities of the cerebellum, situated near the fourth ventricle of the brain.

VERNAL, something belonging to the spring season. See **SPRING**. Hence, vernal leaves are those leaves of plants, which come up in the spring, &c.

VERNAL Equinox. See **EQUINOX**.

VERSE, in poetry, a line or part of a discourse, consisting of a certain number of long and short syllables, which run with an agreeable cadence; the like being also reiterated in the course of the piece. This repetition is necessary to distinguish the notion of verse from that of prose; for in prose, as well as verse, each period and member are parts of discourse, consisting of a certain number of long and short syllables; only prose is continually diversifying its measures and cadences, and verse regularly repeats them. See **POETRY**.

VERSE is also used for a part of a chapter, section, or paragraph, subdivided into several little articles. The whole Bible is divided into chapters; and the chapters are divided into verses. The five books of the law are divided into fifty four sections. See **PENTATEUCH**. The division of verses in the New Testament was first made by Robert Stephens; and so negligently was it done, that his son Henry Stephens assures us, he worked at it as he travelled from Paris to Lyons. Many learned men find great fault with this division, and yet it is every where followed.

VERSIFICATION, the art or manner of making verse; also the tune and cadence of verse. Versification is properly applied to what the poet does more by labour, art, and rule, than by invention, and the genius, or furor poeticus. See **POETRY**. The matter of versification is long and short syllables, and feet composed of them; and its form is the arrangement of them in correct, numerous, and harmonious verses; but this is no more than a mere translator may pretend to, and which the Catilinarian war, put in measure, might merit. It is with reason, therefore, that these simple matters are distinguished from the grand poetry, and called by the name versification. In effect, there is much the same difference between grammar and rhetoric, as there is between the art of making verses, and that of inventing poems.

VERSION, a translation of some book, or writing, out of one language into another. For various versions of the Scriptures, see **SEPTUAGINT**, and **POLYGLOT**.

VERT, in heraldry, the term for a green colour. In engraving, it is expressed by diagonals, or lines drawn athwart, from right to left, from the dexter chief corner to the sinister. See the System, Sect. III. Plate II.

VERTEBRÆ, in anatomy, a chain of little bones, reaching from the top of the neck, down the back, to the os sacrum; and forming a third part of the human skeleton, called the *spina dorsalis*. For a particular description, see the System, Part I. Sect. III. Art. 1. and Plate I. fig. 2. letters *e* and *c*.

VERTEBRÆ of fish. The vertebræ of fish are extremely different in shape in the several kinds, and even vary in number in the different species of the same genus. The anterior vertebræ in some have three apophyses, as in the cyprini, efoces, pleuronecti, &c. and in the clupeæ they have no less than seven of these apophyses, but they are slender and capillary. For representation of the spine of a thornback, and water tortoise, see the System of **COMPARATIVE ANATOMY**, Chap. III. Sect. II. Plate V.

VERTEBRAL Artery, in anatomy, is an artery that goes out from the posterior and upper side of the subclavian, and runs up through all the holes in the transverse apophyses of the vertebræ of the neck; sending off little twigs, through the lateral notches of these vertebræ, to the medulla spinalis and its coverings, and giving arteries to the vertebral muscles and others near them. See the System, Part V. Sect. I. and the Figure in Plate VIII. letter R.

VERTEBRAL Muscles, in anatomy, are those which lie along the spine, the greatest part of which serve for the motions of the neck,

V E S

back, and loins. For the origin, insertion and uses of these several muscles, see the System, Part II. Sect. II. Table, Art. 8, and 9. For the first and second layer of the muscles of the vertebræ of the back, see Plate II. of **ANATOMY**, fig. 2 and 4, and its explanation. See also Plate III. fig. 2 and 4, and its explanation.

VERTEBRAL Vein, in anatomy, arises posteriorly from the subclavian or axillary, sometimes by two stems, and sometimes by one, which soon afterwards divides into two. See the System, Part V. Sect. 1. and the fig. in Plate XII. letter O.

VERTEX, in anatomy, the crown of the head, or that uppermost and middle part situate between the sinciput and occiput. Hence, also, vertex is figuratively used for the top of other things. Thus the vertex of a cone, pyramid, conic section, &c. is the point of the upper extremity of the axis, or the top of the figure.

VERTEX, in astronomy, the point of heaven perpendicularly over our heads, called the zenith.

VERTICAL Circle, in astronomy, is a great circle of the sphere, passing through the zenith N, and the nadir S, and any other given point on the surface of the sphere. The vertical circles are also called azimuths. The meridian of any place is a vertical circle. All the vertical circles intersect each other in the zenith and nadir. See the System of **ASTRONOMY**, Sect. IX. and the System of **GEOGRAPHY**, Plate II. fig. 1 and 2.

VERTICAL Plane, in perspective. See the System, Sect. III. Article **DEFINITIONS**.

VERTICAL Plane, in conics, a plane passing through the vertex of a cone, and parallel to any one conic section. Vertical line in conics, is a right line drawn on the vertical plane, and passing through the vertex of the cone. See the System of **GEOMETRY**, Part II. Article **CONIC SECTIONS**.

VERTICITY is that property of the loadstone whereby it turns or directs itself to some peculiar point. The attraction of the magnet was known long before its verticity.

VERTIGO, in medicine, an indisposition of the brain, wherein the patient sees the objects about him as if they turned round, and fancies he turns round himself: though he is all the while at rest. Physicians distinguish two kinds or rather two degrees of vertigoes. The first, called simple vertigo, is when the body and external objects appear to turn round, without any great dimness of sight. The other called *scotomia*, or *vertigo tenebrosa*, is when the eyes are also darkened, and, as it were covered with a mist. Causes of vertigoes are a continued turning round of the body, drunkenness, too long fasting, immoderate exercise, surprize, voracity, much use of pulse, onions, leeks, radishes, cabbage, mustard, &c. and in general whatever may press, distend, or contract the arteries. The first step in the cure is bleeding in the jugular, or cupping; then they proceed to an emetic; then a vesicatory on the neck, or a perpetual blister, or issues, with sternutatories, and the other medicines that obtain in the apoplexy.

VESICULA, *vesicle*, a diminutive of **VESICA**; signifying a little bladder. The lungs consist of vesiculæ, or lobules of vesiculæ, admitting air from the bronchiæ; and not only air, but also dust, &c. There are several parts in the body which bear this appellation; as,

VESICULÆ Seminales, in anatomy, are soft, whitish, knotted bodies, about three or four fingers breadth in length, one in breadth, and about three times as broad as thick, situated obliquely between the rectum and lower part of the bladder, in such a manner, as that their superior extremities are at a distance from each other, and their lower extremities united between those of the vasa deferentia. See the System, Part III. Sect. XV. Art. 1. and Plate X. upper Division, fig. 1. letters DD. See also **GENERATION**.

VESICULÆ Seminales. These vessels are very evident in fish; the females of most fish have double ovaria, though in some they are single, as in the osmerus, and perca fluviatilis of Bellonius; but the vesiculæ seminales in the males are two in number in all fish, not excepting the males of these here mentioned. They differ, however, very much in regard to their figure and situation. See **COMPARATIVE ANATOMY**, Chap. III. Sect. III.

VESPER, in astronomy, called also *Hesperus*, and the *evening star*, is the planet **VENUS**, when she is eastward of the sun, and consequently sets after him. See the System, Sect. VIII.

VESPER, in the Romish church, *evening song*; that part of the office which is rehearsed after noon: answering to our *evening prayers*; except that it differs more from the office of the morning, called *matins*.

VESPERTILIO, the **BAT**, a genus of quadrupeds, belonging to the order of primates. All the teeth are erect, pointed, near each other; and the first four are equal. The fore-feet have the toes connected by a membrane expanded into a kind of wings, by which the creature is enabled to fly. There are many species; of which the most remarkable are, the vampyrus, vampire, or Ternate bat, with large canine teeth; four cutting teeth above, the same below; sharp black nose; large naked ears; the tongue is pointed, terminated by sharp aculeated papillæ; talons very crooked, strong, and compressed sideways; no tail; the membrane divided behind quite to the rump; head of a dark ferruginous colour; on the neck, shoulder, and under-side, of a much lighter and brighter red; on the back the hair shorter, dusky, and smooth; the membranes of the wings dusky. They vary in colour; some being entirely of a reddish

reddish brown, others dusky. These monsters inhabit Guinea, Madagascar, and all the islands from thence to the remotest in the Indian Ocean. They fly in flocks, and perfectly obscure the air with their numbers; they begin their flight from one neighbouring island to another immediately on sun-set, and return in clouds from the time it is light till sun-rise. They live on fruits, and are so fond of the juice of the palm-tree, that they will intoxicate themselves with it till they drop on the ground. The Indians eat them, and declare the flesh to be very good: they grow excessively fat at certain times of the year. The French who live in the Isle de Bourbon, boil them in their bouillon, to give it a relish. The negroes have them in abhorrence. Many are of an enormous size: Beckman measured one, whose extent from tip to tip of the wings was three feet four inches. Their bodies are from the size of a pullet to that of a dove: their cry is dreadful, their smell rank, their bite, resistance and fierceness great when taken.

The noctule hath the nose slightly bilobated: ears small and rounded; on the chin a minute verruca; hair reddish ash-colour: extent of wings 13 inches. Inhabits Great Britain and France; flies high in search of food, not skimming near the ground. Bats appear abroad in this country early in the spring; sometimes they are tempted by a warm day to fall out in the winter. They fly in the evenings, and live on moths and other nocturnal insects. They fly by jerks, not with the regular motion of birds, for which the antients mistook them. They frequent glades and shady places: will go into larders and gnaw any meat they find. They bring two young at a time, which they suckle at their breast. They retire at the end of summer into caves, the eaves of houses, and into ruined buildings, in vast multitudes, where they generally remain torpid, suspended by the hind legs, enveloped in their wings. They are the prey of owls. Their voice is weak. Ovid takes notice both of that and the origin of the Latin name. See the System of Mammalia, Plate I. Order I. Genus IV. Species 6.

VESSEL, a thing proper to hold or contain liquor. Thus a tun or hoghead, &c. are vessels fit to contain ale, wine, &c. The chymists use a great diversity of vessels in their operations. See CHYMICAL APPARATUS, in the System, and Plate annexed.

VESSEL, among anatomists, &c. all the tubes or canals wherein the blood and other juices or humours, are secreted, conveyed, deposited, &c. as the veins, arteries, lymphatics, spermatics, &c. are called vessels. See those articles, in the System of ANATOMY, under their respective heads.

VESSEL, in navigation, is a general name common to all sorts of ships; i. e. all floating machines or vehicles that move in water; whether they are navigated on the ocean, or in canals and rivers. For the construction of ships in general, and description of the several important parts, see the Treatise on NAVAL AFFAIRS, Sect. IV. throughout. For the Section of a first rate ship of war from stem to stern, the representation of a first rate ship of war with rigging, &c. also the sails and yards of a ship, see the Plate annexed to the Treatise. The name vessel, however, is more particularly applied to those of the smaller kind, furnished with one or two masts.

VESTIBULE, in anatomy, denotes the fore-part of the labyrinth of the ear. The vestibule is a small cavity, of an irregular form, placed immediately above the basis of the stapes; between the semicircular canals, and the cochlea. In it appear divers foramina; as that of the fenestra ovalis; the five foramina of the semicircular canals; that of the cochlea; and five other very small ones, through which so many nerves pass. See the System, Part VII. Sect. IV. and Plate XI. fig. 6, letter G.

VETCH, or *Tara*, a species of pulse useful as fodder for cattle. For the cultivation see the System of AGRICULTURE, Sect. VII.

VIBRATION, in mechanics, a regular, reciprocal motion of a body, e. g. a pendulum, which being suspended at freedom, swings, or vibrates, first this way, then that. For the bob being raised, falls again by its gravity; and with the velocity thus acquired, rises to the same height on the other side; whence its gravity makes it fall again; and thus its vibrations are continued. For the doctrine of pendulums respecting their vibrations, &c. see PENDULUM.

The VIBRATIONS of a stretched Chord, or String, arise from its elasticity; which power being of the same kind with that of gravity, the vibrations of a chord follow the same laws as those of pendulums; consequently the vibrations of the same chord equally stretched, though they be unequal in length, are equidurnal, or are performed in equal times; and the squares of the times of the vibrations are among themselves, inversely, as the powers whereby they are equally bent, and inflected: see CHORD. The vibrations of a spring, too, are proportionable to the powers whereby it is bent; these follow the same laws as those of the chord, or pendulum; and consequently, are equidurnal; which is the foundation of spring-watches. For the vibration of sounds, see the System of ACOUSTICS, Sect. I.

VICAR, VICARIUS, a person appointed as deputy of another to perform his functions in his absence, and under his authority. The pope pretends to be vicar of Jesus Christ on earth. He has under him a grand vicar, who is a cardinal; and whose jurisdiction extends over all priests, both secular and regular.

VICAR, in the canon law, denotes a priest of a parish, the pre-

dial tithes whereof are impropriated, or appropriated; that is, belonging either to a chapter, religious house, &c. or to a layman, who receives them, and only allows the vicar the small tithes, or a convenient salary, antiently called *portio congrua*. He is thus called, *quasi vice fungens rectoris*, as serving for, or in lieu of, rector, who would be entitled to the great tithes. Hence, the part or portion of the parsonage, allotted to the vicar for his maintenance and support, or the promotion or living which he has under the parson, is called a vicarage. The endowments have usually been by a portion of the glebe, or land belonging to the parsonage, and a particular share of the tithes, called small, or vicarial TITHES. Some, however, were more liberally, and some more scantily endowed: and hence many things, as wood in particular, are in some countries a rectorial, and in some a vicarial tithe. The distinction therefore of a parson and vicar is this: that the parson has generally the whole of all the ecclesiastical dues in his parish; but a vicar has generally an appropriator over him, entitled to the best part of the profits, to whom he is in effect a perpetual curate, with a standing salary. Though in some places the vicarage has been considerably augmented by a large share of the great tithes; which augmentations were greatly assisted by the statute 29 Car. II. cap. 8. enacted in favour of poor vicars and curates, which rendered such temporary augmentations, when made by the appropriators, perpetual. Blackst. Com. book 1. p. 387.

VICE, in ethics, is ordinarily defined an elective habit, deviating either in excess, or defect, from the just medium wherein virtue is placed. It is called a habit, to distinguish it from sin, which is only an act: hence a sin is looked upon as something transient; and a vice, as something permanent. In the common use of the terms vice and sin, there is no ground for this subtle distinction. Vice, as opposed to virtue, is better defined the disagreement of the actions of any intelligent being with the nature, circumstances, and relation of things; hence called the moral unfitness of such actions. Some authors distinguish three states of vice: the first *incontinentia*, of incontinence, wherein a person sees and approves the good, but is hurried to evil by the violence of his passions. The second *intemperantia*, of intemperance; wherein even the judgment is depraved and perverted; the third *feritas*, of obduracy; wherein the person is totally immersed in vice, without any sense or feeling thereof.

VICE, is also used in the composition of divers words, to denote the relation of something that comes instead, or in the place, of another. In this sense the word is Latin, *vice*, stead, place, turn, &c. VICE-ROY, a governor of a kingdom, who commands therein in the name and stead of a king, with full and sovereign authority. Thus when Naples and Sicily were subject to Spain, vice-roys were sent thither; and the name is now given to those who govern in Mexico and Peru. The lord-lieutenant of Ireland is sometimes called the vice-roy.

VICE versa, a Latin phrase frequently retained in English writings; signifying as much as on the contrary. Thus, as the sun mounts higher and higher above the horizon, insensible perspiration increases; and, *vice versa*, as he descends lower it diminishes.

VIGNETTE, in the art of printing, is a French word, now often used among English artists and writers, to denote the flourish or ornament, placed at the beginning of a book, preface, or dedication. These vignettes or head-pieces are very various in their form and size.

VILLAGE, VILLA, or VILL, an assemblage of houses, inhabited chiefly by peasants and farmers, having usually a church, but no market. The want of a market distinguishes a village from a town.

VILLAIN, or VILLEIN, VILLANUS, in our ancient customs the same with Bondman: called also, in Doomday-book, *servus, slave*. A villain was one who held lands in villenage, or on condition of rendering base services to his lord. Under the Saxon government, there was, as Sir William Temple speaks, a sort of people in condition of downright servitude, employed in the most servile works, and belonging, they, their children and effects, to the lord of the soil, like the rest of the cattle or stock upon it. These seem to have been those who held what was called the *folk-land*, from which they were removeable at the lord's pleasure. On the arrival of the Normans here, it seems not improbable, that they, who were strangers to any other than the feudal state, might give some sparks of enfranchisement to such wretched persons as fell to their share, by admitting them, as well as others, to the oath of *fealty*, which conferred a right of protection, and raised the tenant to a kind of state superior to downright slavery, but inferior to every other condition. This they called *villanage*, and the tenants *villains*, either from the word *vilis*, or else, as Sir Edward Coke tells us, a *villa*, because they lived chiefly in villages, and were employed in rustic works of the most fordid kind; hence they were also denominated *pagenis* and *ruffici*. These villains belonging principally to lords of manors, were either *villains regardant*, by the civilians called *glebae addicti* or *ascriptitii*, that is annexed to the manor or land; or else they were in *grafs*, or at large, that is annexed to the person of the lord, and transferable from one owner to another. They could not leave their lord without his permission; but if they ran away, or were purloined from him, might

might be claimed and recovered by action, like beasts or other chattels. They held indeed small portions of land by way of sustaining themselves and families; but it was at the mere will of the lord, who might dispossess them whenever he pleased; and it was upon villain services, that is, to carry out dung, to hedge and ditch the lord's demesnes, and any other the meanest offices; and their services were not only base, but uncertain both as to time and quantity.

A villain could acquire no property either in lands or goods, but if he purchased either the lord might enter upon them, oust the villain, and seize them to his own use, unless he contrived to dispose of them again before the lord had seized them; for the lord had then lost his opportunity. In many places also, a fine was payable to the lord, if the villain presumed to marry his daughter to any one without leave from the lord; and by the common law, the lord might also bring an action against the husband for damages in thus purloining his property. For the children of villains were also in the same state of bondage with their parents; whence they are called in Latin *nativi*, whence the female appellation of a villain, who was called a *neife*. In case of a marriage between a freeman and a neife, or a villain and a free-woman, the issue followed the condition of the father, being free if he was free, and villain if he was villain; but no bastard could be born a villain. The law, however, protected the persons of villains, as the king's subjects, against atrocious injuries of the lord; for he might not kill, or maim his villain; though he might beat him with impunity, since the villain has no action or remedy at law against his lord, but in case of the murder of his ancestor, or the maiming of his own person. Neifes indeed had also an appeal of rape, in case the lord violated them by force.

Villains might be enfranchised by *manumission*. Hence, and by other means, they gained in process of time considerable ground on their lords; and in particular strengthened the tenure of their estates to that degree that they came to have in them an interest in many places full as good, in others better, than their lords. For the good nature and benevolence of many lords of manors having, time out of mind, permitted their villains, and their children, to enjoy their possessions without interruption, in a regular course of descent, the common law gave them title to prescribe against their lords; and, on performance of the same services, to hold their lands, in spite of any determination of the lord's will. For though, in general, they are said to hold their estates at the will of the lord; yet it is such a will as is agreeable to the customs of the manor; which customs are preserved and evidenced by the rolls of the several courts-baron in which they are entered, or kept on foot by the constant immemorial usage of the several manors in which the lands lie. And, as such tenants had nothing to shew for their estates but these customs, and admissions in pursuance of them, entered on those rolls, or the copies of such entries witnessed by the steward, they now began to be called *tenants by copy of a court-roll*, and their tenure itself a *copy-hold*. Copy-holders are, therefore, in truth no other but villains, who, by a long series of immemorial encroachments on the lord, have at last established a customary right to those estates, which were before held absolutely at the lord's will. These encroachments at length became so universal, that when tenure in villenage was virtually abolished (though copy-holds were reserved) by the statute of Charles II. there was hardly a *pure villain* left in the nation. To this purpose Sir Thomas Smith testifies, that in all his time (and he was secretary to Edward IV.) he never knew any villain in gross throughout the realm; and the few villains regardant that were then remaining, were such only as had belonged to bishops, monasteries, and other ecclesiastical corporations, in the preceding times of popery. By several means the generality of villains in the kingdom have long ago sprouted up into *copy-holders*; their persons being enfranchised by manumission or long acquiescence; but their estates in strictness, remaining subject to the same servile conditions and forfeitures as before; though, in general, the villain services are usually commuted for a small pecuniary quit-rent.

VINCULUM, in Algebra, a character in form of a line, or stroke drawn over a factor, divisor, or dividend, when compounded of several letters, or quantities; to connect them, and shew, that they are to be multiplied, or divided, &c. together by the other term. Thus, $d \times a + b - c$, shews that d is to be multiplied into $a + b - c$. See the System. Sect. I. Definition 18.

VINE, in botany, the English name of the genus *vitis*. For definition of the Genus, &c. see the article VITIS.

VINEGAR, ACETUM, an agreeable acid and penetrating liquor, prepared from wine, cyder, beer, and other liquors; of considerable use, both as a medicine and a sauce. The word is French, *vinaigre*; formed from *vin*, "wine;" and *aigre*, "sour." See ACETUM and WINE. Wine and other vinous liquors are said to gain a grateful sharpness, i. e. to become vinegar, by having their salts extracted by insolation or other means, and their sulphurs weakened or depressed. Others ascribe the conversion of vinous liquors into vinegar, to the grinding or sharpening of the longitudinal particles thereof; by which means they become more sharp and pungent.

VINEYARD, *vinetum*, a plantation of vines. See VITIS. Vineyards were formerly common in England, but for a considerable time the cultivation of them has been altogether neglected. No. 146.

There was a famous vineyard at Bath, planted with white Muscadine and black cluster grapes, which at one time, yielded sixty hogheads of wine at a vintage, though, in 1721, it only yielded three hogheads. Bradley also mentions a small vineyard of a private person at Rotherhithe, consisting only of a hundred vines, which yielded at a vintage ninety-five gallons of wine, that had the true Burgundy flavour, as being made of that sort of grape, and exceeded any made on this side of Paris. Mr. Miller apprehends, that renewed trials, conducted with judgment, might be attended with a success beyond the expectations that are now generally entertained. With this view particular attention should be given to the soil, situation, &c. The best soil, he says, for a vineyard in England, is such whose surface is a light sandy loam, and not above a foot and a half, or two feet deep, above the gravel or chalk: the most desirable situation is that on the north side of a river, upon an elevation inclining to the south, with a small gradual descent for draining the moisture; always open to the east, defended from the north and north-west wind by hills with a chalky surface, and surrounded by an open hilly country.

VINOUS, *vinosus*, something that relates to wine; or that has the taste and smell thereof. All vegetables, by a due treatment, afford a vinous liquor; as corn, pulse, nuts, apples, grapes, &c. A second fermentation, duly managed, turns any vinous liquor into an acetous one. The proper character and effect of fermentations are, to produce either a vinous or an acetous quality in the body fermented. See FERMENTATION.

VINTAGE, the crop of wine, or what is got from the vines each season. The word is also used for the time or season of gathering, or pressing the grapes. In France a decree or ordinance of the proper judge, and a solemn publication thereof, are acquired before the vintage can be begun.

VIPER, *vipera*, in natural history, a kind of serpent, the *coluber verus*, of Linnæus, famed not only for the exceeding venomousness of its bite, which is one of the most dangerous poisons in the animal kingdom, but, also for the great usefulness of its flesh in medicine! whence vipers come to make a considerable article in the materia medica. The head of the viper is inflated, which distinguishes it from the common snake; the snout not unlike that of a hog; the tongue is forked; the teeth, which are sixteen in each jaw, small and immovable; besides the four canine teeth, which are placed two on each side the upper jaw, and are the instruments of poison; these are long, crooked, and moveable, and can be raised and depressed at pleasure; these are hollow from near the point to the base, near which is a gland that secretes, prepares, and lodges the poison; and the same action that gives the wound, forces from this gland, through the tooth, the fatal juice into it. The viper has only one row of teeth; whereas many others of the serpent kind have two; its body is not at all fetid: whereas the inner parts of the bodies of other serpents are intolerably so; it creeps but slowly, and never leaps like other serpents; though it is nimble enough to bite when provoked.

Vipers are found in many parts of this island; but the dry, stony, and, in particular, the chalky countries abound with them. They are said to swarm in many of the Hebrides. Wormius says, the viper feeds on worms; but this assuredly is not its only diet, since there are frequently found in its stomach, frogs, toads, lizards, mice, beetles, moles, small birds, and the like; many of which are often found whole; and it is surprising to conceive how they are swallowed, since they are often three times as thick as the whole neck of the serpent, which must, therefore, be capable of a very extraordinary distension. The viper is capable of supporting very long abstinence; some of them have been kept in a box six-months without food and yet with unabated vivacity. See ABSTINENCE. They feed only for a small part of the year, but never during their confinement, except, as it is said, females with young; for if mice, their favourite diet, should at that time be thrown into their box, though they will kill, they will not eat them. The poison decreases in proportion to the duration of their confinement; and the virtues of their flesh are at the same time considerably lessened. These animals, when at liberty, remain torpid through the winter; but when confined have never been observed to take their annual repose. The male and female have the organs of generation very perfect; the female viper brings forth her young living; whereas all other serpents lay eggs, and hatch them; on which account the viper is ranked among the viviparous animals. See Philos. Transf. No. 84, p. 138.

Though vipers are viviparous, they are of that class of animals of whose generation Aristotle (*De Gen. Anim. lib. iii. cap. 2*) says, that they conceive a perfect egg within; but bring forth their young alive. The species is far from being prolific, more than eleven eggs not being found in one viper, which are, as it were, chained together, and each about the size of a blackbird's egg. They copulate in May, and are supposed to be about three months before they bring forth. It is said, that the young of the viper, when terrified, will run down the throat of the parent, and seek shelter in its belly, in the same manner as the young of the opossum retire into the ventral pouch of the old one; whence some have erroneously imagined, that the viper devours its own young. The method of catching vipers is by putting a cleft-stick on or near their head, after which they are seized by the tail, and put into a bag. Ray and Pennant.

V I P

As to the manner wherein the viper conveys its poison, authors are a little disagreed. Francisco Redi, and Moise Charras, have each of them written very curious pieces on the subject: but their result is very different. Redi maintains, that all the venom of the viper is contained in the two vesiculæ, or bags, which cover the base of the two canine teeth; whence, upon biting a yellowish liquor is squeezed out into the wound; where, mixing with the blood; and other juices, it produces those dreadful symptoms. This hypothesis he maintains by a great number of experiments; as of animals, viz. cocks, &c. being bit with vipers, after these vesiculæ and their juice had been taken out without any signs of poison, or any ill consequence at all. Charras, on the other hand, maintains, that this yellow liquor is not poisonous; that he has given it to pigeons as food, without their being at all disordered thereby; that the viper's bite he has always found mortal to animals, even after the bag has been taken clear out, as well as before; and lastly, that the poison must lie in the irritated spirits of the viper, which it exhales in the ardour of its biting, and which are so cold, that they curdle the blood, and stop the circulation. The controversy between these two ingenious authors is very extraordinary; their systems are opposite, yet both are maintained by a great number of well attested experiments.

Effects of the bite of the Viper. The symptoms following the bite of a viper are, an acute pain in the place wounded: swelling, first red, afterwards livid, spreading by degrees; great faintness: a quick, low, and sometimes interrupted pulse; sickness at the stomach: bilious convulsive vomiting; cold sweats: sometimes pains about the navel; and death itself, if the strength of the patient, or slightness of the bite do not prevent it. If he overcomes it, the swelling continues inflamed for some time; and the symptoms abating, from the wound runs a sanious liquor, little pustules are raised about it, and the colour of the skin is as if the patient were icterical. By the microscope, the virus, according to Dr. Mead, was found to consist of minute salts in continual motion; after which a number of spicula or darts appeared, resembling, but much finer, a spider's web. This, when mixed with syr. violar. inclined it to red, no ways to green; so that the juice is not alkalinous: but Mr. Boyle, and Dr. Pitcairn, prove the blood to be only an alkali. Such a small quantity of the virus seems to have so great an effect, partly by wounding the fibres, and partly by altering the cohesion of the globules of the blood, which by the elastic matter thereof, proves a nimble vehicle to carry the viperine spicula almost every where suddenly. These will stimulate and fret the sensible membranes; whereupon a more than usual afflux of the animal juices may be carried to the parts. There have been various opinions with respect to the cause of the death of animals bitten by vipers. Some have thought that it is occasioned by the immediate coagulation of the blood; and others, by a sudden inflammation of the whole frame. Hoffman, and his disciples, attribute this death to an universal spasm. Dr. Mead, as we have seen above, to the effects of the caustic saline property of the virus; Buffon, who discerns organic molecules in all animated nature, asserts that they exist in this venom, and constitute its deleterious property. Baker maintains, that this poison affects the figure and solidity of the red globules of the blood, and that a single atom of it is sufficient to corrupt the whole mass of that fluid. But the Abbe Fontana, apprehending that the life of an animal is wholly dependent on the irritability of its muscular fibres, ascribes the deleterious property of the poison of vipers, to its effect upon the irritability which it destroys, disposing the parts to a very rapid putrefaction; or rather, this loss of irritability is the consequence of the change produced in the blood by the venom.

The viper-catchers, Dr. Mead adds, have a specific, in which they can so far confide as not to be afraid of being bitten. That specific is, the axungia of the viper presently rubbed into the wound: which, consisting of clammy, viscid, penetrating, and active parts, sheathes the salts of the virus. The same author applying it to the nostrils of a dog bitten, found the creature well the next day; when this is not timely applied, and the virus has insinuated into the blood, the sal. viper is excellent, given and repeated till sweats be produced. This succeeded well with M. Charras: and Dr. Mead relates, that it recovered one after the virus had induced an universal icterus.

The dissections of the animals which had died by the bite of the viper whether they had or had not been rubbed with fallad oil, recommended in this case, afforded all the same appearances. The limb which had received the wound was in all swelled and livid, and these symptoms were usually carried along the thigh to the belly, and sometimes up to the breast. Incisions made along these parts always discovered the cellules of the membrana adiposa full of bloody coloured water, and the membrane itself was swelled, blackish, and gangrened. And this appeared always more plainly in the belly than in any other part: the membrana adiposa in all other parts of the body was in its natural state. The injured parts often had a cadaverous smell; the muscles of the wounded limb were also found of a brownish colour, and their fibres had lost their consistence, and seemed ready to give way to the approaching gangrene. Nor is this effect confined to the external parts alone: a goose that had been bitten had three gangrenous spots on its heart, and all the indications of a beginning gangrene in other parts of it;

V I R

the concave side of the liver was also gangrened, and had wholly lost its consistence; and the lungs of a fowl, that had been bitten on the wing, were found in part gangrened. The effects, however, were different in degree, from the bite of the several vipers; and there seems no reason to doubt, but that the bites of different animals though of the same species, under different circumstances, either in regard to the creature wounding, or the creature wounded, may be followed with very different consequences; so that remedies are not to be depended on from their success in one or two trials. Mem. Acad. Scienc. Par. 1737.

The poison of the viper is only noxious when immediately conveyed into the blood. Nor is it mortal to eat the flesh of creatures killed by vipers, or to drink the wine in which they have been drowned, or to suck the parts they have wounded. On the contrary, signior Redi says, sucking the wound is a sovereign remedy against the bite of vipers. This author denies what has been affirmed by Aristotle and Galen, that the spittle of a fasting person kills vipers, Phil. Transf. No 9, p. 160.

The practice of sucking out poisons is very ancient, and indeed nothing can be more rational. Where the bite cannot be cut out, this is the most likely way for extracting the poison. There can be no danger in performing this office, as the poison does no harm, unless it is taken into the body by a wound. The person who sucks the wound, ought, however, to wash his mouth frequently with fallad oil, which will secure him from the least inconvenience. The Psylli in Africa, and the Mersi in Italy, were famed for curing the bites of poisonous animals, by sucking the wound; and we are told that the Indians in North America practise the same at this day. When the wound is well sucked, it should be afterwards rubbed with warm fallad oil. A poultice of bread and milk, softened with fallad oil, should likewise be applied to it, and the patient should drink freely of vinegar-whey, or water-gruel with vinegar in it, to make him sweat. Vinegar is indeed one of the best medicines which can be used in any kind of poison, and ought to be taken very liberally. If the patient be sick, he may take a vomit. This course, says Dr. Buchan, will be sufficient to cure the bite of any of the poisonous animals of this country. The form in which they are used to the best advantage, is that of broth, or jus viperinum, of which an elegant preparation is directed by the London College.

VIRGIN, VIRGO, a female who has had no carnal commerce with a man; or, more properly, who has still the *flor virginis*, or maidenhood. By the Mosaic law, the priests are enjoined to take none to wife but those that are virgins, the widow, the divorced, and the harlot are to be refrained from.

VIRGIN, is also applied by way of eminence, to Mary the mother of our Saviour. Many of the fathers, with the modern churches, hold that the Virgin not only conceived, but brought forth, or was delivered without breach of her virginity: otherwise faith St. Augustine, it would be false which is said in the creed, that he was born of a virgin. It is even alleged that she still remained a virgin to the end of her life; whence the Greeks always called her *aei parthenos*, ever Virgin Mary; and after them the Latins, *semper virgo*. Though, as this is not recorded in Holy Writ, many have denied it, and held, that she had afterwards to do with Joseph, and bore other children; and this as early as the time of Origen.

VIRGINITY, VIRGINITAS, the test or criterion of a virgin or that which entitles her to the denomination. In the first ages of the christian church, virginity grew into great honour and esteem, inasmuch that the women were admitted to make solemn vows thereof in public. Yet it was held infamous among the Jews for a woman to die a maid. Solomon says expressly, there are four things too wonderful for him to know: "The way of an eagle in the air; of a serpent on the rock; of a ship in the midst of the sea; and the way of a man in a maid: which our translators have rendered, less justly, *the way of a man with a maid*."

Yet Moses established a test, which was to be conclusive among the Jews. The nuptial sheets, it seems, were to be viewed by the relations on both sides; and the maid's parents were to reserve them as a token of her virginity, to be produced, in case her husband should ever reproach her on that score. In case the token of virginity was not found thereon, she was to be stoned to death at her father's door. This test of virginity has occasioned abundance of speculation about the parts concerned; but the nicest enquiries cannot settle any thing certain about them. Dr. Drake says expressly, that, whatever might be expected among the Jews, there is not the same reason to expect those tokens of virginity in these countries; for besides that the Hebrews married extremely young, as is the custom in all the Eastern countries, there are several circumstances which may here frustrate such expectations, even in virgins not vitiated either by any male contact, or any wantonness of their own. In effect, in these northern climates, the inclemency of the air exposes the sex to such checks of perspiration, as gives a turn to the course of the humours, and drives so much humidity through the parts, as may extraordinarily supple and relax those membranes from which the resistance is expected; and from which, in hotter countries, it might more reasonably be depended on.

What most commonly passes among us for the test of virginity is the hymen; and yet the most curious among the anatomists are greatly divided, not only about the figure, substance, place, and perforations

forations of this famous membrane, but even about the existence thereof, some positively affirming, and others as flatly denying it. See HYMEN.

In Peru, and several other provinces in South America, we are assured by Pedro de Cieca, in the history of the Yncas, &c. that the men never marry but on condition that the next relation or friend of the maids shall undertake to enjoy her before him, and take away her virginity. And our countryman, Lawson, relates the like of some of the Indian nations of Carolina. So little is the *flax virginis* valued in some places.

VIRGO, in astronomy, one of the signs or constellations of the zodiac, into which the sun enters in the middle of August. The stars in the constellation Virgo, in Ptolemy's catalogue, are 32; in Tycho's, 33; in Hevelius's, 50; and in the Britannic, 110; See the System, Sect. IX.

VIRILE, something that belongs, or is peculiar to men, or the male sex. Thus virile member, *membrum virile*, is frequently used for the penis.

VIRILE, *Age, etas virilis*, is the strength and vigour of a man's age, viz. from thirty to forty-five-years, which is an age wherein we are equally removed from the extremes of youth and old age. See AGE. The civil lawyers only make one age of youth and virility, and yet their different temperatures seem to require a distinction, for which reason some compare youth to summer, and virility to autumn.

VIRTUE, a term used in various significations. In the general it denotes power, or perfection of any thing, whether natural or supernatural, animate or inanimate, essential or accessory. But in its more proper or restrained sense, virtue signifies a habit which improves and perfects the possessor and his actions. See MORALS.

VIRULENT, a term applied to any thing that yields a *virus*, that is, a contagious or malignant pus. The *gonorrhœa virulenta* is what we commonly call a clap.

VIS, a Latin word signifying *force* or *power*; adopted by physical writers to express divers kinds of natural powers or faculties. This is active and passive; the *vis activa* is the power of producing motion; the *vis passiva*, that of receiving or losing it. The *vis activa*, is again subdivided into *vis viva* and *vis mortua*.

Vi, *absoluta*, or *absolute force*, is that kind of centripetal force which is measured by the motion that would be generated by it in a given body, at a given distance, and depends on the efficacy of the cause producing it. See the article MOTION.

Vis acceleratrix or *accelerating force*, is that centripetal force which produces an accelerated motion, and is proportional to the velocity which it generates in a given time. This is different at different distances from the same central body; and depends not on the quantity of matter that gravitates, being equal in all sorts of bodies at equal distances from the centre. See ACCELERATION, and the System of MECHANICS, Sect. IV.

Vis inertia, *power of inactivity*, is defined by Sir Isaac Newton to be a power implanted in all matter, whereby it resists any change endeavoured to be made in its state; i. e. whereby it becomes difficult to alter its state, either of rest or motion. See the System of mechanics, Sect. I.

VISCERA, in Anatomy, a term of equal import with entrails, including the heart, liver, lungs, spleen, intestines, and other inward parts of the body. For description of these several parts, see the System, Part III. Sect. I. to XI. For representation, see Plate V. fig. 3, 4; and its explanation.

VISCIDITY or **VISCOSITY**, the quality of something that is *viscid* or *viscous*, i. e. glutinous and sticky, like bird lime. *Viscid bodies* are those which consist of parts so implicated within each other, that they resist, a long time, a complete separation, and rather give way to the violence done them by stretching, or extending each way. The two great *viscidities* of foods has very ill effects; thus meals, or farinæ not fermented, jellies, &c. of animals, tough cheese, or curd too much pressed, produce a weight, or oppression in the stomach; wind, yawnings, crudities, obstructions of the minuter vessels in the intestines, &c. Hence an inactivity of the intestines themselves, a swelling of the abdomen: and hence a *visciditas* of the blood, from the re-union of the *viscid* particles; obstructions of the glands, paleness, coldness, tremors, &c.

VISCOUNT, or **VISCOUNT**, is used for a degree of nobility, next below a count or earl, and above a baron. Camden observes that this was an ancient name or office, but a new one of dignity never heard among us till Henry VIth's days, who, in his eighteenth year, created in parliament, John lord Beaumont, viscount Beaumont; but it is much more ancient in other countries. Du Cange, indeed, will have the dignity to have had its first rise in England; but it is much more probable it was first brought over hither by the Normans. The privileges of a viscount are, that he may have a cover of assay held under his cup when he drinks, and may have a traverse in his own house. And a Viscountess may have her gown borne up by a man, out of the presence of her superiors; and in their presence, by a woman. See the System of PEERAGE, on the progress and increase of BARONIAL honours. For titles and creations of English viscounts, see Part I. Sect. IV. For arms, &c. see Plate III. For Scotch viscounts, &c. see Part II. Sect. IV. and Plate VI. For Irish viscounts, see Part. III. Sect. IV. and Plate VIII.

VISIÉR; or **VIZIÉR**, an officer or dignitary in the Ottoman empire, whereof there are two kinds; the first called by the Turks *visier azim*, that is, *grand visier*, first created in 1370. by Amurath I. in order to ease himself of the chief and weightier affairs of the government. The *grand* or *prime visier*, is the prime minister of state of the whole empire. He commands the army in chief, and presides at the divan or great council. Renegade Christians have been sometimes raised to the *visierate*; such were Khairédain, surnamed Barbarossa: Ulug Ali, Cuproli, &c. Next to the grand visier there are six other subordinate visiers, called *visiers of the bench*, who officiate as his counsellors or assessors in the divan.

VISION, **VISIO**, the act of seeing or perceiving external objects by the organ of sight. Vision is well defined to be a sensation, whereby, from a certain motion of the optic nerve, made in the bottom of the eye by the rays of light emitted or reflected from objects, and hence conveyed to the common sensory in the brain, the mind perceives the luminous object, its quantity, quality, figure, &c. The phenomena of vision, the causes thereof, and the manner when it is effected, make one of the greatest and most important articles in the whole system of natural knowledge. Indeed, a great part of the physical, mathematical, and anatomical discoveries and improvements of the moderns, terminate here, and only tend to set the business of vision in a clearer light. Hitherto refer what Sir Isaac Newton and others have discovered of the nature of light and colours; the laws of inflexion, reflexion, and refraction of the rays; the structure of the eye, particularly the retina and optic nerves, &c.

VISION in optics. The laws of vision, brought under mathematical demonstrations, make the subject of *optics*, taken in the greatest latitude of that word: for among the writers of mathematics, optics is generally taken, in a more restrained signification, for the doctrine of *direct vision*; catoptrics, for the doctrine of *reflected vision*; and dioptrics, for that of *refracted vision*. For an anatomical description of the eye, or organ of vision, see the System of ANATOMY, Part VII. Sect. V. For representation of the several parts appertaining to this organ, see Plate XI. fig. 10, 11, 12, 13 and 14. For the properties of light, the nature of vision, and whatever relates to the sight, see the system of OPTICS throughout. For a general illustration of the subject, see the Plates annexed to that system.

VISION, among divines, is used for an appearance which God occasionally sent to his prophets and saints; either by way of dream or in reality. Such were the visions of Ezekiel, Amos, &c. the vision of St. Paul, lifted up to the third heaven, &c. of Joseph, by which he was assured of the purity of the virgin, &c. Some have represented our blessed Lord's temptation in the wilderness, Matt. v. 1. &c. as a vision. Mr. Farmer, in particular considers it as a divine vision, representing the trials he was to endure, and designed to prepare him for encountering and vanquishing them. Many among the Romish saints, have pretended to visions: as St. Theresa, St. Bridget, St. Catharine de Sienna, &c. Hence the word has come into disrepute, and become a common name for all chimeras or spectres, which either our folly or our fear possesses us with; and hence a person that frames to himself wild romantic notions, is called a visionary. Quevedo's visions are descriptions of what passed in the imagination of that author.

VISITATION, *visitatio*, an act of jurisdiction, whereby a superior or proper officer, visits some corporation, college, church, or other public or private house, to see that the laws and regulations thereof be duly observed. Among us, the bishop of each diocese is obliged to hold a visitation every third year, and the archdeacon the other two years; to see that the discipline be well observed, the people well instructed, and to take care, that neither the church, nor the pastors thereof, receive any detriment.

VISITATION of the Virgin Mary, is a feast instituted in memory of the visit paid by the Virgin to Elizabeth, first established by Bonaventure, general of the order of St. Francis, by the decree of a general chapter, comprehending the churches of his own order, held at Pisa in 1263; and afterwards extended to the whole church by pope Urban IV. in the year 1379, and ordered to be kept on the second of July.

VITAL, *vitalis*, in Anatomy, something that ministers principally to the constituting or maintaining of life in the bodies of animals. Thus the heart, lungs, and brain are called vital parts.

VITAL Functions, or *Actions*, are those operations of the vital parts whereby life is affected; so as that it cannot subsist without them. Such are the muscular action of the heart; the secretory action of the cerebellum, the respiratory action of the lungs; and the circulation of the blood and spirits through the arteries, veins, and nerves. See FUNCTION.

VITAL Principle or *Substance*, denotes a kind of agent or instrument, supposed by Dr. Grew to be employed under the direction and subordination to the will of the Creator in the production of plants, animals, &c.

VITIS, the vine, in botany, a genus of the angiospermia order belonging to the didynamia class of plants. The uses of the fruit of the vine for making wines, &c. are well known. However, the number of vines cultivated in this country is by no means sufficient to supply the consumption. The plant was introduced by the Romans, and appears formerly to have been very

very common. From the name of vineyard yet adhering to the ruinous sites of our castles and monasteries, there seems to have been few in the country but what had a vineyard belonging to them. The county of Gloucester is particularly commended by Malmesbury in the twelfth century, as exceeding all the rest of the kingdom in the number and goodness of its vineyards. In the earlier periods of our history, the Isle of Ely was expressly denominated the Isle of Vines by the Normans. Vineyards are frequently noticed in the descriptive accounts of Doomsday. And those of England are even mentioned by Bede, as early as the commencement of the eighth century. But Doomsday exhibits to us a particular proof of the wines made in England, during the period preceding the conquest. And, after it, the bishop of Ely appears to have received at least three or four tuns of wine annually, as tythes from the produce of the vineyards, in his diocese; and to have made frequent reservations in his leases of a certain quantity of wine for rent. A plot of land in London, which now forms East Smithfield and some adjoining streets, was with-held from the religious house within Aldgate by four successive charters of the Tower, in the reigns of Rufus, Henry, and Stephen, and made by them into a vineyard, to their great emolument and profit. In the old accounts of rectorial and vicarial revenues, and in the old registers of ecclesiastical suits concerning them, the tithe of wine is an article that frequently occurs in Kent, Surry, and other countries. France was famous for its vineyards in the reign of Vespasian, and even exported its wines into Italy. The whole province of Narbonne was then covered with vines: and the wine-merchants of the country were remarkable for all the knavish dexterity of our modern brewers, tinging it with smoke, colouring it, as was suspected, with herbs and noxious dyes, and even adulterating the taste and appearance with aloes. For the culture and management of vines, see the Treatise on GARDENING, Article Fruit Garden, Months of January, March, May, and July. For the mode of preserving grapes on the vines see the same Article, Month of August.

VITREUS Humor, or *Vitreous Humour*, in anatomy, denotes the third, or glassy humour of the eye; thus called from its resemblance to melted glass. It lies under the crystalline; by the impression of which, its fore-part is rendered concave. It greatly exceeds in quantity both the aqueous and crystalline humours taken together, and consequently occupies much the greatest part of the cavity of the globe of the eye. For description, see the System, Part VII. Sect. V.

VITRIFICATION, the act of converting a body into glass, by means of fire. Of all bodies, sand, flints, and pebbles, with alkaline salts, vitrify the most easily; accordingly; it is of these that glass is principally made. For a copious description of this subject, see the article GLASS.

VITRIOL, a compound, imperfect salt, formed by the union of certain metals with the sulphureous acid. It is of three colours, white, blue, and green. For description of the qualities and properties of this branch of Chemistry, see the System, Part I. Sect. II. Chap. V. throughout. Native vitriol is often met with in our coal-mines. From an old cannel coal-pit, near Wigan, in Lancashire, Dr. Watson procured a considerable quantity of it very well crystallized; and Dr. Rutty has observed, that the vitriolic water at Haigh in Lancashire, is the strongest in Britain, yielding 1920 grains of vitriol from a gallon of water. See **VITRIOLIC Waters**, under the Article WATER.

The **White VITRIOL**, or vitriol of zinc, is found native in the mines of Goslar, sometimes in transparent pieces, more commonly in white efflorescences; which are dissolved in water, and crystallized into large irregular masses, somewhat resembling fine sugar; it is also found dissolved in mineral waters, and generally with some proportion of the vitriol of iron and copper: it is in taste sweetish, nauseous, and styptic. It has been disputed whether white vitriol is any thing else than green vitriol calcined. But it seems that white vitriol is of a quite different species from either the green or the blue vitriols. See Geoffroy, Mat. Med. tom. i. p. 124. In the condition in which white vitriol is usually bought, it contains somewhat both of copper and iron; but being purified by solution, filtration and crystallization, it is freed from both these metals, and appears to be a native *vitriol sui generis*. See Cramer, Elem. Art. Docim. vol. i. p. 302. ed. 2. Med. Ess. Edinb. Abrid. vol. ii. p. 472. See also the System of CHEMISTRY, Part III. Chap. I. Sect. I.

Blue VITRIOL, or vitriol of copper, is commonly called Roman or Cyprian vitriol, or blue-stone. After being long exposed to the air, it degenerates into a mixture of blue and rusty yellow. It requires about four times its weight of water to dissolve it in the temperature of 60°. Its specific gravity is about 2.23. This salt rarely occurs crystallized, but is often found naturally dissolved in water, in Hungary, Sweden, and Ireland; from which water blue vitriol is generally prepared, by evaporating the water to a proper standard; after which it is let out into coolers, where it shoots into regular and beautiful crystals of a rhomboidal form. See **ZEMENT water**. It is also occasionally extracted from sulphurated copper ores after torrefaction, by the application of water, or washed out by rain or subterraneous waters. Mr. Cronstedt says, it is seldom free from iron and zinc. If a piece of clean polished iron be dipped into the solution of this salt, it will almost immediately be

covered with a cupreous coat: this, together with the deep blue colour arising from mixing it with a volatile alkali, discovers its basis; as its uniform mixture with other vitriolic salts does its acid. Hence it also appears, that the acid of vitriol has a greater affinity with iron than with copper, because it quits copper to unite itself with iron. This fact explains, in a very satisfactory manner, the nature of that transmutation of iron into copper which was formerly considered as a perplexing phenomenon. Agricola speaks of waters in the neighbourhood of Newfol, in Hungary, which had the property of transmuting the iron which was put into them into copper. In the year 1673, our countryman, Dr. Brown, visited a famous copper-mine at Herrn-Grundt, near Newfol; and he informs us, that he there saw two springs called the old and new ZIMENT, which turned iron into copper. The iron in this case is taken up by the water, and remains suspended in it in the place of the copper: so that this transmutation is nothing but a change of place; and as the copper is precipitated by the iron, so the iron might be precipitated by potash, or any other substance which has a greater affinity with the acid of vitriol than iron has. The cause of the impregnation of these copper waters in Germany is not difficult to be explained. Most copper ores contain sulphur, and when the sulphur is in any degree decomposed, its acid unites itself to the copper, and forms blue vitriol, which is the substance with which the waters issuing from the copper-mines are impregnated. The copper contained in these waters has been for some centuries collected in Germany, by putting old iron into pits filled with the coppery water; and thus the iron is dissolved, and the copper is precipitated, and being raked out in the form of mud, it is afterwards melted into very fine copper. The quantity of copper procured by an hundred tons of iron amounts sometimes to ninety tons, and seldom to less than eighty-four. Of late years some successful attempts of this kind have been made in England and Ireland. See **COPPER**. In the Isle of Anglesey, near Paris Mountain, which abounds in copper ore, the water in which the roasted ore is washed is so strongly impregnated with copper, that they have found it useful to adopt the German method of precipitating it by means of old iron, and they have obtained in one year near a hundred tons of copper precipitated from this water. The water after the copper has been precipitated by means of iron, is at present thrown away; whereas, by evaporation, it would yield green vitriol: and as above a hundred tons of iron must be employed in obtaining the forementioned quantity of copper, Dr. Watson suggests, whether a manufactory of green vitriol might not be established at this and at all other places where copper is obtained by precipitation. One hundred tons of iron would yield, at the least, two hundred tons of vitriol, which at the low price of three pounds per ton, would defray the expence of extracting it; more especially as the water solution might be evaporated by a proper application of part of that heat. The greatest part of the blue vitriol, now met with in the shops, is prepared in England, by artificially combining copper with its sulphur or its acid. See System of CHEMISTRY, Part III. Chap. II. Sect. IV.

Green VITRIOL, or vitriol of iron, is commonly called English vitriol, or copperas; and it is the Roman vitriol of the Italian writers. This vitriol is of a greenish colour, when perfectly and recently crystallized, but effloresces by exposure to the air, and becomes yellowish; it requires six times its weight of water to dissolve it in the temperature of 60°. Its acid is known by this, that the solution of this salt mixes without turbidity with the solutions of other salts that contain the vitriolic acid, as Epsum, selenite, tartar, vitriolate, &c. but renders the solutions of nitrous or marine selenite turbid, and its basis is known by the black colour which the solution of galls, or vegetable astringents, immediately produce in its solution. It is frequently found native, either in coal-mines, or in the cavities of pyritaceous mines. The common green vitriol is made at Deptford near London, and other places, from a species of the pyrites found on Sheppey Isle, the Isle of Wight, and various other parts of Essex, Kentish, Suffex, and Dorsetshire coasts. Vitriol is made from the pyrites found among coal; there are manufactories of it near Wigan, at Whitehaven, at Newcastle upon Tyne, and in several other parts of the kingdom. But all the vitriol works have sunk in value of late years; the home consumption of vitriol being much diminished, since the acid, which used to be procured from the distillation of vitriol, has been obtained from the burning of sulphur. It is not easy to determine when this method of making vitriol was introduced into England. From the green vitriol the vitriolic acid has been generally extracted; by distilling the calcined vitriol in earthen long necks, with a strong fire continued for two days or longer; though it is now mostly obtained by collecting the vapour of burning sulphur. See **SULPHUR**.

VITRIOL, in medicine and the arts, has various applications and uses. White vitriol is sometimes given, from five or six grains to half a dram and more; as an emetic, and appears to be one of the quickest in operation of those that can be employed with safety. Its chief use is for external purposes, as cooling, refrigerant and desiccative: a dilute solution of it, as sixteen grains in eight ounces of water, with the addition of sixteen drops of weak vitriolic acid, or the aqua vitriolica of the Edinburgh Dispensatory, is an excellent collyrium in defluxions and slight inflammations of the eyes; and after bleeding and purging, in the more violent ones. A solution of it with alum in the proportion of two drams of each to a pint

pint of water, called the aqua aluminosa Bateana, is used as a repellent fomentation for some cutaneous eruptions, for cleansing foul ulcers, and as an injection in the fluor albus and gonorrhœa, when not accompanied with virulence. This vitriol is sometimes likewise employed as an errhine, and said to be a very effectual dissolvent of mucous matters; in which intention it is recommended, in the German Ephemerides, against obstructions of the nostrils in newborn infants. Blue vitriol, like the other preparations of copper, acts in doses of a few grains, as a most virulent emetic. Its use is chiefly external, as a detergent, escharotic, and for restraining hæmorrhages; for which last intention a strong styptic liquor is prepared in the shops, called aqua vitriolica cœrulea. Blue vitriol has of late been considerably employed as an emetic by some practitioners; and is said to be by no means an unsafe one, as it operates the instant it reaches the stomach, before it has time to injure by its corrosive quality. The peculiar advantage in using it is represented to be, that it has no tendency to become also purgative, and that its astringent power prevents the tone of the stomach from being impaired after vomiting with it. It is much recommended in the early state of tubercles in the lungs; and the following method of exhibition directed. (See Simmons on the Treatment of Consumptions; p. 70.) Let the patient first swallow about half a pint of water, and immediately afterwards, the vitriol dissolved in a cup full of water. The dose may be varied according to age, constitution, &c. from two grains to ten, or even twenty; always taking care to begin with small ones. After the emetic is rejected, another half pint of water is to be drank, which is likewise speedily thrown up, and this is commonly sufficient to remove the nausea. In still smaller doses, the blue vitriol has been much used by some as a tonic in intermittents, and other diseases.

Pure green vitriol is in no respect different from the artificial *SAL martis*. It is one of the most certain of the chalybeate medicines, scarcely ever failing to take effect where the calces and other indissoluble preparations, pass inactive through the intestinal tube. It may be conveniently given in a liquid form, largely diluted with aqueous fluids: two or three grains or more, dissolved in a pint, or quart of water, may be taken in a day, divided into different doses. This vitriol is used also, especially when calcined, as an external styptic: the *STYPTIC* of Helvetius, and, as it is said that of Eaton is no other than French brandy impregnated with the calcined vitriol; a dram of the vitriol is commonly directed to a quart of the spirit, but only a minute portion of the dram dissolves in it. As French brandy has generally an astringent impregnation from the oaken casks in which it has been kept, the vitriol changes it, as it does the watery infusions of vegetable astringents to a black colour; but makes no such change in spirituous liquors that have not received some astringent tincture. The acid of vitriol or sulphur largely diluted is the most salubrious of all the mineral acids. It is mixed with watery infusions, spirituous tinctures and other liquids, as an antiphlogistic; as a restraining in hæmorrhages; and as a stomachic and corroborant in weaknesses, loss of appetite, and decays of constitution, accompanied with slow febrile symptoms, brought on by irregularities, or succeeding the suppression of intermittents by Peruvian bark. In several cases of this kind, after bitters and aromatics of themselves had availed nothing, a mixture of them with the vitriolic acid has taken effect: the form commonly made use of is that of a spirituous tincture; six ounces of oil of vitriol are drop by degrees into a quart of rectified spirit of wine; the mixture digested for three days in a very gentle heat, and afterwards digested for three days longer with an ounce and a half of cinnamon, and an ounce of ginger; this is the *elixir vitrioli* of the Edinburgh Dispensatory. Or a pint of an aromatic tincture drawn with proof spirit is mixed with four ounces of the strong acid, so as to form the acid *ELIXIR* of vitriol of the London Dispensatory; these liquors are given from ten to thirty or forty drops, in any convenient vehicle, when the stomach is most empty. A mixture of oil of vitriol with spirits of wine alone, in the proportion of one part of the former to three of the latter, digested together for some time, is used in France as a restraining in gonorrhœas; female fluors, and spittings of blood, under the denomination of *aqua Rabbiana*, and *Eau de Rabel*. The acid of vitriol, diluted with water, has been given internally with great success in the itch. It was first used for this purpose in the Prussian army in 1756, and has since been much employed in several parts of Germany. The dose recommended is from an eighth to a fourth of a dram of the pure acid twice or thrice a day. It is said to succeed equally in the dry and moist itch; and when given to nurses, to cure both themselves and their children. The spirit of vitriol of the Edinburgh pharmacopœia, called *spiritus vitrioli dulcis*, taken from ten to eighty or ninety drops, strengthens the stomach and digestive powers, relieves flatulencies, promotes urine, and, in many cases, abates spasmodic strictures, and procures rest. It is not essentially different from the celebrated mineral anodyne liquor of Hoffman; to which it is frequently, by the author himself, directed as a substitute. The principal use of green vitriol is in *DYEING*, and in the making of *INK*. When the vitriol is dissolved in water, the iron contained in it becomes black by the addition of an infusion of gall-nuts. Mr. Lemery the younger, in order to account for this blackness, imagines, that as the vitriol, of which ink is made is iron dissolved by an acid, and intimately mixed with it; and as

galls are an alkali or absorbent, this alkali, meeting the acids which hold the iron dissolved, unites with them, and makes them let the iron loose; which thereupon revivifies and resumes its natural blackness; so that in strictness we write with the iron.

VITRIOLIC, something that partakes of the nature of vitriol. Vitriolic minerals are compound fossil substances, formed of various stony and earthy particles, mixed with others of iron and copper, and that either separately or conjunctly; so that, in effect, they are ores of vitriols. The different kinds of these minerals are, 1. The chalcites. 2. The misy. 3. Sory, or rusma. 4. Melanteria. 5. Pyrites, or fire-stone. 6. Marcasites.

VITRIOLIC Air. See the System of AEROLOGY, Sect. XI. & XIII.

VITRIOLIC Waters. The countries which abound with mines of copper and iron usually afford a great many vitriolic waters. One of the most remarkable springs of this kind, of which we have an account, is that near Paderborn in Germany: this is a sort of treble spring, having three openings, and all three yielding very different waters. Two of these openings are not more than a foot and a half distant from one another, and yet of so different qualities, that the one is limpid, bluish, milk-warm, and bubbling, and contains sal ammoniac, ochre, iron, vitriol, alum, sulphur, nitre, and orpiment, all these substances having been separated in its analysis. The other is cold as ice, and is turbid, whitish, and much heavier, and stronger to the taste than the other. This holds much orpiment, with some salt, alum, nitre, sal ammoniac, and vitriol. The first of these waters is taken by the people in the neighbourhood against worms, and disorders of the spleen, also against epilepsies; the other is poisonous to birds, all that drink of it dying in a very little time. The experiment has been tried on common hens, with the water brought from the springs into other places, and given them to drink. Those to which salt is given, after the swallowing of this poisonous water, struggle longer before they die by it; and vinegar is found to save them very often from death, after drinking largely of it; but in this case they are sickly for seven or eight days after it, and have the pip, as the good women express it. In the dissecting of those birds which have died by drinking this water, the lungs are always found quite shrivelled up. The people of the country have not been deterred by this bad effect of the water, from using it in medicine; they take small quantities of it diluted in water, to destroy the worms, and it performs this very well; but gives them a grievous sickness while it operates. The third stream, or opening of this remarkable spring, is about twenty paces distant from the others; the water is here very clear, of a greenish colour, and of a sour, but not very disagreeable taste. It is of a middle weight, and of middle qualities between the other two, and is evidently formed of the joining of those two springs with some other fresh water in the way; for a liquor exactly resembling this third kind may be prepared by mixing equal quantities of the other two, with a sufficient quantity of common well-water. See the Article WATER.

VIVERRA, a genus of quadrupeds, belonging to the order of *FERRÆ*. They have six fore-teeth, the intermediate ones being shorter, and more than three grinders, and the claws are exerted. The species are as follow.

SPECIES I. *The Ichneumon.*

This animal in Egypt is domestic like the cat; and is retained by the natives for the same useful purposes of clearing their houses of rats and mice. With all the strength and agility of the cat, it has a more general appetite for carnage. It attacks, without dread, the most deadly serpents, and preys on every noxious reptile of the torrid zone, which it seizes and kills with great avidity. It is said, that when this animal is wounded by a serpent, and begins to feel the effect of the poison, it immediately has recourse to a certain root which the Indians call after its name, and assert that it is an antidote for the bite of any venomous reptile.

The Ichneumon is the most formidable enemy of the crocodile: it destroys its eggs, which it digs out of the sand, where they are laid to hatch by the heat of the sun; and kills great numbers of the young crocodiles soon after their production, before they are able to reach the water. It was for this reason that the ancient Egyptians worshipped this animal, and ranked the Ichneumon amongst those deities that were most propitious to them.

These animals, in their domestic state, are perfectly tame and gentle. M. d'Obsonville speaks of one which he reared from a young one. It became tamer than a cat, was obedient to the call of its master, and followed him wherever he went. These animals are numerous in all the southern regions of Asia, from Egypt to the island of Java; they are also found in Africa, in the country about the cape of Good Hope, they frequent the banks of rivers, are fond of fish, are said to take the water like an otter, and will continue in it a considerable time without rising to take breath. The Ichneumon varies in size. The domestic kind is generally larger than those that are wild, and its colours more variegated. It is in general about the size of a common cat; somewhat longer in the body, and shorter in the legs. Its fur contains tints of white, brown, fawn-colour, and a dirty silver grey, which altogether form a mixture very agreeable to the eye. Its form is like that of the polecat. Its eyes are small but inflamed, and sparkle with a singular vivacity; its nose is long and slender; its ears small, rounded, and almost naked; its tail is very thick at

the base, and tapers to a point; underneath the tail is an orifice, from which a most foetid humour is secreted; its claws are long. It darts upon its prey like an arrow, and seizes it with inevitable certainty. It frequently sits up like a squirrel, and feeds itself with its fore feet; catches any thing that is thrown to it; and will often feign itself dead till its prey come within its reach. For representation see Plate V. Genus 14. Species 1.

SPECIES II. *Nausa, Coati, or Brazilian Weasel.*

This animal has some resemblance to the bear, in the length of its hind legs, in the form of its feet, in the bushiness of its hair and in the structure of its paws; but it is small, and its tail is long, and variegated with different colours. Its upper jaw is much longer than the lower, and very pliant; its ears are rounded; its hair is smooth, soft, and glossy, of a bright bay-colour; and its breast is whitish. Linnæus describes one of these animals, which he kept a considerable time, and in vain attempted to bring into subjection. It was so obstinate, that it would do nothing to which it was disinclined. It killed the poultry, tore off their heads, and sucked their blood. It defended itself with great force whenever any person attempted to lay hold of it contrary to its inclination; and it stuck fast to the legs of those with whom it was familiar, when it wanted to ransack their pockets, and carry off any thing that it found in them. This creature inhabits Brazil and Guiana, runs up trees very nimbly, eats like a dog, and holds its food between its fore-legs like a bear. The Coati stands with ease on its hind feet. It is said to gnaw its own tail, which it generally carries erect, and sweeps it about from side to side. For representation, see Plate V. Genus 14. Species 2.

SPECIES III. *Putorius or Skunk.*

This animal, which is called the *chiribi* by the natives of Brazil, is about the size of a common cat. This creature inhabits Peru and other parts of South America, and is remarkable above all the weasel kind for a most intolerable, suffocating, foetid vapour, which it emits from behind, when attacked, pursued, or frightened. The stench of this effluvia is insupportable, and is the creature's best means of defence. There are three or four varieties of this animal, mentioned by Mr. Buffon under the name of *stinking-pole-cats*; all of which possess this wonderful faculty of annoying their enemies from the same quarter. Some turn their tale to their pursuers, and emit a most horrible stench, which keeps both dogs and men at a considerable distance: Others eject their urine to the distance of about eighteen feet; and it is of so virulent a quality, as almost to occasion blindness, if any of it should happen to fall into the eyes. Cloaths infected with it, retain the smell for many days: No washing can make them sweet; but they must be even buried in fresh soil before they can be thoroughly cleansed. Dogs that are not properly bred, turn back as soon as they perceive the smell: Those that have been accustomed to it, will kill the animal; but are obliged to relieve themselves by thrusting their noses into the ground. For representation, see Plate V. Genus 14. Species 4.

SPECIES IV. VARIETY 2. *Vulgaris, or Common Civet.*

Though originally a native of the warm climates of Africa or Asia, this creature can live in temperate, and even in cold countries; but it must be fed with nourishing diet, and carefully defended against the severities of the weather. Numbers of them are kept in Holland for the purpose of collecting this valuable perfume. The civet procured at Amsterdam is more esteemed than that which comes from the Levant or India, being less adulterated. To collect this perfume, the animal is put into a cage, so narrow that it cannot turn itself: the cage is opened at one end, and the animal drawn backwards by the tail, and securely held by its hind legs: a small spoon is then introduced into the pouch, which contains the perfume, with which it is carefully scraped, and the matter put into a vessel properly secured. This operation is performed two or three times a week. The quantity of odorous humour depends much on the quality of the nourishment, and the appetite of the animal; which always produces more in proportion to the goodness of its food. Boiled flesh, eggs, rice, small animals, birds, and particularly fish, are the kinds of food the civet mostly delights in; and these ought to be varied, so as to excite its appetite, and preserve its health. It requires very little water; and, though it drinks seldom, it discharges its urine frequently. It is somewhat remarkable, that in this operation the male is not to be distinguished from the female. The perfume of this animal is so strong, that it infects every part of its body. If a person be shut up in the same apartment, it is almost insupportable; and when heated with rage, it becomes still more pungent. The civet is naturally savage, and somewhat ferocious; yet it is easily tamed, so as to be handled without danger. The teeth of this creature are strong and sharp; but its claws are weak. It is an active and nimble animal. It leaps like a cat, and runs with great swiftness. It lives by hunting; surprises small animals and birds; and, like the weasel, will sometimes steal into the yard, and carry off poultry. Its eyes shine in the dark; and it is probable, that it can see well enough to pursue its prey in the night, as it is known to be most active at that time. The civet is very prolific in its native climate; but, though it lives and produces its perfume in temperate regions, it is never known to breed there. Its voice is stronger than that of the cat, and has some resemblance to the cry of an enraged dog. For representation, see Plate V. Genus 14. Species 5. Variety 2.

SPECIES V. VARIETY 1. *Annulatus, or Annulated Zibet.*

Is so similar to the civet, as to be considered by some authors as only a variety of that animal; and it must be allowed, that they have many essential relations, both in their external and internal structure; but they differ from each other by such distinguishing characteristics, as entitle them to be regarded as two distinct species. The ears of the zibet are larger and more erect; and its muzzle is thinner and flatter: Its body is longer than that of the civet; and its tail, which is longer, is marked with annular spots, like that of the genet: It has no mane or long hair on the neck and spine; and its hair is shorter and softer. The perfume of the zibet is peculiarly violent and piercing, beyond that of either the civet or the genet. This odorous liquor is found in a fissure near the organs of generation. It is a thick humour of the consistence of pomatum; and, though very strong, it is agreeable even as it issues from the body of the animal. This matter of the zibet must not be confounded with musk, which is a sanguineous humour, derived from a species of the roe-buck, or goat without horns; and has nothing in common with the zibet but its strong perfume. For representations, see Plate V. Genus 14. Species 5. Variety 1.

SPECIES VI. *Genetta, or Genet.*

Is as much distinguished for the agreeable perfume which it yields, as the skunk we have just described is for the rankest and most disagreeable odour in nature. The body of the genet is longer than that of the martin; its head is long and slender, with a sharp muzzle; its ears are a little pointed; its hair soft, smooth, and shining, of a tawny-red colour, spotted with black; along the ridge of the back there is a kind of mane of long hair, which forms a black line from head to tail; the spots on the sides are round and distinct, those on the back almost close; its tail is long, and marked with seven or eight rings of black. From an orifice beneath its tail, it yields a kind of perfume which smells faintly of musk. This creature is found in Turkey, Syria, and Spain. We are told by Belon, that he saw genets in the houses at Constantinople as tame as cats; and that they were useful to the inhabitants in destroying rats, mice, and other vermin. It is a most beautiful, cleanly, and industrious animal, and very active in pursuing its prey. Its nature is mild and gentle; its colours beautifully variegated; and its fur valuable. Upon the whole, it seems to be one of those animals that, with proper care and attention, might become a useful addition to our stock of domestic quadrupeds. For representation, see Plate V. Genus 14. Species 6.

VIVIFICATION, in medicine, the art of vivifying, that is, of contributing to the action that gives life, or maintains life. The chemists also use the word in speaking of the new force, vigour, and lustre, which, by their art, they give to natural bodies, particularly to mercury; which, after having been fixed, or amalgamated, they restore to its first state.

VIVIPAROUS, *viviparus*, in natural history, an epithet applied to such animals as bring forth their young alive and perfect; in contradistinction to such as lay eggs, which are called *oviparous animals*. The females of all the quadruped class are *viviparous*, and those of the bird class are all *viviparous*. The laws of nature in the larger animals are, therefore, in a great measure fixed and certain; but it is not so in the insect tribes nor in the fishes; for of these some are viviparous, and others oviparous; and those of genera nearly allied to one another. See the System of ENTOMOLOGY and ICTHYOLOGY.

Among insects the much greater number are *oviparous*; but there are many which are not so, as the pucerons, proglan insects, cochineal, &c. The millepedes and scorpions are also well known to be so; all the females of the butterfly, and of some other classes lay only eggs; but the most singular and remarkable inconsistency in nature, if we may be allowed the expression, is that in the fly kingdom; the same class of insects, and even the same genus, will furnish us with some which are viviparous, and others which are oviparous; the two winged flies give us instances of this; but these are not singular in that respect; for among the reptile world, there are other creatures which are subject to the same varieties; and Swammerdam has observed a viviparous snail. Vipers are distinguished from snakes, in that the latter lay eggs in dunghills, to be hatched by the warmth thereof; but the former are viviparous, that is, they keep their eggs within their bellies and bring forth live vipers.

ULCER, *Ulcus*, in surgery, a solution or discontinuity of texture, or loss of substance, in the soft parts of the body and skin, proceeding from an internal cause. Galen defines ulcer, an inveterate erosion of the soft parts of the body; by which, instead of blood, they are brought to yield a kind of pus, or sanies; which prevents the consolidation. Etmuller defines an ulcer, a solution of continuity, from some corrosive sharpness or acidity, that takes away from the parts, and turns the proper nourishment of the body into a sanious matter. A like solution of continuity, happening in a bony part, is called a caries. Galen commonly uses the word ulcer and wound indifferently; but the Arabs, and the moderns, after them, distinguished between the two. Spontaneous ulcers are generally supposed to proceed from acrimony, or a corrosive disposition of the humours of the body; whether brought on by poisons, by the venereal taint, or by other causes. Ulcers are divided into *simple and complicated*. They are again divided, with regard to their circumstances, into *putrid*, or *forid*, wherein the flesh all around

U L C

around is corrupted, and foetid; *verminous*, where the matter, being thick, does not flow away, but generates worms, &c. *virulent*, which, instead of pus, or sanies, yield a malignant virus, &c. They are again distinguished with regard to their form, into *sinuous*, *fistulous*, *varicose*, *carious*, &c. They are distinguished also, with regard to their causes, into *scorbutical*, *venereal*, *cancerous*, &c. with regard to the part of the body which they infect, being sometimes found in the skin, fat, and glands, and sometimes in the muscular parts; with regard to their situation in the body, as ulcers of the nose, fauces, breast, anus, &c. with regard to their size, some spreading wide; others occupying but a small space; some being deep, and others shallow; and also with regard to their duration, they are called *recent* or *inveterate*. When an ulcer happens in a good constitution, and proves easy of cure, it is said to be *simple*. When attended with other concurring symptoms, as a cacochymic habit, which greatly retards or obstructs the cure, it is called a *compound* ulcer. A *simple* ulcer is attended with no other sign than that of erosion; but *compound* ulcers, happening in a scorbutic, dropical, or scrophulous constitution, may be attended with pain, a fever, convulsions, a large and emaciating discharge of matter, inflammation and swelling of the part, callosity of the lips, a caries of the bones, &c. Ulcers may be the consequence of wounds, bruises, or imposthumes improperly treated; and they may likewise proceed from an ill state of the humours, or what may be called a bad habit of the body. In the latter case they ought not to be hastily dried up, lest it should prove fatal to the patient. Ulcers happen most commonly in the decline of life, and persons who neglect exercise, and live grossly are most liable to them. They might often be prevented by retrenching some part of the solid food, or by opening artificial drains, as issues, setons, or the like.

The ulcerative process, according to the idea of Mr. Hunter, is an action of the absorbent system, whereby, in consequence of a stimulus, it takes up the soft parts, and carries them into the circulation. With regard to the proper treatment and cure of ulcers in general, it requires skill to determine whether it is expedient and safe to dry up an ulcer or not. All ulcers which proceed from a bad habit of body, should be suffered to continue open, at least till the constitution be so far changed by proper regimen, or the use of medicine, that they seem disposed to heal of their own accord. Ulcers, which are the effect of malignant fevers, or other acute diseases, may generally be healed with safety after the health has been restored for some time. The cure ought not, however, to be attempted too soon, nor any time without the use of purging medicines and a proper regimen. When wounds or bruises have, by wrong management, degenerated into ulcers, if the constitution be good, they may generally be healed with safety. When ulcers either accompany chronic diseases, or come in their stead, they must be cautiously healed. If an ulcer conduces to the patient's health, from whatever cause it proceeds, it ought not to be healed; but if, on the contrary, it wastes the strength, and consumes the patient by a slow fever, it should be healed as soon as possible. Mr. Sharp observes, that except the callous and the sinuous ulcer, and the ulcer with a caries in the bone, the cure of all the other kinds depends chiefly on that of the morbid habit of the body in general. If the body is free from any degree of cacochymy, the healing of an ulcer is the work of nature, and the effect of topical application is merely to maintain the fibres in such a mean state between laxity and rigidity, as will render them most capable of carrying on this natural operation. While an inflammatory hardness exists, an emollient poultice laid over the dressings will relieve, after which dry lint generally suffices, or at the most it may be moistened in some mild astringent, to give a tone to the new flesh. When a too great laxity, or sponginess is observed in ulcers, gently stimulating and bracing applications take place. The most proper regimen for the cure of ulcers in general, is to avoid all spices, salted, and high seasoned food, and all strong liquors, and to lessen the usual quantity of flesh-meat. The body ought to be kept gently open by a diet consisting chiefly of cooling laxative vegetables, and by drinking butter-milk, whey sweetened with honey, or the like. The patient ought to be kept cheerful, and should take as much exercise as he can easily bear.

VENEREAL ULCERS. These are almost always situated either in the groins, after the supuration of venereal buboes, or else in the prepuce, frænum, or glans penis, which is usually termed a chancre. In females they are frequently situated in the vagina, or labia pudendi, and in either sex sometimes in the nose, palate, lips, fauces, tongue, and uvula; and sometimes the os frontis, and other bones both of the head and other parts of the body, are subject to them. For the methods of treating venereal ulcers, see the *System of MEDICINE*, Genus 59.

ULCER in the Lungs occasions the disease which we call phthisis pulmonalis; for the cure of which Dr. Percival and Dr. Withering have in several cases successfully administered fixed air. Dr. Percival directed his patients to inspire the steams of an effervescing mixture of chalk and vinegar, or of vinegar and pot-ash; and observed that the hectic fever, in several instances, considerably abated; and the matter expectorated became less offensive and better digested; though in no instance he was happy enough to effect an absolute cure. Dr. Withering, however, by a similar course, was more successful. It is observed that fixed air can only be employed,

U N C

with any prospect of success, in the latter stages of the phthisis pulmonalis, when a purulent expectoration takes place. Percival's *Ess.* vol. ii. Priestley on Air, vol. i. p. 301. For a copious description of this disease, with the causes and methods of treatment, see the *System of MEDICINE*, Genus 30.

ULCERATION, a little aperture, or hole in the skin, caused by an ulcer. Caustic medicines occasion ulcerations in the skin. Arsenic always ulcerates the part it sticks to. A salivation ulcerates the tongue and palate.

ULMUS, in botany. See *ELM*, under the article *TIMBER*.
ULNA, in anatomy, a long hard bone in the arm, with a cavity in the middle; called also *os olecranon*, and *cubitus*. See the *System*, Part I. Sect. IV. Art. II. and Plate I. Fig. 1. letter g.

ULNARIS extensor, in anatomy, a muscle called also *EXTENSOR carpi*. This is a long muscle, lying on the outside of the forearm, fleshy towards the os humeri, and tendinous towards the carpus. See the *system*, Part II. Sect. II. Table, Art. 22. and Plate I. Fig. 2. Letter i.

ULNARIS Gracilis, a muscle, called by some *PALMARIS longus*. It is a small muscle, lying between the os humeri and the carpus, on the inside of the forearm. See the *System*, Table, Art. 22. and Plate I. Fig. 2. letter e.

UMBELLIFEROUS Plants, are such as have their flowery tops produced in an umbel on the top of the stalks, or branch, and spread out, like an umbrella, on each little subdivision of which there is growing a small flower; such as fennel, dill, &c. For the natural method of classification, see the *System of BOTANY*, Sect. II.

UMBILICAL, in anatomy, something that relates to the umbilicus, or navel. *Umbilical region*, is that part of the abdomen lying round the umbilicus, or navel. *Umbilical vessels*, are a set or assemblage of vessels belonging to a foetus; constituting what we call the *funiculus umbilicalis*, or navel-string. These vessels are two arteries, a vein, and the urachus. The *umbilical arteries* arise from the hypogastricæ, run up by the sides of the bladder, and remain hollow and filled with blood, even in adults, as high as the middle of the bladder, through all which space they likewise send off ramifications. Afterwards they lose their cavity, and become ligamentary as they ascend. At the upper part of the bladder they approach each other, and joining the urachus, form that rope which may be termed the superior ligament of the bladder. The *umbilical vein*, from innumerable capillaries united into one trunk, descends from the placenta to the liver of the foetus, where it is partly distributed into the porta, and partly into the cava. The use of these vessels is to maintain a continuity and communication between the mother and the foetus. Some authors will have it that the foetus receives its food and increase this way, and that it grows, like a vegetable, from the mother as a root, of which the umbilical vessels are the stem, and the child the head or fruit of this plant-animal. For a full illustration of this particular, see the *System of MIDWIFERY*, Fig. 40 and 41, with the explanation.

UMBILICALIS Funiculus, commonly called the navel-string, is a kind of string formed of the umbilical vessels, which being tied up in a common coat, or membrane, traverse the secundines, and are inserted, at one end, into the placenta of the mother, and, at the other, into the abdomen of the foetus. For the method of tying the navel-string after the delivery, see the *system of MIDWIFERY*, Part IX. Sect. I. For representation of the funiculus, see fig. 14. Let. M.
UMBILICUS; Navel, in anatomy, the centre, or middle part of the venter, or belly, being the place through which the umbilical vessels pass, out of the foetus, to the placenta of the mother. See the *System*, Part III.

UNCIÆ, in Algebra; are the numbers prefixed to the letter of the members of any power produced from a binomial, residual, or multinomial root; now usually called coefficients.

UNCIFORME Os, in the carpus, is the fourth bone of the second row; it has its name from the Latin *uncus*, a hook, and is composed of a body, and a hook, or unciform apophysis. See the *system of ANATOMY*, Part I. Sect. IV. Art. 3. and Plate I. fig. 1. letter b.

UNCTION, UNCTIO, the act of anointing, or rubbing with oil, or other fatty matter. Mercurial unction, properly applied, brings on a salivation. The surgeons cure divers wounds, ulcers, &c. by repeated unctions, with oils, unguents, cerates, &c.

Unction, in matters of religion, is used for the character conferred on sacred things, by anointing them with oil. Unctions were very frequent among the Hebrews. They anointed both their kings and high priests at the ceremony of their inauguration. They also anointed the sacred vessels of the tabernacle and temple, to sanctify and consecrate them to the service of God. The anction of kings is supposed to be a ceremony introduced very late among the Christian princes. It is said that none of the emperors were ever anointed before Justinian, or Justin. The emperors of Germany took the practice from those of the eastern empire: king Pepin of France was the first who received the unction. In the ancient Christian church, unction always accompanied the ceremonies of baptism and confirmation. Extreme unction, or the anointing persons in the article of death, was also practised by the ancient Christians, in compliance with the precept of St. James, chap. v. 14 and 15 verses; and this extreme unction the Romish church has advanced to the dignity of a sacrament. It is adminis-

tered

tered to none but such as are afflicted with some mortal disease, or are in a decrepid age. It is refused to impenitent persons, as also to criminals. The parts to be anointed are the eyes, the ears, the nostrils, the mouth, the hands, the feet, and the reins. The laity are anointed in the palms of the hands, but priests on the back of it, because the palms of their hands have been already consecrated by ordination. The parts before-mentioned are anointed in the form of a cross. The priest begins anointing the sick person's eyes, saying, "May God, by his holy anointing, pardon you the sins you have committed by the eyes." In like manner he proceeds to the other parts, varying the words according to the parts he anoints.

UNDERSTANDING, *intellectus*, is defined by the peripatetics, to be a faculty of the reasonable soul, conversant about intelligible things, considered as intelligible. They also make it two-fold; viz. *active* and *passive*.

Active **UNDERSTANDING**, they hold that faculty of the soul, by which the species and images of intelligible things are framed, on occasion of the presence of phantasms or appearances thereof. For maintaining the intellect to be immaterial, they hold it impossible it should be disposed to think by any disproportionate phantasms of mere body; and therefore, that it is obliged to frame other proportionate species of itself: and hence its denomination *active*.

Passive **UNDERSTANDING**, is that which receiving the species framed by the active understanding, breaks forth into actual knowledge. The moderns set aside the Peripatetic notion of an active understanding. The Cartesians define the understanding to be that faculty whereby the mind, conversing with, and, as it were, intent on itself, evidently knows what is true in any one thing not exceeding its capacity. The Corpuscular philosophers define the understanding to be a faculty, expressive of things which strike on the external senses, either by their images, or their effects, and so enter the mind. Their great doctrine is, *Nihil esse in intellectu, quod non prius fuerit in sensu*; and to this doctrine our famous Mr. Locke, and most of the latest English philosophers subscribe. See **CORPUSCULAR PHILOSOPHY**, and the Article **PHILOSOPHY**.

The Cartesians exclaim much against it: and between these and the Corpuscularians, there is this farther difference, that the latter make the judgment to belong to the understanding; but the former to the will. Hence, according to the most approved opinion of the Corpuscularians, the understanding has two offices, viz. perception and judgment; according to the Cartesians, it has only one, viz. perception.

UNDULATED Leaf, among botanists. See the **System**, Sect. I. Plate I.

UNDULATORY Motion, is applied to a motion in the air, whereby its parts are agitated after the like manner as waves in the sea; as is supposed to be the case when the string of a musical instrument is struck. This undulatory motion of the air is supposed the matter or cause of sound. Instead of the undulatory, some authors chuse to call this a vibratory motion.

UNGUENT, *ointment*, in surgery, a topical remedy, or composition chiefly used in the dressing of wounds and ulcers. Unguents, liniments, and cerates, are external forms, applied on divers parts of the body, both to cure, and to ease, and to relieve them. They only differ from each other in their consistence; unguents hold the medium; being stiffer than liniments, but softer than cerates.

UNGUIS, *ossa*, in anatomy, is applied to two bones of the nose, which help to complete the internal sides of the orbit of the eye, to cover the fore-part of the labyrinth of the nose, and form the lachrymal duct. They have their name from the Latin *unguis*, a nail of the hand; and are also, by some authors, from their office in forming the lachrymal duct, called *ossa lachrymalia*. Others call them *orbitaria ossa*. See the **System**, Part I. Sect. II. Art. 2. and Plate I. fig. 1. letter c.

UNICORN, in the **system** of mammalia, a species of the genus *Rhynoceros*. See **RHYNOCEROS**. We have representations of unicorns, in coats of arms, which partake of the form of a horse; with a horn projecting from the middle of the forehead; but this like the mermaid and many other animals have no existence in nature: but are introduced by heraldic painters, as supporters for arms.

See **UNICORN**, the English name of a species of the genus *monodon*, in the **system** of mammalia. See **MONODON**.

UNIFORMITY, *regularity*, a similitude or resemblance between the parts of a whole. Such is that we meet with in figures of many sides, and angles respectively equal, and answerable to each other. A late ingenious author makes beauty to consist in uniformity, joined or combined with variety. Where the uniformity is equal in two objects, the beauty he contends, is as the variety; and where the variety is equal, the beauty is as the uniformity. The works of nature are remarkable in their uniformity: not less than in their variety: and the mind of man is fitted to receive pleasure equally from both. Uniformity and variety are interwoven in the works of nature with surprising art. Variety, however great, is never without some degree of uniformity; nor the greatest uniformity without some degree of variety. There is great variety in the same plant, by the different appearances of its stem, branches, leaves, blossoms, fruit, size, and colour: and yet when we trace that variety through different plants, especially of the same kind, there is discovered a surprising uniformity. That the earth is

of a greater system, comprehending many bodies attracting each other, and gravitating all towards one common centre, is now thoroughly explored. Such a regular and uniform series of connections, propagated through so great a number of beings, and through such wide spaces, is wonderful; and our wonder must increase, when we observe uniformity propagated from the minutest atoms to bodies of the most enormous size, and so widely diffused as that we can neither perceive their beginning nor their end. That these connections are not confined within our own planetary system, is certain; they are diffused over spaces still more remote, where new bodies and systems rise without end. All space is filled with the works of God, which are conducted by one plan, to answer unerringly one great end.

UNIFORMITY is particularly used for one and the same form of public prayers, and administration of sacraments, and other rites, &c. of the church of England, prescribed by the famous stat. 1 Eliz. and 13 and 14 Car. 2. cap. 4. called the *Act of Uniformity*. See **LITURGY**.

UNION, a junction, coalition, or assemblage of two or more different things in one. Philosophers are much perplexed in accounting for the manner of the union of soul and body, or by what medium it is that two such heterogeneous beings are kept closely together. It is one of the great laws of this union, that such and such an impression on the brain, be followed by such and such a sensation, or perception in the soul.

UNION, in a philosophical sense, is used by Dr. Grew, for one of the three ways of mixture; being the joining together of atoms, or insensible particles, so as to touch in a plane; as is supposed to be the case in the crystallizations of salts and the like bodies.

UNION, or *the UNION*, by way of eminence, is more particularly used among us to express the act whereby the two separate kingdoms of England and Scotland were incorporated into one, under the title of *the kingdom of Great Britain*. The kingdom of Scotland, notwithstanding the union of the crowns on the accession of their king, James VI. to that of England in 1603, continued an entirely separate and distinct kingdom for above a century more, though an union had been long projected; which was judged to be the more easy to be done, as both kingdoms were anciently under the same government, and still retained a very great resemblance, though far from an identity, in their laws. By an act of Parliament, 1 Jac. I. cap. 1. it is declared, that these two mighty, famous, and ancient kingdoms, were formerly one; but great difficulties arose in carrying on the projected union; these, however, were at length overcome, and the great work was happily effected in the year 1707. by the general consent of queen Anne, and the estates of each realm.

The act, or treaty of union, consists of twenty-five articles; which eleven English commissioners, and eleven Scotch ones, examined, approved, and signed on the third of August 1706. The parliament of Scotland approved it on the fourth of February 1707, and the parliament of England on the tenth of March in the same year. On the 17th following, the queen went to parliament, where she approved the same treaty, with the act of ratification.

The purport of the most considerable article is as follows: 1. That on the first of May, 1707, and for ever after, the kingdoms of England and Scotland shall be united into one kingdom, by the name of Great Britain. 2. The succession to the monarchy of Great Britain shall be the same as was before settled with regard to that of England. 3. The united kingdom shall be represented by one parliament. 4. There shall be a communication of all rights and privileges between the subjects of both kingdoms, except where it is otherwise agreed. 9. When England raises 2,000,000. by a land-tax, Scotland shall raise 48,000. 16, 17. The standards of the coin, of weights and measures, shall be reduced to those of England throughout the united kingdoms. 18. The laws relating to trade, customs, and the excise, shall be the same in Scotland as in England. But all the other laws in Scotland shall remain in force, but alterable by the parliament of Great Britain; yet with this caution, that laws relating to public policy are alterable at the discretion of the parliament: laws relating to private right are not to be altered, but for the evident utility of the people of Scotland. 22. Sixteen peers are to be chosen to represent the peerage of Scotland in parliament; and forty-five members to sit in the house of commons. 23. The sixteen peers of Scotland shall have all privileges of parliament; and all peers of Scotland shall be peers of Great Britain, and rank next after those of the same degree at the time of the union, and shall have all privileges of peers, except sitting in the house of lords, and voting on the trial of a peer.

These are the principal of the twenty-five articles of union, which are ratified and confirmed by statute 5 Anne, c. 8. in which statute there are also two acts of parliament recited; the one of Scotland, whereby the church of Scotland, and all the four universities of that kingdom are established for ever, and all succeeding sovereigns are to take an oath inviolably to maintain the same: the other of England, 5 Anne, cap. 6. whereby the acts of uniformity of 13 Eliz. and 13 Car. II. (except as the same had been altered by parliament at that time) and all other acts then in force for the preservation of the church of England, be declared perpetual; and it is stipulated, that every subsequent king and queen shall take an oath inviolably to maintain the same within England, Ireland, Wales, and the town of Berwick upon Tweed: and it is enacted, that

that these two acts shall for ever be observed as fundamental and essential conditions of the union.

Upon these articles and act of union, it is to be observed, 1. That the two kingdoms are now so inseparably united, that nothing can ever disunite them; except the mutual consent of both, or the successful resistance of either, upon apprehending an infringement of those points which, when they were separate and independent nations, it was mutually stipulated should be "fundamental and essential conditions of the union." 2. That whatever else may be deemed "fundamental and essential conditions," the preservation of the two churches, of England and Scotland, in the same state that they were in at the time of the union, and the maintenance of the acts of uniformity which establish the liturgy, are expressly declared so to be. 3. That therefore any alteration in the constitution of either of those churches, or in the liturgy of the church of England, (unless with the consent of the respective churches, collectively or representatively given) would be an infringement of these "fundamental and essential conditions," and greatly endanger the union. 4. That the municipal laws of Scotland are ordained to be still observed in that part of the island, unless altered by parliament; and as the parliament has not yet thought proper, except in a few instances, to alter them, they still (with regard to the particulars unaltered) continue in full force.

Under this article of union we may observe, with respect to Wales, that very early in our history we find its princes doing homage to the crown of England; till at length, in the reign of Edward the First, the line of its ancient princes was abolished, and the king of England's eldest son became, as a matter of course, their titular prince; the territory of Wales being then entirely annexed (by a kind of feudal resumption) to the dominion of the crown of England. 10 Edw. I. By 12 Edw. I. and other subsequent statutes, their provincial immunities were farther abridged; but the finishing stroke to their independency was given by the statute 27 Hen. VIII. cap. 26. which at the same time admitted them to a thorough communication of laws with the subjects of England. By this statute it is enacted, 1. That the dominion of Wales shall be for ever united to the kingdom of England. 2. That all Welchmen born shall have the same liberties as the other king's subjects. 3. That lands in Wales shall be inheritable according to the English tenures and rules of descent. 4. That the laws of England, and no other, shall be used in Wales; besides many other regulations of the police of the principality. And the statute 34 and 35 Henry VIII. cap. 26. confirms the same, adds farther regulations, divides it into twelve shires, and, in short, reduces it into the same order in which it stands at this day; differing from the kingdom of England in only a few particulars, and those too of the nature of privileges (such as having courts within itself, independent of the process of Westminster-hall), and some other immaterial peculiarities, hardly more than are to be found in many counties of England itself. As to Ireland, that is still a distinct, though a dependent, subordinate kingdom. It was entitled the dominion, or lordship of Ireland, stat. Hiberniæ, 14 Hen. III. and the king's style was no other than *dominus Hiberniæ*, lord of Ireland, till the thirty-third year of Henry VIII. when he assumed the title of king, which is recognized by act of parliament, 35 Henry VIII. cap. 3. See Blackst. Comm. vol. i. Int. sect. 4.

UNITARIANS, in ecclesiastical history, a name given to those who confine the glory and attribute of divinity to the One, only great and supreme God, and father of our Lord Jesus Christ. This denomination is sometimes applied to those that are otherwise called ARIANS; but it is now more commonly appropriated to the SOCINIANS, who maintain that the Father alone is the God of the universe, the only true God; that our Lord Jesus Christ was a mere man, with a reasonable soul and human body, who had no existence before he was born, by the immediate operation and miraculous power of God at Bethlehem, and who, in the course of his life and ministry, death, resurrection, and exaltation, was honoured with peculiar and extraordinary tokens of the divine influence and favour; and that the Holy Spirit was not a person, or distinct intelligent agent, but only the power, influence, and energy of God. Some, in imitation of Socinus, allow that Christ is an object of worship; but most of the modern Unitarians restrict prayer and divine worship to God alone. For an account of the progress of Unitarianism in our own country, see an Historical View of the State of the Unitarian Doctrine and Worship from the Reformation to our own Times, by Mr. Lindsey, 8vo. 1783.

UNITY, in poetry. In the drama there are three unities to be observed; the unity of action, that of time, and that of place. In the epic poem, the great and almost only unity is that of the action. Some regard, indeed, ought to be had to that of time; but that of place there is no room for. The unity of character is not reckoned among the unities. The unity of the dramatic action consists in the unity of the intrigue in comedy, and that of the danger in tragedy; and this not only in the plan of the fable, but also in the fable extended and filled with episodes. See POETRY.

UNIVERSAL, in logic, is either complex, or incomplex. A complex universal is either an universal proposition, as, "Every whole is greater than its parts;" or whatever raises a manifold conception in the mind; as the definition of a reasonable animal.

An incomplex universal, is what produces one only conception in the mind, and is a simple thing, respecting many; as human nature, which relates to every individual wherein it is found. See the System, Part II. Sect. III.

UNIVERSE, a collective name, signifying the assemblage of heaven and earth, with all things therein, called by the Greeks *kosmos*, and by the Latins *mundus*. See the System of ASTRONOMY and GEOGRAPHY, with the Plates respectively annexed.

UNIVERSITY, UNIVERSITAS, a collective term, applied to an assemblage of several colleges established in a city, or town, wherein are professors in the several sciences, appointed to teach them as students; and where degrees, or certificates of study in the divers faculties, are taken up. In each university four faculties are usually taught, theology, medicine, law, and the arts and sciences. They are called universities, or universal schools, because the four faculties are supposed to make the grand world, or whole compass of study; or rather, because they form one whole out of many individuals. Universities had their first rise in the twelfth and thirteenth centuries. Those of Paris and Bologna pretend to be the first that were set on foot; but then they were on a very different footing from the universities among us.

Our universities, Oxford and Cambridge, seem entitled to the greatest antiquity of any in the world; and University, Baliol, and Merton colleges in Oxford, and Peter's in Cambridge, all made colleges in the thirteenth century, may be said to be the first regular endowments of this kind in Europe. For though University college in Oxford had been a place for students ever since the year 872, yet this, like many other of the ancient colleges beyond sea, and Leyden to this day, was no proper college; but the students, without any distinction of habit, lived in citizens' houses, having only meeting-places to hear lectures, and to dispute. In after-times, there were houses built for the students to live in society; only each to be at his own charge, as in the inns of court. These, at first, were called inns, but now halls. At last plentiful revenues were settled on several of these halls, to maintain the students in diet, apparel, &c. and these were then called colleges. The Universities of Oxford and Cambridge are governed, next under the king, by a chancellor, who is to take care of the government of the whole university, to maintain the liberties thereof, &c. The chancellor's courts, in the two universities, enjoy the sole jurisdiction, in exclusion of the king's courts, over all civil actions and suits whatsoever, where a scholar or privileged person is one of the parties, excepting in such cases where the right of freehold is concerned. And these, by the university charters, they are at liberty to try and determine, either according to the common law of the land, or according to their own local customs, at discretion.

Privileges of this kind are of very high antiquity, being enjoyed by all foreign universities as well as our own, in consequence (as judge Blackstone apprehends) of a constitution of the emperor Frederick, A. D. 1158. The oldest charter containing this grant to the university of Oxford, which the same learned judge had seen, was 28 Hen. III. A. D. 1244. And the same privileges were confirmed and enlarged by almost every succeeding prince, down to king Hen. VIII. in the fourteenth year of whose reign the largest and most extensive charter of all was granted. One similar to which was afterwards granted to Cambridge, in the third year of queen Elizabeth. All the charters of the two universities were confirmed by the statute of 13 Eliz. cap. 29. This privilege, so far as it relates to civil causes, is exercised at Oxford in the chancellor's court, the judge of which is the vice-chancellor, his deputy, or assessor. From his sentence an appeal lies to delegates appointed by the congregation; from thence to other delegates of the house of convocation; and if they all three concur in the same sentence, it is final, at least by the statutes of the university, according to the rule of the civil law. But if there be any discordance or variation in any of the three sentences, an appeal lies in the last resort to judges delegates, appointed by the crown under the great seal of Chancery. The universities of Scotland are four, viz. that of St. Andrews', founded in 1411, under the direction of a chancellor, two principals, and eleven professors: that of Glasgow, founded in 1454, under the direction of a chancellor, rector, principal, and fifteen professors: that of Aberdeen, founded in 1477, which has two colleges, the King's College and Marischal College; the King's College has a principal, sub-principal, and eight professors; and that of Edinburgh, founded in 1582, under the direction of patrons, a principal, and twenty-five professors.

UNLAWFUL, *illegal*, something prohibited by, or contrary to the terms of a law either divine or human. *Unlawful Assembly*, the meeting of three or more persons together, by force to commit some unlawful act: as, to assault any person, to enter his house, or land, &c. and thus abiding together, whether they attempt the execution or not. See RIOT.

VOCATIVE, in grammar, the fifth case, or state of nouns. When we name the person we are speaking to, to address ourselves to the thing we are speaking of, as if it were a person, the noun or name acquires a new relation, which the Latins and Greeks express by a new termination, called the vocative. In English, and most of the modern tongues, this case is ordinarily expressed in nouns that have an article in the nominative, by suppressing that

article; as, *the Lord is my hope.—Lord, thou art my hope!* though on many occasions we use an interjection. See the *Treatise on GRAMMAR*, Part I. Chap. I. Sect. I. and Part II. Chap. I. Sect. II. and III.

VOICE, *vox*, a sound produced in the throat and mouth of an animal, by an apparatus of instruments for that purpose. Voices are either *articulate* or *inarticulate*.

Articulate VOICES, are those whereby several conspire together to form some assemblage, or little system of sounds. Such are the voices expressing the letters of an alphabet, numbers of which, joined together, form words.

Inarticulate VOICES, are such as are not organized, or assembled into words: such is the barking of dogs, the braying of asses, the hissing of serpents, the singing of birds, &c. The formation of the human voice, with all the varieties thereof observed in speech, music, &c. makes a very curious article of enquiry; and the apparatus and organism of the parts ministering thereto, are something exceedingly surprising. Those parts are, the trachea, or wind-pipe, through which the air passes and repasses into the lungs: the larynx, which is a short cylindrical canal, at the head of the trachea; and the glottis, which is a little oval cleft, or chink, left between two semicircular membranes stretched horizontally within side the larynx; which membranes, though capable of joining close together, do generally leave an interval, either greater or less, between them, called the glottis. For description of these several parts, see the *System of ANATOMY*, Part V. Sect. V. and VI.

VOICE, in grammar, is a circumstance in verbs, whereby they come to be considered as either active, or passive, i. e. either as expressing an action impressed on another subject; as, *I beat*; or receiving it from another; as, *I am beaten*. The Greeks have a third voice, called medial, because it has sometimes an active, and sometimes a passive signification. See the *Treatise*, Part II. Chap. III. Sect. V.

VOICE, in oratory, is one of the parts of pronunciation, upon the proper regulation of which much of the orator's success depends. For this purpose it will be right to observe, in general, what nature does, when free and unconstrained. As persons are differently affected when they speak, so they naturally alter the tone of their voice; it rises, sinks, and has various inflexions given it, according to the present state and disposition of the mind. When the mind is calm and sedate, the voice is moderate and even; when the former is dejected with sorrow, the latter is languid; and when that is inflamed by passion, this is raised and elevated. It is the orator's business, therefore, to follow nature, and to endeavour that the tone of his voice appear natural and unaffected; and for this end, he must take care to suit it to the nature of the subject; but still so as to be always grave and decent. For the proper management of the voice, as it relates to public speaking, see the *Treatise on ORATORY*, Part IV. Sect. II. throughout.

VOIDED, *vide*, in heraldry, is understood of an ordinary whose inner or middle part is cut out, leaving nothing but its edges to shew its form; so that the field appears through it. Hence, it is needless to express the colour or metal of the voided part; because it must, of course, be that of the field.

VOLATILE, in physics, is commonly used to denote a mixt body whose integral parts are easily dissipated by fire, or heat; but it is more properly used for bodies whose elements or first component parts, are easily separated from each other, and dispersed in air.

VOLATILE, in Chymistry. When the fire decomposes any mixt body, the parts most disposed to receive a great motion are soonest loosened, and rise up in the order which the differences of that disposition give them; the rest remaining immovable at the bottom of the vessel. Those that rise first are called volatile parts: such as phlegm, oil, spirits, and salts, both urinous and alkalious. The parts remaining, viz. earth, and lixivial salts, are called fixt.

VOLATILE Alkali, a name given to one of the primary or elementary salts, the basis of all those which go by the name of ammoniacs. It is produced chiefly from animal substances, especially urine, either by distillation with a strong heat, or by putrefaction. In its pure state it is a transparent elastic fluid like common air, but lighter in a considerable proportion; and in this state Dr. Priestley has given it the appellation of alkaline air. It unites very readily with fixed air, and with all kinds of acids, forming with them various neutral salts according to their different natures. It unites also with water, which will imbibe one third of its weight of alkaline air. The mixture then is a caustic volatile spirit, the strongest that can be made, which unites with acids without any effervescence. If fixed air is added, the spirit then contains volatile salt, and is said to be mild; though in fact it is now partly changed into neutral saline mixture along with a quantity of caustic spirit. If a true caustic spirit is exposed to the air, part of the alkali will fly off; but part is also neutralized by the fixed air which it attracts from the atmosphere. The salt formed by an union of fixed air with volatile alkali is the most volatile of all the ammoniacal salts, and may be made perfectly neutral, though it is easily super-saturated with alkaline air, and is then extremely pungent. In this state it is called volatile salt, and is used in smelling bottles: but the superfluous quantity of alkaline air soon flies off, and the salt remains neutral as before. Alkaline air, in large quantities is fatal to animals, though in a small proportion it is a medicine of great efficacy in

cases of fainting. It is very caustic, dissolves oils, and renders them soluble in water; prevents putrefaction; and is inflammable, but burns without explosion. Chymical experiments abundantly prove that volatile salts are obtainable from all kinds of land animals, the amphibious and subterraneous tribes, birds, fish, and reptiles; from alkaline vegetables also, without putrefaction; and from all other vegetables, after putrefaction; as also from food, horns, hoofs, and all refuse animal and vegetable matters, such as the pith of horns, urine, the blood of slaughter-houses, &c. and these are as pure and perfect as from hartshorn; and this affords a hint for the making of volatile alkalies and sal ammoniac cheap in England. Shaw's *Lectures*, p. 168. See also the *System of CHYMISTRY*, Part I. Chap. IV. Sect. II.

VOLCANO, in natural history, is a name given to burning mountains, or to vents for subterranean fires, that belch or vomit flame, ashes, cinders, stones, liquid sulphur, and other substances with astonishing violence, and in a prodigious quantity.

DISSERTATION ON THE NATURE, EFFECTS, AND CAUSES OF VOLCANOS.

Enumeration of the different Volcanos.

The principal Volcanos in Europe are *Ætna*, now called *Gibel*, in the island of Sicily, a volcano famous in all histories. The next is *Vesuvius* near Naples, as memorable as the former. *Stromboli* in Europe is another volcano, which exists in all its force, and in its form is the most pyramidal of all the Lipari islands, which have been all formed by explosion. This volcano differs from *Ætna* and *Vesuvius*, by its continually emitting fire, and seldom any lava. The volcano at *Hecla* in Iceland, rages sometimes with as great violence as *Ætna*, and casts out great stones.

The *Chimera* in Greece is likewise a volcano. Basaltic mountains, common in Sweden, seem to owe their origin to submarine volcanos. The immense masses of lava ejected by volcanos are many years in cooling, and many hundred years are required for their decomposition, which is quicker or slower, as they have been more or less perfectly melted. According to the observations of Sir William Hamilton (*Phil. Trans.* vol. lxi. part i. p. 5, &c.) the lava of *Vesuvius* forms one or two feet of mould in a thousand years; this bed of mould being afterwards covered with fresh lava, and this, after mouldering by means of that of still later eruptions, afford some ground for calculating the age of the volcano, at least within certain limits. Many excellent investigations of this sort may be seen in M. Soulaire's *History of the South of France*. See *Watson's Chem. Ess.* vol. i. ess. 5. *Kirwan's Elem. of Mineral.* p. 388, &c. *Varenus's Geo.* vol. i. p. 145, &c.

The volcanos of Asia are not less numerous than those of Europe: there are several in the mountains of Persia, and in the island of *Ormuz*. The pic of *Adam* in the island of *Ceylon*, also burns at certain times: but the principal volcanos of that part of the world, are in the *Phillippine* and *Molucca* islands. *Java* and *Sumatra* also furnish some in the centre of their largest mountains. The island of *Tenete* affords also a volcano on the top of a mountain very difficult of access, but opening with a vast mouth, and very terrible when it burns. The several violent eruptions of this mountain within the mouth or crater, have given it the appearance of an amphitheatre, formed for holding people at the time of some public shew, several circles appearing in it one above another, formed with a sort of regularity that is surprising. In Japan there are numerous instances of the use that mountains serve to on this occasion, many of the higher mountains of that island burning almost continually: and the little islands which lie scattered about in the same sea have also many of them spiracles of the same kind in the tops of the mountains, seen principally in the night, when the absence of the sun's rays gives their faint fire leave to appear.

Whatever may be the number of these volcanos in Asia, there is no part of the world that yields so many as America. In the kingdom of *Chili* alone there are fourteen very considerable volcanos, all placed in a regular order one by the other; and not a less number in *Peru*; these all burst forth from the summits of those vast mountains the *Andes*. In *New Spain* there are three very formidable for the fierceness of their burning. Near *Guatemala*, in *South America*, are two mountains; the one called volcano of fire, the other of water. Out of the first huge pieces of rocks are frequently hurled, with as much vehemence as balls out of a cannon; and a written letter may be read by the light of its flames at the distance of three miles. Out of the other vast quantities of water are continually thrown up.

The most extreme parts of the northern world are not free from these store-houses of fire. Authors tell us of no less than four of them in the most northern parts of *Tartary*; and we know that *Greenland*, and all the neighbouring country have them. The volcanos of the *Terra del Fuego* are very well known, and it is indeed the general opinion, that farther north than we have yet penetrated, there may be very many undiscovered ones; and some authors have gone so far as to declare, that, were the cold no prevention, we should not be able to come much nearer than we do to the southern pole, for the number and fierceness of the burning mountains. *Africa* also has its volcanos, in the kingdom of *Fez*, and other places.

There are also some volcanos which have left off burning, as that on the island of *Queimoda*, upon the coast of *Brazil*, near the mouth of *Rio de la Plata*; the mountains in *Congo* or *Angola*; those in the *Azores*;

VOLCANOS.

Azores, especially in Tercera and St. Michael, which formerly used to burn, but now only emit occasionally smoke and vapours. The islands of St. Helena and Ascension, Iſchia, and the Lipari islands, in the Mediterranean ſea; ſeveral of the Molucca iſlands in the Indian ſea; ſeveral of the Azores and Antilles, &c. in the Atlantic ocean; Otaheite and Huaheine, &c. in the Southern ocean; all theſe, and many others, furniſh a variety of volcanic appearances and remains. Sir William Hamilton has lately given an account of certain traces of volcanos on the banks of the Rhine. Phil. Tranſ. vol. lxxviii. part i. art. 1.

Ancient extinguished volcanos have, indeed, lately been diſcovered in the inland parts of moſt countries; and as volcanos now exiſting are generally placed in the neighbourhood of the ſea, ſome have inferred from thence, that the ſea at ſome remote period covered thoſe countries. Submarine volcanos have often been obſerved even in our own times. The volcanic mountains, which are of different heights, generally form lofty ſpires, internally ſhaped like an inverted cone, placed on a broader baſis. This cone is called the crater or chimney of the volcano, as the lava commonly paſſes through it, though it ſometimes burſts from the ſides, and even from the bottom of the mountain; ſometimes the crater itſelf falls in, and is deſaced; and ſometimes in extinguished volcanos it is filled with water, and forms thoſe lakes that are obſerved on the ſummit of ſome mountains.

Extraordinary Effects of Volcanos.

The eruptions of Mount *Ætna* are ſeen by thoſe that fail on the Mediterranean, at the diſtance of forty German miles from the ſhore of Sicily. It rages at ſome times with peculiar violence. In 1536 it ſhook all Sicily; the noiſe proceeding from it reſembled that of the firing of great guns, and many houſes were overthrown throughout the whole iſland. After this ſtorm had continued for eleven days, the ground opened in ſeveral places, and diſcharged fire and flame; which in four days conſumed all that were within five leagues of *Ætna*. Then the funnel, on the top of the mountain, diſgorged a great quantity of aſhes, which were not only diſperſed over the whole iſland, but alſo carried beyond ſea to Italy, ſo that ſeveral ſhips that were ſailing to Venice, at 200 leagues diſtance, ſuffered damage. Mr. Oldenburg has given an hiſtorical account of the eruptions of mount *Ætna*, in Phil. Tranſ. No. 48, p. 967. See ERUPTION.

The laſt very great eruption from this mountain happened in 1669; of which the earl of Wincheſea, who was a ſpectator, ſays, that the inundation of fire, cinders, and burning ſtones, advanced into the ſea 600 yards; and a mile in breadth: it deſtroyed in 40 days the habitations of 27,000 perſons; and of 20,000 perſons, who inhabited Catania, 3000 only remained. He adds, that the fiery deluge in its progreſs met with a lake four miles in compaſs, and not only filled it up, though it was four fathoms deep, but raiſed it into a mountain. Borelli has calculated, that the matter diſcharged at this eruption was ſufficient to fill a ſpace of 93,838,750 cubic paces. Sir William Hamilton, who viſited this mountain in 1769, informs us, that the lava which ran from it, and on which there are as yet no ſigns of vegetation, is 14 miles in length, and in many parts ſix in breadth, and that it reached Catania, and deſtroyed part of its walls, buried an amphitheatre, an aqueduct, and many other monuments of its ancient grandeur, and ran far into the ſea, ſo as to form a ſafe harbour, which was ſoon after filled up by a freſh torrent of the ſame inflamed matter. There has been no ſuch eruption ſince, though there are ſigns of many more terrible, that preceded it. From the higheſt point of *Ætna*, Sir William counted 44 mountains in the middle region on the Catanian ſide; and many others on the other ſide of the mountain, all of a conical form, and each having a crater, or chimney, which, he ſays, have been evidently raiſed by exploſion. He eſtimated the great crater of *Ætna* to be about two miles and a half in circumference. The laſt eruption of *Ætna* was in 1776.

The firſt eruption recorded in hiſtory of Veſuvius, near Naples, is that which happened in the time of Veſpaſian, A. D. 79; on which occaſion, ſays Dion Caſſius, great quantities of aſhes and ſulphureous ſmoke were carried not only to Rome, but alſo beyond the Mediterranean; into Africa, and even to Egypt. Birds were ſuffocated in the air, and fell down dead upon the ground, and fiſhes periſhed in the neighbouring waters, which were made hot, and infected by it. Sir William Hamilton reckons, that the eruption in 1767 was the twenty-ſeventh from that in the time of Titus, ſince which there have been nine others; that of 1779 being peculiarly violent and alarming. Mr. Gerhard computes that Veſuvius has eſtimated from the year 1779 to 1783, 309,658,161 cubic feet. Biſhop Berkeley has given a particular account of the effects of the eruption in 1717; for which, ſee Phil. Tranſ. No. 354, p. 708, or the life of Berkeley, in the Biographia Britannica, by Dr. Kippis. We have an account of mount Veſuvius, and of the eruption from it in 1737, by the prince of Caſſano, in the Phil. Tranſ. No. 435, ſect. 1, 2. The matter thrown out flowed like melted lead, and moved about half a mile in an hour, which was an unuſual velocity. The trees, touched by this matter, immediately took fire, and fell. Glaſs in houſes was melted into a paſte.

Sir William Hamilton has given an accurate and circumſtantial deſcription of the eruptions in 1766, 1767, and 1779. See Phil. Tranſ. vol. lxxv. p. 192. vol. lxxviii. p. 1, &c. vol. lxxix. p. 18, &c.

vol. lxx. part i. p. 44, &c.—The uſual ſymptoms of an approaching eruption are rumbling noiſes and exploſions within the bowels of the volcano; a quantity of ſmoke forcibly iſſuing from its crater, accompanied at times with an emiſſion of red-hot ſcoriæ and aſhes, which gradually increaſe ſo as to exhibit in the night-time the moſt beautiful fire-works that can be imagined. When the eruption of 1779 began, the volcano was violently agitated; a white and ſulphureous ſmoke iſſued continually and impetuoſly from its crater, forming clouds reſembling bales of the whiteſt cotton. Such a maſs of theſe was ſoon piled over the top of the volcano as exceeded the height and ſize of the mountain itſelf at leaſt four times. In the miſt of this white ſmoke, an immenſe quantity of ſtone, ſcoriæ, and aſhes, were ſhot up to a height not leſs than 2000 feet; and a quantity of liquid lava was diſcharged, which ran with violence near four miles from the ſpot whence it iſſued. Minute aſhes, of a reddiſh hue, were diſperſed to a great diſtance, and darkened the air; theſe aſhes were mixed with long filaments of a vitrified matter, like ſpun-glaſs; ſeveral birds in cages were ſuffocated by the ſulphureous ſmoke; and the leaves of trees were covered with white ſalts very corroſive. In the progreſs of the eruption, after loud exploſions, a fountain of liquid transparent fire began to riſe, and gradually increaſing, arrived at a height not leſs than three times that of Veſuvius itſelf, which riſes perpendicularly near 3700 feet above the level of the ſea: Puffs of black ſmoke ſucceeded one another haſtily, and accompanied the red-hot, transparent, and liquid lava, within which ſmoke Sir William Hamilton perceived a bright, but pale, electrical fire, briskly playing about, in zig-zag lines. The liquid lava, mixed with ſtones and ſcoriæ, after having mounted at leaſt 10,000 feet, in part perpendicularly, and joining that which iſſued from the crater, formed one complete body of fire, not leſs than two miles and a half in breadth, and of the extraordinary height above-mentioned, caſting a heat to the diſtance of about ſix miles around it. This volcanic lightning, however, very rarely quitted the cloud, but uſually returned to the great column of fire, toward the centre of the volcano, from whence it originally came. The air, for ſome time after the eruption had ceaſed, continued in a conſiderable degree electrical. While the eruption laſted, a mixed ſmell, like that of ſulphur, with the vapours of an iron foundry, was ſenſible. The air, after one day's eruption, was filled at night for many hours with meteors, ſuch as are vulgarly called falling ſtars, which ſhot generally in a horizontal direction, leaving behind them a luminous trace, which quickly diſappeared. Many ſmall volcanic ſtones and cinders were afterwards found to have fallen more than 30 miles from Veſuvius, and minute aſhes fell in great abundance at the diſtance of 100 miles. The number and ſize of the ſtones, or fragments of lava, which were thrown out of the volcano in this eruption, were incredible: the largeſt was in circumference no leſs than 108 feet, and 17 feet high. It was a ſolid block much vitrified. This was thrown at leaſt a quarter of a mile clear of the volcano. For an account of theſe, and many other curious circumſtances attending the eruption of 1779, illuſtrated by a figure, ſee Phil. Tranſ. vol. lxx. part 1. art. 4. The known qualities and effects of the noxious vapours, called in Italy *moſete*, that are uſually ſet in motion by an eruption of the volcano, and that are then manifeſt in the wells and ſubterraneous parts of its neighbourhood, correſpond with thoſe attributed to fixed air. Id. vol. lxi. part i. p. 41.

The force with which a volcano explodes ſeems to be the greateſt hitherto known in nature. So great indeed is this force, that we muſt of neceſſity ſuppoſe the reſiſtance of the air to be exceedingly leſſened before the projected materials. Under the article PROJECTILES, it is ſhown how great this reſiſtance is, and what an effect it has upon globes of ſolid iron. Upon irregular maſſes of rock, then, and much more upon ſtreams of liquid lava, the reſiſtance muſt be ſuch, as to ſtop their motion almoſt as ſoon as it began. Nevertheless, in the great eruption of Veſuvius in 1779, Sir William Hamilton informs us, that a ſtream of lava of an immenſe magnitude was projected to the height of at leaſt 10,000 feet above the top of the mountain; and if to this we add the depth of the ſource whence this lava was derived, the force by which it was impelled muſt exceed our imagination. Indeed, let us ſuppoſe the cauſe to be what we will, had the air exerted its reſiſting power upon this lava, as it does on a cannon-ball, the force neceſſary to have carried it to that amazing height muſt have daſhed the ſtream in pieces, at its firſt emiſſion from the mouth of the volcano. Either the extreme heat of the lava, therefore, or ſome other cauſe, muſt contribute to keep off this reſiſtance; without which we cannot ſuppoſe that it could have reached to ſuch an height, much leſs could the lighter materials, aſhes, cinders, &c. have ariſen to an height ſufficient to carry them to the diſtance of 100 miles from the mountain, which we are aſſured was the caſe at that time. Dr. Hook formerly had maintained, that all land was raiſed out of the ſea by earthquakes; and modern philoſophers ſeem to admit his hypotheſis, though not, perhaps, in its utmoſt latitude. Von Troil (Letters on Ireland, p. 222.) is of opinion, that this iſland has been produced by volcanos in the courſe of ſeveral centuries. Dr. Foſter, in his Obſervations made during a Voyage round the World, p. 151, after giving an ingenious conjecture concerning the origin

VOLCANOS.

origin of all the tropical low isles in the South Sea, assures us, that of the higher isles there is hardly one of them which has not strong vestiges of its having undergone some violent alteration by a volcano. Some of them have volcanos still existing; others, among which are Otaheite and Huaheine, seem to have been elevated, in remote ages, from the bottom of the sea by subterraneous fires. Sir W. Hamilton is confident, that the island of Ischia, the whole basis of which is lava, rose out of the sea in the same manner as some of the Azores.

The effects of volcanos in the course of many ages must be allowed to be very considerable; and hence some have taken occasion to account for the formation of mountains, islands, and even the immense continents in our present globe. That many mountains owe their origin to volcanos, is an unquestionable fact, confirmed by several observations recited by Sir William Hamilton. The mountain called Montagno Novo, near Puzzoli, which is an hundred and fifty feet high, and three miles round, rose in one night out of the Lucrine lake, in 1538; and he says it is not more extraordinary, that Vesuvius itself should in many ages rise above two thousand feet. All the high grounds near Naples are formed in the same manner, as Sir William could not discover, in any place, what could be called virgin earth; and if he were to establish a system, he says, it would be, that mountains are produced by volcanos, and not volcanos by mountains.

Mr. Whitehurst, in his inquiry into the Original State and Formation of the Earth, 4to. 1778, apprehends, that subterraneous fire must at different times have existed universally in the bowels of the earth, and that in union with water, or by the expansive power of steam, it has produced the immense continents, as well as the mountains of our globe, and also the universal deluge. When these fires were first kindled, by what sort of fuel they are still maintained, at what depths below the surface of the earth they are placed; whether they have a mutual communication; of what dimensions they consist, and how long they may continue, are questions which do not admit an easy decision.

Investigation of the Causes of Volcanos.

There are no phenomena in nature whose causes seem more difficult to be explained than volcanos. The fermentation of pyrites, of sulphur and iron, the explosions of nitre, of aqueous steam violently heated, or of air pent up and greatly rarefied, have all been thought of to explain them, but with very little success. Dr. Woodward and others have recourse to a central fire which they suppose to exist in the bowels of the earth, and suppose that volcanos are so many spiracles or chimneys to prevent it from destroying the whole world.

It must, however, be very evident, that the immense force which we observe in volcanos cannot by any means be accounted for from any such principles. It is impossible that beds of pyrites can be so totally inexhaustible as to remain for thousands of years under, or nearly under, the same part of the surface of the earth. And as to nitre, it is never found in a fossil state, nor indeed can we conceive that such quantities of nitre can exist under any one part of the surface as would be sufficient for a single explosion: besides, nitre does not explode instantaneously, unless it is thoroughly mixed with sulphur and charcoal, in order to convert it into gun-powder; an operation which cannot take place in the bowels of the earth. As little can we suppose those eruptions owing to the expansion of aqueous steam; for though this will in some cases explode with great violence, yet in others it seems to be in a manner totally deprived of that power. With melted lead, copper, or salts, it explodes with the utmost fury, even when water in a very small quantity is thrown upon the surface of such substances; yet on the surface of melted glass, which is much hotter than any of them, water will not explode, but evaporates quietly, seemingly kept at some distance from the surface of the glass by the violent emission of steam from its under part. Nay, with this violent heat, it does not even appear to boil; but gradually lessens in its dimensions, until at last it quite disappears. Indeed, if we suppose water intimately mixed and dispersed in small quantities through the substance of melted glass or any similar substance, no doubt a very violent explosion will take place; but in this case the matter, instead of being thrown up in a full stream, would be scattered all around in an immense number of small drops. Indeed we cannot conceive how any such intimate mixture could take place; for if we suppose any large collections of water to exist under ground at the same time that a lava is by some unknown means melted in such a manner as to come in contact with it, either the water must fall upon the lava, or the lava into the water. If the water falls upon the lava, no explosion will take place, as has been already shewn; and if the lava falls into the water, the liquid must no doubt be heated boiling hot, and the steam dissipated with those noisy explosions, when a lava of that mountain ran into the sea. On this supposition, however, the lava could never be projected above the mountain; much less can we suppose that solid rocks should be moved from their places, and thrown to great distances, as experience shews them to be. In the eruption of Vesuvius in 1779, Sir William Hamilton measured one which was 108 feet in circumference, and 17 feet high, and which was thrown to the distance of more than 1300 feet from the crater of the volcano. If we suppose this stone to have been only twice as heavy as water, it must have weighed considerably

more than 700 tons; and the projectile power employed to throw this to such a distance must have exceeded any thing we can conceive, almost of the force of gunpowder itself.

Some have supposed, that the earth, at a considerable distance below its surface, is surrounded with a stratum of ignited matter of a definite thickness; or that the whole central part of it is nothing but a mass of melted minerals, which, every where struggling for vent, bursts forth where there is the least resistance, shivering into rude fragments the superincumbent crust of earth, and deluging with mountainous torrents of liquid fire the adjoining countries.

When we consider the immense power exerted by volcanos, we can scarce find any thing in nature to which it can be ascribed. What only seems to resemble it is the explosions of inflammable air in mines, and of which an account is given under the article DAMPS. But as it is impossible to account for the continual generation of this air, which we know must be destroyed by every explosion, we cannot have recourse to this agent; nor, though electricity seems to be very much concerned in volcanos, are we acquainted with any laws according to which that fluid acts, by which a succession of violent explosions could be occasioned. The primary consideration, however, in attempting to account for the phenomena of volcanos, is the means by which the fire is originally kindled, because upon this, some how or other, all the rest of the phenomena depend. This, from what has been already observed, cannot be occasioned by fermentations of metalline, mineral, or saline substances, which in time would wear out; but must depend upon some inexhaustible cause. The only inexhaustible source of fire which we are acquainted with, is the electric fluid, by means of which every degree of heat, even to that which vitrifies gold and platina, may be excited. From the many articles in this work, where the nature of the electric fluid has been considered, it must appear very probable that it is no other than the light of the sun himself absorbed by the earth, pervading every part of it, receiving new motions, and becoming subject to new laws, in consequence of this absorption, as if it were different fluid. As the sun perpetually sends down an immense quantity, great part of which is still absorbed, it is impossible that such an absorption can take place without an emission of an equal quantity somewhere or other. The outlets to this fluid are innumerable; but by various causes many of these may occasionally be stopped. In this case it is evident, that the fluid must move with greater velocity through those which remain open. But it has been shewn, under the articles ELECTRICITY, and HEAT, that the violent motion of the electric fluid through any substance is heat; that when this fluid converges to a centre, or diverges from one, heat always takes place in the central point, and that more or less violent according to the quantity of fluid which thus converges or diverges. If then, from any cause, the electric matter diffused through a very large portion of the earth should converge towards one particular spot on the surface, then that spot would undoubtedly be heated, or perhaps set on fire; and if a sufficient quantity of electric matter should constantly be directed in this manner, we must easily see that the heat must be continual. Hence may be understood the origin of *sol fataras*, or spots of earth which have a continual heat in them, and of hot springs. But if this violent flux of electric matter should by any means be interrupted and renewed at uncertain intervals, we see, in that case, the heat must occasionally increase and decrease, without any cause visible to those who dwell near the spots above-mentioned. In volcanos, however, it is probable that the flux of electric matter always continues to a very considerable degree, but occasionally is increased in such a manner as to melt down the earth, stones, and mineral substances, through which it passes into the semivitrified compounds called *lava*. We cannot indeed, as yet, particularly know the causes by which the electrical flux is at all times occasioned. In general, we are certain, that whatever has a tendency to solicit the matter to the surface, will increase the violence of an eruption; and whatever can increase it after it has begun, will also contribute to bring it on originally. This will happen when the pressure of the atmosphere directly over the mountain is lessened; when a cloud passes over it whose electricity is opposite to that of the mountain itself, or which, by acting as a conductor, may facilitate the escape of the confined electric matter; or it will readily happen if by any means the surface of the mountain and of the earth round it is rendered a better conductor than usual. But above all, the state of electricity in the neighbouring earth and air must contribute towards the bringing on an eruption, or increasing one which is already begun. Under the article EARTHQUAKE, has been shewn, that when there is a perfect equality between the electricity of the earth and of the atmosphere, there is then great danger of a concussion, because the electric matter can neither get into the atmosphere from the earth, or into the earth from the atmosphere. It must therefore stagnate altogether, and be ready to burst out on all sides, when the pressure upon it becomes sufficiently strong. In such circumstances, if there happens to be a volcano in the neighbourhood, it is probable that it will be set on fire, or perhaps a new volcano may be produced on this occasion.

These causes seem to be sufficient for the production of volcanos, and setting them on fire from time to time, as usually happens with them;

VOLCANOS.

them; though no doubt there may be others much more unknown to us which take place in the bowels of the earth itself; but as these are entirely concealed from us, we can only guess at their existence. But that all the before mentioned causes do contribute towards the eruption of burning mountains, experience evinces. Sir William Hamilton mentions it as a common observation, that the inward explosions of Vesuvius increase during bad weather, when we know that the pressure of the atmosphere is lessened, and the descending vapours serve as conductors to the electric fluid. The same gentleman informs us, that, on the 7th of August 1779, as he was observing Vesuvius, a collection of thunder-clouds passed directly over its summit, and mingled with the sulphureous and mineral clouds of smoke, cinders, and ashes, which were then piled up to an amazing height over its top. "At this moment (says he) a fountain of fire was shot up to an incredible height; casting forth a bright light, that the smallest objects could be clearly distinguished at a place within six miles or more of Vesuvius." Thus we see that these clouds, acting either by their conducting power as aqueous vapours, or by an electricity opposite to that of the volcano, caused a vast discharge of the fire as soon as they came directly over it. The cause of the volcano in the island of Tanna taking fire after rain, according to Mr. Forster's observation, appears evident, namely, that by this means the surface of the ground all round was rendered a much better conductor than before, and perhaps supplied with a greater quantity of electricity, the passage of which to the volcano was now free, in consequence of which it took fire and burnt violently till this supply was again exhausted. Lastly, it is well known that some countries which were formerly very subject to earthquakes, have been freed from these destructive phenomena by the breaking out of a volcano. In the time of earthquakes also, temporary volcanos are often formed, and the neighbouring ones throw out vast quantities of fire. This was particularly observed in the great earthquake of 1692, when Catania was destroyed, at which fatal moment a vast flame was seen to issue from mount Ætna. But whether any such appearance was observed during the earthquakes of the year 1783, which seem not to have been less violent than that of 1692, has not been authenticated.

We shall only add one remark more in confirmation of the hypothesis that volcanos are set on fire by electricity, namely, that in a volcanic eruption the quantity of this fluid emitted from the mountain is quite incredible. For a long time together, the smoke is sometimes so much electrified as to attract the ashes which are thrown out along with it almost into a solid column. The stones thrown out, according to Sir William Hamilton, are sometimes transparent, which we can only attribute to an immoderate electricity. Nay, the same author informs us, that the vast stream of lava which issued in 1779 to the height of almost two miles, was transparent also. Add to this, that the volcanic smoke proves very dreadful by reason of the thunder-storms which issue from it. In the great explosion of 1779, which, however, lasted only twenty-five minutes, a cloud of electrified smoke was produced, which threatened the destruction of Naples at six miles distance from the mountain; and though it was happily driven from thence by the wind, the air continued so much electrified, that a Leyden vial, armed with a pointed wire, soon became considerably charged by being only held out at a window. At Ottaviano, which was involved in this cloud, incessant flashes of lightning added greatly to the horror of the scene, as well as to the danger of the inhabitants. By another day's eruption, the air was filled with meteors resembling falling stars, which give us a yet higher idea of the quantity of electric matter emitted, as these indicate a greater degree of electricity than even the most violent forked lightning. See LIGHTNING.

Thus we have attempted to explain the original cause of volcanos, the formation of lava, and the reason why the volcanic eruptions are not constant, but only take place at uncertain intervals. It now remains only to assign a reason why volcanos do not burn quietly as any common fire, but, even during the time of an eruption, by fits and intervals. The explosions indeed are in a manner continued; but Sir William Hamilton observes, that the burning mountains are subject to what he calls a *crisis at noon and midnight*. The exacerbations also are very remarkable; so that our author distinguishes them by the name of *fever-fits*. All these phenomena, however, may be solved by an attentive consideration of the principles above laid down. The lava is formed by a great quantity of electric matter violently forcing itself through a small spot of earth; in consequence of which that spot is melted, and thus becomes a better conductor of electricity than before, whence the force of the electric blast towards that place is still augmented. Now, as the earth is composed of what we call simply *mould*, together with stones, and minerals of various kinds, moistened with a certain quantity of water, it is not possible that a mass of this kind can be melted without the production of an incredible quantity of steam of various kinds. It is not only the aqueous vapour that is here concerned, but almost all the different kinds we can imagine. No doubt the steam of water alone shows, in certain circumstances, an incredible degree of strength; but of all vapours hitherto known, the aerial ones are the most powerful in their effects; as well as the quickest in their operation. Mr. Robins, in

his Treatise on Gunnery, relates some experiments, from which he concluded, that air, heated to an intense white heat, was expanded into more than four times its usual bulk, and consequently, in such circumstances, has more than four times its usual elasticity. From another experiment he shewed, that inflamed gun-powder produces a quantity of permanently elastic steam equivalent to 244 times the bulk of the gun-powder itself. Hence he concludes, that the force of inflamed gun-powder is nearly equal to 1000 times the pressure of the common atmosphere. Now, though the air produced by the inflammation of gun-powder is of a different kind from that which we may suppose to be produced by the melting of a lava, and in much greater quantity in proportion to the bulk of most of the materials, yet it does not appear that the elasticity of the volcanic steam is at all inferior, as far as it goes. From Dr. Priestley's experiments it appears, that the expansion of the different kinds of air by heat are in the following proportions: Common air, 132; inflammable, 205; nitrous, 202; fixed, 220; marine acid, 133; dephlogisticated, 221; phlogisticated, 165; vitriolic acid, 237; fluor acid, 283; alkaline, 475.

In order to form some estimate of the force of volcanic steam, it is necessary not only that we should know the different elasticity of the airs which may be supposed to be extricated, but the proportions which are yielded by different substances. But here our data are very slender. Dr. Priestley, to whom we must in a manner wholly have recourse, has not made experiments on those substances which we can most reasonably suppose to exist in the bowels of the earth. From some, however, air was discharged in the following proportions, with a heat indeterminate indeed, but certainly not greater than that of a volcano. Wood ashes, 160 times their own quantity; pit-coal ditto, 110; lapis calaminaris, 306; manganese, 40; chalk, 1. All these substances we may with good reason suppose to exist in a volcano, or at least substances equally ready to discharge the air. Nay, Dr. Priestley himself supposes as much dephlogisticated air to be discharged from the melted materials of a lava as is sufficient to continue the burning. But however much he may be in the right with regard to the quantity of dephlogisticated air produced in this manner, he must certainly be mistaken as to the use of it. It is certain that the burning must have commenced before any air could be emitted from the materials, and the cause which produced it, must also be sufficient to continue it; not to mention that lava could not be kept melted, nor stones red-hot, by blowing air in any quantity upon their surfaces.

With regard to the effects of this steam, we must easily see, that where the quantity of materials is very large, it must be extremely formidable. From the calculations of Dr. Priestley above-mentioned, it appears, that fixed air let loose and heated is more powerful than atmospheric air, and consequently more so than even the air emitted by gun-powder, which Mr. Robins observes to have much the same elasticity with common air. It is true, that nitre yields pure dephlogisticated air, which is somewhat more elastic than fixed air; but it is instantly phlogisticated by the other ingredients; and Dr. Priestley found what remains after the accension of gun-powder to be more phlogisticated than common air, and consequently to have very little more elasticity, as Mr. Robins observed. Now, the steam of a volcano must undoubtedly be composed of fixed air, vitriolic acid, some marine acid, dephlogisticated and inflammable air, all blended together at once by the melting of the lava, not to mention a prodigious quantity of aqueous steam rarefied and heated to an extreme degree. As all these are more powerful than an equal quantity of the vapour of inflamed gun-powder, no wonder that such terrible effects ensue from it. From Dr. Priestley's calculation, it appears that two ounces of wood-ashes, if a white strong heat could be suddenly applied to them in such a manner as to make them give out all their air at once, would be much more powerful than one ounce of gun-powder; three ounces of pit-coal ashes would be more powerful than an ounce and an half of gun-powder; six ounces of manganese would be more than an equivalent to one ounce, and 15 pounds of chalk would be the same; though this last we may be assured would in such circumstances yield more than fifty times the quantity of air that Dr. Priestley could obtain from it. Lapis calaminaris would be terrible beyond all measure; one ounce of it being nearly equivalent to two of gun-powder. What must be the consequence, then, if thousands of tons of materials equally prolific in such kinds of air are melted at once? When all this is attentively considered, we shall be so far from being surprised at the immense power of volcanos, that it will rather be matter of surprise that more mischief is not done by them than what actually happens.

Thus we may in a very plausible manner account for the general phenomena of volcanos; and if extraordinary phenomena sometimes occur, we may reasonably suppose them to be owing to some accidental circumstance. Thus the vast height to which the lava of Vesuvius ascended in 1779, must certainly have been occasioned by some extraordinary pressure, such as indeed we may well be surprised how the sides of the mountain could bear. There are three circumstances which may reasonably be supposed to cause the lava to spring up to a considerable height. 1. Its being very suddenly formed; for thus all the elastic steam will be discharged in a manner at once, and the tendency to expand will be inconceivably great. 2. The degree of resistance. And, 3. The capability of the materials

terials to produce elastic steam. All these seem to have concurred to produce the great explosion on the 8th of August 1779. The immense quantity of electric fluid which at this time issued from the mountain, indicated that the lava had been suddenly formed. Immediately before its emission, such a report was heard as shook the houses at Portici, broke the windows, and cracked several walls; and the fitness of the materials at that time in the mountain for producing elastic steam, appeared from the vast quantities of smoke which issued along with the lava. See Theory of the EARTH, and Dissertation on the causes and effects of EARTHQUAKES.

Uses of Volcanos.

With regard to the uses of volcanos, we may observe, that however terrible their eruptions may be, they answer very important purposes in nature, by giving vent to such quantities of electric matter as might otherwise render the earth totally uninhabitable, if not endanger its frame altogether; being a kind of spiracles, or tunnels, whereby to vent the fire and vapour that would otherwise make a more dreadful havock, by convulsions and earthquakes. Accordingly, Dr. Woodward observes, there is scarce any country much annoyed with earthquakes, but has one of these fiery vents; which is constantly observed to be all in flames, whenever an earthquake happens: by which means it soon disgorges that fire, which, while it was underneath, was the cause of the disaster; and there are not wanting instances of countries that have been wholly freed from earthquakes, by the eruption of a new volcano. Sulphur, sal ammoniac, and various other salts, are produced by them; their ashes fertilize the neighbouring country, and the lavas, tufa, basaltos, &c. afford materials for building. By their means also many islands have been thrown up from the bottom of the sea, and afford new habitations for man.

Dr. Priestley (Obs. on Air, vol. i. p. 263.) thinks it not improbable, that the volcanos, with which there are evident traces of almost the whole surface of the earth having been overspread, may have been the origin of our atmosphere, as well as (according to the opinion of some) of all the solid land.

Artificial Volcanos.

Mr. Lemery seems to have been the first person who illustrated, by actual experiment, the origin of subterraneous fires. He mixed twenty-five pounds of powdered sulphur with an equal weight of iron filings; and having made with water a paste of the mixture, he put it into an iron pot, covered it with a cloth, and buried it a foot under ground. In about eight or nine hours time the earth swelled, became warm, and cracked: hot sulphureous vapours were perceived; a flame which dilated the cracks was observed; the superincumbent earth was covered with a yellow and black powder; and, in short, a subterraneous fire, producing a volcano in miniature, was spontaneously lighted up from the reciprocal actions of sulphur, iron, and water. See Artificial EARTHQUAKES.

The above experiment has been often repeated; and it has been observed, that large quantities of the materials are not requisite to make the experiment succeed, provided there be a due proportion of water; half a pound of steel filings, half a pound of flower of brimstone, and fourteen ounces of water, will, when well mixed, acquire heat enough to make the mass take fire. But it was known long before the time of Lemery, that natural mixtures of sulphur and iron would spontaneously take fire. These substances, it is well known, are supplied by the pyrites; a small quantity of which is sufficient to kindle fire; a proper portion of water (for too great a quantity would extinguish the subterraneous fire) may be derived either from fissures and channels communicating with the sea, or from sources in the earth, wherein it is known to abound; and air, if it should be thought absolutely necessary to the spontaneous firing of the pyrites, may be conceived either to accompany the water, or to descend into the innermost parts of the earth through the fissures which are found on its surface. Or, if we suppose the heated pyrites to have been in contact with black wad and petrol, the flame may arise, as it is produced by art, from the defecation of that substance, and its mixture with the mineral oil. That ore when heated affords dephlogisticated air, of which a very small quantity is sufficient to produce flame; and the flame when once produced, may be supported by dephlogisticated air from other ores, as Dr. Priestley has shewn, (Obs. on Air, vol. iv. p. 210, &c.) and the phlogiston may be supplied by pyrites, bituminous, shistus, bitumen, and coal. After the eruption in any place, the volcanos themselves serve for spiracles or air-holes, by which the subterranean fire may receive necessary supplies; so that these serve to keep the magazines of internal fire in a due state, as well as to discharge the smoke and other matters with which it would otherwise be choked up and extinguished.

Volcanos in the Moon.

Dr. Herschel, now so well known and universally celebrated on account of his various astronomical observations, has on the 4th of May, 1783, discovered a burning volcano in the moon. This discovery confirms the conjectures formed by M. Äpinus in 1778, and published in a memoir printed at Berlin in 1781, concerning the volcanic origin of the inequalities in the moon's surface. Similar ideas occurred to professor Beccaria of Turin, nearly at the same time, and also to professor Lichtenberg, of Göttingen. The nephew of professor Beccaria discovered, Oct.

11, 1772, a luminous spot on the moon, during its total eclipse of that night, in or near the place marked Copernicus; and from this time the professor mentioned this observation in his public lectures, as an evidence that the round cavities on the surface of the moon were so many craters of distinct volcanos; adding that he considered those straight radiations, or bright paths, which are observed particularly on the place of the moon marked Tycho, as so many torrents of the lava, which spouted off in some former conflagration of a volcano. The reader may see this account, given by the professor himself, in a letter concerning the luminous appearance observed by Don Ulloa on the moon, during the total eclipse of the sun, June 24, 1778; in which he maintains that such a luminous spot was an actual burning volcano, and not a real hole through the mass of the moon, as Don Ulloa asserted it to be. This letter is inserted in the Journal de Physique for the month of June, 1781. M. Äpinus observes, that the opinion of volcanos in the moon was first suggested by Dr. Hooke, in his Micrographia, printed at London in 1665; in the twentieth chapter of which work he speaks at large concerning this opinion.

Dr. Herschel, on the 4th of May, 1783, discovered two small conical mountains in the very same spot where he had observed the volcano; these are situated in the Mons Porphyrites of Hevelius, just by a third mountain, much larger, which Dr. Herschel had often observed before. See Gent. Mag. for August, 1784, p. 563, &c. On the 19th of April 1787, the same ingenious and indefatigable observer discovered three volcanos in different places of the dark part of the new moon. Two of them were nearly extinct, or in a state ready to break out. The third shewed an actual eruption of fire, or luminous matter. From another observation he infers, that the diameter of this volcano cannot be less than 3', and that the diameter of its burning part is equal to at least twice that of the third satellite of Jupiter, with which it was compared. Hence the shining or burning matter is computed to be above three miles in diameter. Phil. Trans. vol. lxxvii. part i. p. 230. See the System of ASTRONOMY, Sect. VIII. under the article MOON.

VOLUNTARY, in the Schools, the generality of philosophers use the term *voluntary*, in the same sense with *spontaneous*; but through the force of habit in weak minds, it has been appropriated to convey an idea of willing subjection to a state of degradation at which the enlightened and liberal mind must revolt. And it is melancholy to reflect, that many of the human race are voluntary slaves.

The following striking reflections upon Despots and the nature of their Government, appear in a small treatise upon Voluntary Servitude, written in French by Stephen de la Boete, King's Counsellor in the Court of Parliament, at Bourdeaux, in the reign of Charles IX. of France.—

"Poor infatuated people, blind to your own good, you permit your revenues to be carried off before your eyes—and all this not by a professed enemy, but a man, whose greatness you yourselves are the authors of. For whose caprice you cheerfully go to war, and for whose aggrandisement you are prodigal of your blood. And yet, he, who thus domineers over you, has only two eyes, two hands, and one body; and possesses nothing of his own, that is not common to an infinite number of men. It is from you he derives the hands he makes use of to strike you—the eyes to inspect you and count your money, and the feet to trample upon you! What could he do if you did not protect the robber that pillages you? You sow and plant that he may destroy; and you are accomplices in effecting your own ruin. You endure indignities which the brutes themselves would resist, if they felt them. And yet, you might free yourselves if you had but the will to attempt it. I do not advise you to overthrow your tyrant—only forbear to support him; and when this basis is taken away, he will fall by his own weight and be crushed in pieces. But, continues this Author, to the development of the secret spring, the very foundation and bulwark of tyranny, they are much mistaken who think that the guards in particular, or the military in general, are the security of a tyrant. It must be allowed, that the guards hinder people from entering a palace who have not preconcerted their measures—No! the soldiers are not the people who defend tyrants! For, incredible as it may appear, it is five or six persons who support the nominal head, and five or six who keep all the country in bondage!—Those six have six hundred which act under them; and these six hundred are to them what the six are to the tyrant. And further, the six hundred have six thousand that they have raised to posts and perpetual employments, who cannot subsist but under the shadow of their superiors, nor escape the punishment due to their crimes by the laws, but through the protection and connivance of the former. The consequence of the connection is fatal indeed, and whoever will amuse themselves in tracing this chain, may be convinced, that not only the six thousand, but the hundred thousand, and even millions, are attached to the tyrant by its various links; while he makes the same use of it, as Jupiter does of that in Homer, where he boasts, that by only touching one extremity of it, he can draw all the gods towards him."

VOMICA, in medicine, a collection of pus in any part of the body. When this mass, or collection, is in the lungs, it is called *vomica pulmonum*. When in the kidneys, *vomica renum*, &c. *Vomica pulmonum*, in medicine, the name of a disease which is a fan-

U R E

ous collection of matter, or an impostume formed in the lungs, and included in its own proper membrane; this sometimes seizes one lobe, sometimes the other; and sometimes lies deep in the substance, sometimes near the surface. It finally breaks, and then discovers itself by a discharge of purulent matter from the lungs. This differs from an empyema, which is a collection of pus in the cavity of the thorax. For description, prognosis, causes, and cure, see the System, Genus 30. under the head PHTHYSIS.

VOMITING, as a disease, a violent casting up, or evacuating by the mouth, what is contained in the stomach. See EVACUATION. This action has generally been allowed to be owing principally to the contraction of the fibres of the stomach, when irritated by the acrimonious quality, or oppressed with the quantity of its contents. Boerhaave, and most of our latest writers, allow the stomach, the diaphragm, and the muscles of the abdomen, all to have their share in the action of vomiting; accordingly that diligent author makes vomiting to consist in a convulsive and retrograde motion of the muscular fibres of the gullet, stomach, and intestines, as well as those of the abdomen, and the septum transversum; which, when in a less degree, produces a nausea, and, in a greater, a vomiting. By the contraction of so many parts, the stomach comes to be squeezed, as in a press, when it is obliged to give up what is contained in its cavity, and the neighbouring parts, just as water is forced out from a bladder, or sponge, when squeezed between the hands. The evacuation, too, must be upwards rather than downwards, by reason the passage is more open and easy that way; and that the intestines are pressed by the diaphragm and the muscles of the lower venter.

The primary causes of vomiting are commonly the too great quantity, or too much acrimony, of the contents, foulness of the stomach, a translocation of the morbid matters of ulcers, the gout, the erysipelas, or other diseases of the stomach; a looseness suddenly stopped; the stoppage of any customary evacuation, as the bleeding piles, meneses, &c. a weakness of the stomach, the cholera, the iliac passion, a rupture, a fit of the gravel, worms, &c. It arises also from poisons, contusions, compressions, inflammations, and wounds in the brain; inflammations of the diaphragm, stomach, intestines, spleen, liver, kidneys, pancreas, and mesentery, unusual agitation at sea, in coaches, &c. It may be likewise excited by violent passions: sometimes it proceeds from a regurgitation of the bile into the stomach, in which case the matter discharged is generally of a yellow or greenish colour, and has a bitter taste. Persons who are subject to nervous affections are often suddenly seized with violent fits of vomiting; and, moreover, vomiting is a common symptom of pregnancy, in which case it generally comes on about two weeks after the stoppage of the meneses, and continues during the first three or four months. The treatment of vomiting, as a disease, must therefore be also various, according to the different causes producing it.

VOMITING of Blood, a very dangerous kind of hæmorrhage consisting in bringing up, by vomit, pure and unmixed blood from the stomach, and being a method used by nature to throw off a portion of the blood, which molests the whole in the vena porta, and, by that means, facilitates the circulation of the rest of the mass. For causes, prognosis, and cure, see the System of MEDICINE, Genus 30.

VOMITING excited by Medicines. The effects of vomits, on the motion of the blood, appear by the following experiments: by observing the pulse of several men after taking a vomit, it has been found, that so soon as a man begins to grow sick, his pulse becomes low, quick, and irregular, and, in the action of vomiting, is often so low as not to be felt; that in the intervals, between the vomits, the pulse is still low and quick, but not near so low and quick as in the action of vomiting; and that, after the operation is over, the pulse rises gradually, and, in the space of half an hour or an hour, becomes fuller than it was before the vomit was taken. Hence we may see the effects of vomits on the motion of the blood; they lessen that motion during the whole time of the operation, and almost quite stop it in the very act of vomiting; and after the whole operation is over, they increase the motion of the blood, so as to make it greater than it was before. From these effects, of vomits on the motion of the blood, we discover their great usefulness in the cure of many diseases.

URANIA, in mythology, one of the nine muses, that presided over astronomy; she is represented as clothed with an azure-coloured robe, crowned with stars, holding a globe in her hand, or sometimes with the globe at her feet, and surrounded with several mathematical instruments.

URETERS, in anatomy, two long and slender canals, which come from the pelvis or basin of the kidneys; one on each side runs down obliquely to the lateral parts of the inner or anterior side of the os sacrum, and passing between the rectum and bladder, terminates in the bladder; serving to convey the urine, secreted in the glands of the kidneys, into the bladder. See the System, Part III. Sect. XI. and Plate 5. fig. 4. letters P. P.

URETHRA, in anatomy, a tube or canal arising from the neck of the bladder, and continued to the pudendum; serving to discharge, or carry off the urine out of the bladder. See the System, Part III. Sect. XV. and Plate X. fig. 1. letter H, upper division; and lower division, fig. 2. letters E. F.

U R I

URINE, **URINA**, formed from *urere*, which signifies the same; a liquid excrement, or humour, separated from the blood in the kidneys, conveyed thence into the bladder, and discharged by the urethra. The urine is secreted from the arterial blood, in the glands of the kidneys, from which arise numerous little pellucid pipes, and veins; which, receiving the secreted urine, at length join into twelve papillæ: out of which the urine issues into a cavity called the pelvis, from whence it runs into the ureters of either side, and through them into the bladder: and, from that, at length, through the urethra out of the body. The secretion of the urine, then, is not performed by any attraction, as some will have it; or by any fermentation, as others; or any precipitation: but by the force of the heart, and arteries, whereby the blood is driven through innumerable turnings and windings of the vessels, attenuated by resistances, opposite motions, violent concussions, and various mixtures, till the more liquid and serous part thereof is forced through canals smaller than the blood-vessels, and so collected and discharged.

The secretion of urine, as also that of perspiration, is considerably influenced by the passions. It is more than probable, that the blood of the emulgent artery, conveyed through all the little branches that spread through the exterior membranes of the vesiculæ, whereof the kidneys are composed, being by this means exceedingly divided, and, as it were, attenuated, enters the vesiculæ themselves, and gives them their red colour: that it is there filtrated, and the serous or urinous part secreted; that this filtration is promoted by the alternate contraction and dilatation of the fleshy fibres that enclose the little vesicles; and that, after filtration, the parts that remain of blood are resumed by the capillary branches of the veins; the rest entering the excretory ducts of the vesiculæ, which are the first receptacle of the urine. See the System of Anatomy, Part III. Sect. XII.

M. Morin, in the Memoirs of the Academy of Sciences, marks out a new route or course of the urine. The ordinary one, which is the passage of any liquor we drink through the stomach into the intestines, thence into the lacteals, thence into the receptacle of the chyle; thence into the subclavian vein; thence into the cava, thence into the right ventricle of the heart, thence into the lungs, and thence into the left ventricle of the heart, thence into the aorta, thence into the emulgent artery, thence into the kidneys, thence into the ureters, and at last into the bladder, seem to him too long and circuitous; considering how readily mineral waters pass, and what a speedy effect asparagus is found to have on our urine. Besides that, on this principle, the liquors we drink mixed with so many other liquors in their way, should be greatly altered thereby; whereas we frequently find a tincture of cassia rendered by urine almost as black as when first taken; and the like is observed of divers other liquors. M. Morin, therefore, maintains, that a considerable part of the liquor we drink, issues through the membranes of the stomach, and falls into the abdomen; where it enters the bladder through the pores thereof, without getting into the intestines, which are lined with too thick and viscid an humour to allow it ingress. This system is confirmed hence, that both the stomach and bladder, even of a dead animal, are found easily permeable in water.

Accordingly, Dr. Morgan assures us, that if the contents of the abdomen be taken out of an animal body, after it is just opened, and the stomach be filled with warm water, while the parts are yet reeking, the liquor will pass into the bladder; which will visibly receive it, and be filled in proportion as the stomach empties. The same author adds, that if a ligature be made upon the ureters, while the animal is yet living, and the blood continues to circulate: though this must cut off all communication from the kidneys to the bladder; yet any liquor with which the stomach is filled, will pass into the bladder. From the whole, he says, though some of our best anatomists hold, that a circulation of the whole mass of blood is effected in five minutes, and others in two, which might account for the quick passage of the urine, it is hard to conceive, but that part of it must go immediately from the stomach into the bladder. The general design of nature, in this urinary drain, is supposed to be, to prevent any sudden plethora, or immoderate distention of the vessels upon drinking. As a necessary consequence of this system, the author establishes two kinds of urine, the one filtrated immediately out of the stomach into the bladder, the other passing the long course of circulation. But Dr. Rega endeavours to prove, by an easy calculation of the quantity of urine secreted in the kidneys, that they are capable of furnishing all the quantity observed at any time. And lastly, he mentions the fulness and great frequency of the pulse, after drinking these liquors, as a proof of their being mixed with the blood. Med. Ess. Edin.

The specific gravity of the human urine, made in the night-time, has been found greater than that made in the day. Hence Dr. Bryan Robinson infers, that urine draws off more contents from the blood in sleep than when bodies are awake; and consequently that natural sleep is a very good sign in fevers, in which the blood abounds more with contents, than it does in health. Of the Food and Discharge of Human Bodies, p. 85.

In the Phil. Trans. we have an instance given us by Mr. Young, of a boy six years old, that discharged almost all his urine by his navel. In the same Transactions, Dr. Richardson gives an account of a boy at North Bierly, in Yorkshire, who lived to 17 years of age without ever making water; yet was in perfect health. He

had

had constantly a diarrhoea on him, but without much uneasiness. The obstruction, that author observes, must have been in his kidneys, for he had never any inclination to make water.

Urine is of various kinds and properties. After drinking plentifully of any aqueous fluid, the urine is crude, insipid, void of smell, and easily retained. That yielded by chyle well concocted, is sharper, more saline, less copious, somewhat fetid, and more stimulating. That from chyle already converted into serum, is redder, sharper, saltier, and more fetid and stimulating. And that secreted, after long abstinence, from humours well concocted and worn off the solid parts, is the least copious, sharpest, saltiest, reddest, most fetid, almost putrefied, and, of all others, the hardest to retain. The urine, therefore, contains the watery part of the blood, its sharpest, subtlest, and most volatile salt, and that nearest to the alkaline kind; its sharpest, smallest, and most volatile oil, and that nearest to putrefaction; and its smallest, most volatile earth.

The phosphorus, in use among us, is made from human urine. Saltpetre is likewise prepared from the urine, and other excrements of animals. The Indians scarce use any other medicine but cows urine. The Spaniards make great use of urine to clean their teeth: and so did the Celtiberians of old. Urine is also used in dyeing, to ferment and warm the woad. Old urine tinges silver with a fine gold colour.

URINE, in medicine. The urine affords one of the principal criterions, or signs, whereby physicians judge of the state of the patient, and the course of the disease. In casting or examining urine, the things to be considered are, its quantity, colour, smell, taste, fluidity, and the matters swimming therein. For the causes, prognosis, and cure of the various disorders which relate to the urine, see the System of MEDICINE, Genus 49, 78, 79, and the article STONE.

Bloody URINE, *miſcus cruentus*, in medicine, the name of a very troublesome and often dangerous disease; it is a voiding of pure blood by the urinary passages, and takes its origin from a congeition of blood in the emulgent, and is the method, (though an unhappy one) taken by nature to discharge the load of a plethora, and give the mass of blood freer room to circulate. This is the natural or simple *miſcus cruentus*; but, besides this, there is another accidental one, arising from an injury of the vessels of the kidneys or bladder, occasioned by their being either enlarged, broken, or eroded.

URINE, in agriculture, is of excellent use as a manure. See the System, Sect. II. Persons versed in agriculture and gardening, prefer urine for land, trees, &c. before dung; as penetrating better to the roots, and removing divers infirmities of plants. In Holland, and many other parts, they preserve the urine of their beasts, &c. with as much care as their dung. Mr. Hartlib, Sir Hugh Plat, Mr. Mortimer, &c. make a common complaint, that so great an improver of land, and so remarkable a strengthener of manure, should be so much disregarded among us.

URSUS, the bear; a genus of quadrupeds belonging to the order of feræ. There are six fore teeth in the upper jaw, alternately hollow in the inside, and six in the under jaw, the two lateral ones being lobated. The dog-teeth are solitary and conical; the eyes are furnished with a nictitating membrane; the nose is prominent; and there is a crooked bone in the penis. There are four species, viz. 1. The Fuscus or brown bear, has strong, thick, and clumsy limbs; very short tail; large feet; body covered with very long and shaggy hair. It inhabits the northern parts of Europe and Asia; the Alps of Switzerland and Dauphine; Japan and Ceylon; North America and Peru. They are sometimes carnivorous, and will destroy cattle, and eat carrion; but their general food is roots, fruits, and vegetables: they will rob the fields of pease; and when they are ripe, pluck great quantities up, beat the peas out of the husks on some hard place, eat them, and carry off the straw: they will also, during winter, break into the farmer's yard, and make great havoc among his stock of oats; they are also particularly fond of honey. The bears of America are small and black, and confine themselves entirely to vegetables: they are remarkably greedy of maize and potatoes; and will even reject animal-food, though pressed by hunger; neither of these varieties will attack mankind, unless wounded, or when they have their young: they strike with their fore feet like a cat; seldom or never use their mouths in fighting, but seizing the assailant with their paws, and pressing him against their breast, almost instantly squeeze him to death. The females after conception retire into the most secret places; left, when they bring forth, the males should devour the young: it is affirmed that out of the several hundred bears that are killed in America during winter, (which is their breeding season) scarce a female is found among them; so impenetrable is their retreat during their pregnancy: they bring two, rarely three, young at a time. The flesh of bears in autumn, when they are excessively fat, by feeding on acorns, and other mast, is delicate food; and that of the cubs still finer: but the paws of the old bears are reckoned the most exquisite morsel; the fat white, and very sweet; the oil excellent for strains and old pains. The latter end of autumn, after they have fattened themselves to the greatest degree, the bears withdraw to their dens, where they continue for a great number of days in total inactivity, and abstinence from food, having no other nourishment than what they get by sucking their feet, where the fat lodges in great abundance; their retreats are, either in cliffs of rocks, in the deepest recesses of the thickest woods, or in the hollows

of ancient trees, which they ascend and descend with surprising agility: as they lay in no winter provisions, they are in a certain space of time forced from their retreats by hunger, and come out extremely lean: multitudes are killed annually in America, for the sake of their flesh or skin; which last makes a considerable article of commerce. For representation, see Plate V, Genus 16, Species 1, Variety 1.

The Polar, or white bear, has a long head and neck; short round ears; great teeth; the hair long, soft, and white, tinged in some parts with yellow: growing to a vast size, the skins of some being 13 feet long. This animal is confined to the coldest part of the globe; it has been found as far as navigators have penetrated northwards, above lat. 80. The frigid clime only seems adapted to its nature; for we do not learn from any authority that it is met with farther south than Newfoundland. Its bounds in respect to longitude are also very limited; being an animal unknown except on the shores of Hudson's Bay, Greenland, and Spitzbergen, on one side, and those of Nova Zembla on the other; for such as have appeared in other parts have been brought there involuntarily on floating islands of ice; so that the intermediate countries of Norway and Iceland are acquainted with them but by accident. We cannot trace them farther east than Nova Zembla; though the frozen sea, that is continued from thence as far as the land of Tichukfchi, that lies above Kamtschatka, is equally suited to their nature. The late histories of those countries are silent in respect to them.

During summer, the white bears are either resident on islands of ice, or passing from one to the other: they swim admirably, and can continue that exercise six or seven leagues, and dive with great agility. They bring two young at a time: the affection between the parents and them is so strong, that they would die rather than desert one another. Their winter retreats are under the snow, in which they form deep dens, supported by pillars of the same. They feed on fish, seals, and the carcases of whales, and on human bodies, which they will greedily tear up: they seem very fond of human blood; and are so fearless as to attack companies of armed men, and even to board small vessels. When on land, they live on birds and their eggs; and allured by the scent of seals flesh, often break into and plunder the houses of the Greenlanders; their greatest enemy in the brute creation is the Rosmarinus, or morse, with whom they have terrible conflicts, but are generally worsted, the vast teeth of the former giving it a superiority. The flesh is white, and said to taste like mutton: the fat is melted for train-oil, and that of the feet used in medicine: but the liver is very unwholesome, as three of Barentz's sailors experienced, who fell dangerously ill on eating some of it boiled. One of this species was brought over to England a few years ago; it was very furious, almost always in motion, roared loud, and seemed very uneasy, except when cooled by having pailfuls of water poured on it. For representation, see Plate V, Genus 16, Species 1, Variety 2.

2. The Luscus, wolverene, or glutton, has a black sharp pointed visage; short rounded ears, almost hid in the hairs; the sides of a yellowish brown, which passes in form of a band quite over the hind-part of the back, above the tail; the legs are very strong, thick and short, of a deep black: the whole body is covered with very long and thick hair, which varies in colour according to the season. It inhabits Hudson's Bay and Canada, as far as the straits of Michilimakinac; is found under the name of the *glutton* in the north parts of Europe and Asia, being a native of the most rigorous climates. It is a most voracious animal, and slow of foot; so is obliged to take its prey by surprise. In America it is called the *beaver-eater*, watching those animals as they come out of their houses, and sometimes breaks into their habitations, and devours them. It often lurks on trees, and falls on the quadrupeds that pass under; will fall on the horse, elk, or stag, and continue eating a hole into its body, till the animal falls down with pain; or else will tear out its eyes: no force can disengage it; yet sometimes the deer in their agony have been known to destroy it, by running their head violently against a tree. It devours the fishes, or white fox; searches for the traps laid for the fables and other animals; and is often beforehand with the huntmen, who sustain great losses by the glutton. In a wild state, it is vastly fierce; a terror to both wolf and bear, which will not prey on it, when they find it dead, perhaps on account of its being so very fetid, smelling like a pole cat: it makes a strong resistance when attacked; it is capable of being tamed, and of learning several tricks; burrows, and has its den under ground. The skin is sold in Siberia, for 4s. or 6s.; at Jakutsk for 12s.; and still dearer at Kamtschatka, where the women dress their hair with its paws, which they esteem a great ornament. The fur is greatly esteemed in Europe: that of the north of Europe and Asia, whose skins are sometimes to be seen in the furriers shops, is much finer, blacker, and more glossy than that of the wolverene, or American kind. The glutton has by some authors been confounded with the hyæna. For representation, see Plate V, Genus 16, Species 4.

3. The Lotor, or racoon, has the upper part of the body covered with air, ash-coloured at the root, whitish in the middle, and tipped with black; tail very bushy, annulated with black; toes black; and divided. It inhabits the warm and temperate parts of America; is found also in the mountains of Jamaica; and in the isles of Maria, between the south point of California and Cape Corientes, in the South

South Sea; is easily made tame, very good-natured and sportive; but as unlucky as a monkey. It is almost always in motion; and very inquisitive, examining every thing with its paws. It makes use of them as hands; sits up to eat; is extremely fond of sweet things, and strong liquors, and will get excessively drunk. It has all the cunning of a fox; and is very destructive to poultry; but will eat all sorts of fruits, green corn, &c. It is hunted for its skin; the fur being next to that of the beaver for making hats. For representation, see Plate V. Genus 16, Species 3.

4. The Meles, or common badger, is an animal of a very clumsy make, with short thick legs, long claws on the fore feet, and a fetid white matter exuding from the orifice below the tail. It inhabits most parts of Europe, as far north as Norway and Russia, and the step or desert beyond Orenburgh, in the Russian Asiatic dominions, north of the Caspian sea: inhabits also China, and is often found in the butchers shops in Pekin, the Chinese being fond of them; but a scarce animal in most countries. It seldom appears in the day; confines itself much to its holes: is indolent and sleepy; generally very fat: feeds by night; eats roots, fruits, grubs, insects, and frogs; but it is not carnivorous: it runs slowly; when overtaken, it comes to bay, and defends itself vigorously; its bite is dangerous. It burrows under ground; makes several apartments, but forms only one entrance from the surface. It is hunted during night for the skin, which serves for pistol-furniture; the hairs for making brushes to soften the shades in painting. Its flesh makes good bacon. For representation, see Plate V. Genus 16, Species 2.

URTICA Marina, in Vermeology, the name of a remarkable genus of aquatic animals, so called from a supposition of their affecting the skin on touching them, with a painful sensation like that of the stinging of nettles. These are animals of the lowest class, and have by many been reckoned among those creatures, called *zoophytes*, or plant animals, as supposed to partake of the nature of vegetables and of animals. Some of the species of this fish are found loose upon the smooth shores, and some fixed to the rocks which are always covered with water. This has given birth to a distinction of them into two classes, which is as old as Aristotle; those of the one being such as move in the open sea, called by later writers *urticae solutae*, and referred by Linnæus to the genus of MEDUSA, and denominated by the common people sea-jellies and sea-blubbers; and those of the others such as are fixed to rocks, and were supposed always to remain immovably in the same place, which belong to the ACTINIA of Linnæus. For other remarkable properties of these animals, see the article VERMEOLOGY.

USQUEBAUGH, a strong, rich, compound liquor, chiefly taken by way of drachm; its basis being brandy, or a more ordinary spirit. The manner of making it is somewhat various, and the ingredients numerous. We shall give a receipt, much commended formerly, as a specimen. To two gallons of brandy, or spirits, put a pound of Spanish liquorice, half a pound of raisins of the sun, four ounces of currants, three of dates, sliced; tops of thyme, balm, savory, and mint, and tops or flowers of rosemary, of each two ounces; cinnamon and mace bruised, nutmegs, aniseeds, and coriander seeds, bruised likewise, of each four ounces; citron, or lemon orange-peel, scraped, of each an ounce: all these are to be left to infuse forty-eight hours in a warm place, often shaking them together; then set them in a cool place for a week; after which, the clear liquor is to be decanted off, and to it put an equal quantity of net white port wine, and a gallon of canary. The whole is finally to be sweetened with a proper quantity of double-refined sugar.

UTERINE. UTERINUS, something belonging to the uterus, or womb of women. Uterine brothers or sisters are those born of the same mother, but by different fathers.

Furor UTERINUS, in medicine. Men are subject to the like disease, as well as women; so that it might with more propriety be called the *furor venereus*, or *venereal fury*. It had its name, *furor uterinus*, from an opinion, that it proceeded from vapours arising from the womb to the brain. It has been frequently found, that maids, supposed to be disordered in their senses, were only seized with the *uterine fury*. For the nature and cure of this disease, see the System of MEDICINE, Genus 78, and 79.

UTERINE hæmorrhages. In this dangerous disorder the STYPTIC powder of Helvetius is much recommended; and the stibium ceratum has also been tried with great success. In the Stockholm Acts, 1770, there are several cases of uterine hæmorrhages cured by $\frac{1}{4}$ or $\frac{1}{2}$ grain of IPECACUANHA, rubbed with sugar, given every four hours or oftener. In one case, the hæmorrhage returned on discontinuing the medicine, and ceased on repeating it. These small doses had good effects in catarrhal coughs, even in those which attend consumptions; and if not beneficial, are at least not hurtful, in bloody coughs, in which vomiting has several times been observed to come on, without any increase of the hæmorrhage. They may be used in peripneumony and pleurisy, in which cough is often the most troublesome symptom, and in which seneca root (which in increased doses proves also emetic) has been so much recommended. For a more copious treatment of this subject, see the System of MEDICINE, Genus 3a, and the System of MIDWIFERY, Part X. Sect. III.

UTERUS, in anatomy, the *matrix*, or *womb*; that organ of generation, in women, wherein conception is performed, and wherein the embryo or foetus is lodged; and grows, during the time of

gestation, or till its delivery. For a more copious description, see the System of ANATOMY, Part III. Sect. XV. &c. For representation, Plate X. fig. 1. letter A, and B, and fig. 5. in every part; see also the System of MIDWIFERY, Part I. Sect. I. II. III. and IV. and fig. 4, 5, 6, 7, 8, and 9.

UTERUS of Fish. Among the fish kinds, all those which are oviparus have no uterus; but on the contrary, all the viviparus fishes have this part. The whales, and all the cetaceous kinds, as also many of the cartilaginous ones, have the uterus very fair. It is probable that the eel kind also have it; but this is less certain, the generation of these fishes being yet somewhat obscure. The uterus in the cetaceous fishes is always divided into two processes or horns; but in the cartilaginous ones it is divided into two glandulous bodies, which are pervious, and, according to the opinion of Needham, discharge a whitish liquor into the womb, and are of great use in gravitation. See the System of Comparative ANATOMY, Chap. III.

UVA Ursi, in botany, the name of a species of *arbutus*, with trailing stalks, and entire leaves, called in English *bears whortleberry*. The plant is found on the snowy hills of Austria and Syria, but more plentifully on the Swedish hills; it is also a native of the Highlands of Scotland, and is now cultivated in some of our gardens. The leaves of this plant have a bitterish astringent taste, without any remarkable smell. Infusions of them in water strike a deep black colour, with solution of chalybeate vitriol, but soon deposit the black matter, and become clear. For their use in dyeing, see DYEING.

The leaves of the uva ursi have of late been greatly celebrated in calculous and nephritic complaints, and other disorders of the urinary organs; the dose is half a dram of the powder of the leaves every morning, or two or three times a day. See STONE. De Haen relates, after large experience of this medicine in the hospital of Vienna, that suppurations though obstinate and of long continuance, in the kidneys, ureters, bladder, urethra, scrotum, and perineum, without any venereal taint or evident marks of a calculus, were in general completely cured by it; that of those who had a manifest calculus, several found permanent relief, so that, long after the medicine had been left off, they continued free from pain or inconvenience in making water, though the catheter shewed that the calculus still remained; that others, who seemed to be cured, relapsed on leaving off the medicine, and were again successively relieved on repeating the use of it; while others obtained only temporary and precarious relief. In several cases, paregorics were joined to the uva ursi, and other mild astringents have been recommended for the same intentions. Dr. Lewis observes, that the trials of the uva ursi, made in this country, have by no means answered expectation; in all cases within his knowledge, it produced great sickness and uneasiness, without any apparent benefit, though continued for a month. Mat. Med.

UVEA, in anatomy, the third tunic, or membrane of the eye. It is called uvea, on account of its resembling the figure and colour of a grape, called by the Latins *uva*. The hind part of this coat, or that next to the orbit of the eye, on each side, is called the *choroides*; and is derived from the *pia mater*. The anterior or fore-part is, like the former, transparent, but thinner; and is, by authors, reckoned as a different tunic, and called *uvea*. Of the duplicature of this part, is formed that striped, variegated circle, called the *iris* of the eye. And in its middle is a perforation, through which appears a little black speck, which is the sight, or pupil of the eye; and about which the iris forms a ring. See the System, Part VII. Sect. V. and Plate XI. fig. 11.

VULCAN, in Mythology, the son of Jupiter and Juno, who, on account of his deformity, was cast down from heaven into the island Lemnos, and breaking his leg with the fall, is always represented as lame. At Lemnos, he set up the trade of a smith, and taught the Lemnians, in recompence of the succours they afforded him, the manifold uses of fire and iron: he is also represented as the manufacturer of Jupiter's thunder, and the arms of the other gods. The poets describe him as blackened and hardened from the forge; with a face red and fiery, whilst at his work; and tired and heated after it. This poor god is almost always the subject, either of pity or of ridicule. He is the great cuckold of heaven; and his lameness serves to divert the gods. The great celestial deities seem to have admitted Vulcan among them merely to make them laugh, and to be the butt of the whole company. Spence's Polymetis, p. 81.

VULGATE, a very ancient Latin translation of the Bible; and the only one the church of Rome acknowledges to be authentic. The Ancient Vulgate of the Old Testament was translated; almost word for word, from the Greek of the Septuagint. It was the common, or vulgar version, before St. Jerome made a new one; whence it has its name Vulgate. It has since been retouched from the correction of St. Jerom: and it is this mixture of the ancient Italian version, and some corrections of St. Jerom, that is now called the Vulgate, and which the council of Trent has declared to be authentic. It is this Vulgate alone that is used in the Romish church, excepting some passages of the ancient Vulgate left in the missal, and the psalms; which are still sung according to the old Italic version.

VULGATE of the New Testament. This the Romanists generally hold preferable to the common Greek text, because it is this

V U L

alone, and not the Greek text, that the council of Trent has declared authentic: accordingly that church has, as it were, adopted this edition, and the priests read no other at the altar, the preachers quote no other in the pulpit, nor the divines in the schools. In 1675, a new edition of the Greek Testament was published by the University of Oxford; and great care taken therein, to compare the common Greek text with all the most ancient manuscripts in England, France, Spain, and Italy; and to note the differences observed therein. In the preface of this work, the editors, speaking of the divers versions of the Bible in the vulgar tongues, observe of the Vulgate, that there is no version of any language to be compared with it. And this they justify, by comparing passages that occur in the most celebrated Greek manuscripts, with the same passages in the Vulgate, where there is any difference between that and the common printed Greek copy. In effect, it is probable, that at the timethe ancient Italic, or Vulgate version of the New Testament was made, and at the time it was afterwards compared with the Greek manuscripts by St. Jerom; as they were then nearer the times of the apostles, they had juster Greek copies, and those better kept, than any of those used when printing was first set on foot. M. Simon calls the Greek version of the Septuagint, before it was revised and reformed by Origen, the ancient Vulgate Greek. Origen's correction was preferred to the ancient Greek, which was consequently disused; so that we have now scarce any copies thereof. See SEPTUAGINT.

VULNERARY, formed from *vulnus*, wound, in medicine, an epithet given to remedies, proper for the cure of wounds and ulcers. There are divers vulnerary herbs; as aristolochia, or birthwort: sanicle, or self-heal; plaintain, mouse-ear, veronica, or fluellin; agrimony, vervain, or the holy herb, &c. There are also vulnerary potions, composed of various simples. Vulnerary balsams, unguents, plasters, &c.

VULPES, a species of the genus *canis*, in MAMMALIA. For description of the Genus, see CANIS; for representation of this Species, see Plate IV. Order III. Genus 12. Species 4.

VULTUR, in ornithology, the name of a genus of birds of the **HAWK** kind; the characters of which are, that the bill is straight, and hooked only at the end; the head has no feathers, and at the base of the bill is covered with a naked skin, and the tongue is bifid. Of this genus Linnæus enumerates eight species, viz. the *gryphus* or **CONDOR**, the *harpyia* or **crested EAGLE**, the *papa king of vulturs*, or *cozcaquauhtli*, the *monachus*, black crested or Arabic vultur, the *aura* or *urubu* of Brasil, the bearded, golden, or Bætic vultur of Egypt, the *phænicopterus*, or sacred vultur of Egypt, and *albiulla* or **PYGARGUS**. There are no vulturs in Great Britain, nor any north of the Baltic: but the various species are found in the southern parts of Europe, Asia, Africa, and America, as low as Terra del Fuego. They are a sluggish ungenerous race, preying oftener on dead animals, and even on putrid carcases, than on living creatures: their sense of smelling is most exquisite: they collect in flocks from great distances; and are directed to their prey by the sagacity of their nostrils: they fly slowly and heavily; are very greedy, and voracious to a proverb; and they are bold and fearless, preying in the midst of cities, undaunted by mankind. The condor is not only the largest of this genus, but perhaps of all others which are able to fly. The accounts of authors in regard to its extent of wing are various, viz. from 9 to 18 feet, from the tip of one wing to that of the other. In Hawkesworth's Voyages, mention is made of one of these birds shot at Port Desire, off Penguin island, of which he gives the following description: "The head of this bird resembled that of an eagle, except that it had a large comb upon it. Round the neck it had a white ruff, exactly resembling a lady's tippet; the feathers on the back were as black as jet, and as bright as the finest polish could render that mineral: the legs were remarkably strong and large, and the talons like those of an eagle, except that they were not so sharp; and the wings when they were extended, measured, from point to point, no less than 12 feet." This last account seems by no means to exceed the natural size, since we have an account in the Philosophical Transactions of one of the quill-feathers of this bird, brought from Chili,

U V U

which measured 12 feet four inches; the diameter of the quill half an inch; and the extent of the wing 16 feet. The bird was met in lat. 33 south, not far from the island Mocha, in the South Sea, in the year 1691. The seamen shot it on a cliff by the sea-side; and taking it for a kind of turkey, made a meal of it. In this account we are told that the colour was black and white, like a magpie, and the crest, or comb, sharp like a razor. It has been supposed, that these birds were peculiar to South America: but Buffon believes they are likewise inhabitants of Asia and Africa, and not unlikely of Europe also, if the laemmergeir of the Germans be the same bird, which he seems inclined to think; and that the roc, or ruch, mentioned frequently in the Arabian Tales, may also prove to be the same. M. Brisson observes, that these birds vary in colour; which will account for the difference in the plumage by which authors have described them: which circumstance frequently happens in other birds, as well as in this species.

The phænicopterus, or Egyptian vultur, is thus described by Mr. Haffelquist.

The appearance of this bird is as horrid as can well be imagined, viz. the face is naked and wrinkled; the eyes are large and black; the beak black and hooked; the talons large, and extended ready for prey; and the whole body polluted with filth: these are qualities enough to make the beholder shudder with horror. Notwithstanding this, the inhabitants of Egypt cannot be enough thankful to Providence for this bird. All the places round Cairo are filled with the dead bodies of asses and camels; and thousands of these birds fly about, and devour the carcases before they putrify and fill the air with noxious exhalations. The inhabitants of Egypt, and after them Maillet in his Description of Egypt, say, that they yearly follow the caravan to Mecca, and devour the filth of the slaughtered beasts, and the carcases of the camels which die on the journey; but we were not eye-witnesses of this. They do not fly high, nor are they afraid of men. If one is killed, all the rest surround him in the same manner as do the Royston-crows; they do not quit the places they frequent though frightened by the explosion of a gun, but immediately return thither. Maillet imagines this bird to be the ibis of the ancients; but it is scarcely to be imagined, that a wise nation should pay such honours to an unclean, impure, and rapacious bird, which was perhaps not so common before the Egyptians filled the streets with carcases. If the ibis is to be found, it must certainly be looked for in the order of grallæ of Linnæus; and we imagine it to be the white stork, (*Ardea ciconia*), which is so common in Egypt. The Arabians call it *rochame*; the French living in Egypt, give it the name of *chapon de Pharaon*, or *de Mahometh*. The whole of the species of this genus are of great use, particularly at Grand Cairo in Egypt, and other places where they suffer dead carcases to be exposed in the open air, which they devour with most voracious appetites, and are so fond of the food, that they fight for the banquet. For a representation, see Plate I. fig. 1.

VULVA, *quasi valvæ, doors*, a name which some physicians give to the vagina, and others to the uterus or womb. Vulva is sometimes also used for the cunnus, or whole pudendum muliebre. See System of ANATOMY, Part VII, Sect. XV. and Plate X. lower division, and the Plates of MIDWIFERY, with their explanation.

UVULA, in anatomy, a round, soft, spongy body, like the end of a child's finger; suspended from the palate near the foramina of the nostrils perpendicularly over the glottis. Its use is to break the force of the cold air, and prevent its entering too precipitately into the lungs. It is formed of a duplicature of the membrane of the palate; and it is called by some authors *columella*, and, by others, *gurgulio*. It is moved by two pair of muscles, and suspended by as many ligaments. The muscles are, the *external*, called the Salpingo-Staphilinus, which draws the uvula upwards and backwards; and hinders the masticated aliment from passing into the foramina of the nostrils in deglutition: and the *internal*, called the Palato Staphilinus; which draws the uvula upwards and forwards. Bartholin says, that such as have no uvula are subject to the phthisic, and usually die thereof; because the cold air, entering the lungs too hastily, soon injure them. See PHTHISIS.

W A G

W or w, is the 21 letter of our alphabet; and is composed, as its name implies, of two v's. It was not in use among the Hebrews, Greeks, or Romans; but chiefly peculiar to the northern nations, the Teutones, Saxons, Britons, &c. But still it is not used by the French, Italians, Spaniards, or Portuguese, except in proper names, and other terms borrowed from languages in which it is originally used, and even then it is sounded like the single v: though it is not improbable, says Dr. Johnson, that by our w, is expressed the sound of the Roman v, and Eolic f. This letter is of an ambiguous nature; being a consonant at the beginning of words, and a vowel at the end. It may stand before all the vowels except u; as *water*, *wedge*, *winter*, *wonder*; it may also

W

follow the vowels *a*, *e*, *o*, and unites with them into a kind of double vowel, or diphthong; as in *saw*, *few*, *cow*, &c. It also goes before *r*, and follows *s* and *th*; as in *wrath*, *swear*, *thwart*; it goes before *h* also, though in reality it is sounded after it; as in *when*, *what*, &c. In some words it is obscure, as in *shadow*, *widow*, &c. The English *w* as the Latin *w*, in *quantum*, *suadeo*, *lingua*. Its sound is commonly like the gross or full *u*, rapidly pronounced. In French the sound of the *w* does not differ from that of the single *u* or rather *ou*.

WAGTAIL, in ornithology, the English name of the genus *motacilla*. For description of the Genus, see MOTACILLA.

WALF, or **WARE**, a term primarily applied to stolen goods, which

W A I

which a thief, being either pursued or overburdened, flies, and waives or throws away in his flight.

WAIVE, in law, a woman that is put out of the protection of the law. She is called waive, as being forsaken of the law; and not outlaw, as a man is; by reason women cannot be of the decenna, and are not sworn in leets to the king, nor to the law, as men are; who are therefore within the law; whereas women are not, and so cannot be outlawed, since they never were within it. In this sense we meet with *waviaria mulieris*, as of the same import with *utlegatio viri*.

WAKES, *watch, vigils, or Country-WAKES*, are certain ancient anniversary feasts, in several parishes; wherein the people were to be awake at the several vigils, or hours to go to prayer. They are usually observed, in the country, on the Sunday next before the saint's day, to whom the parish church is dedicated. The learned Mr. Whitaker, in his History of Manchester, hath given a particular account of the origin of wakes and fairs. He observes, that every church at its consecration received the name of some particular saint: this custom was practised among the Roman Britons, and continued among the Saxons; and in the council of Cealchythe, in 816, the name of the denominating saint was expressly required to be inscribed on the altars, and also on the walls of the church, or a tablet within it. The feast of this saint became of course the festival of the church. Thus Christian festivals were substituted in the room of the idolatrous anniversaries of heathenism: accordingly at the first introduction of Christianity among the Jutes of Kent, pope Gregory the Great advised what had been previously done among the Britons, viz. Christian festivals to be instituted in the room of the idolatrous, and the suffering-day of the martyr whose relics were reposit in the church, or the day on which the building was actually dedicated, to be the established feast of the parish. The people actually repaired to the church, and joined in the services of it; and they thus spent the evening of their greatest festivities in the monasteries of the North, as early as the conclusion of the seventh century. These services were naturally denominated from their late hours wæccan or wakes, and vigils or eves. That of the anniversary at Rippon, as early as the commencement of the eighth century, is expressly denominated the vigil. But that of the church's holiday was named *eyric wæccan*, or church-wake, the church-vigil, or church-eve. And it was this commencement of both with a wake, which has now caused the days to be generally preceded with vigils, and the church-holiday particularly to be denominated the church-wake. So religiously was the eve and festival of the patron saint observed for many ages by the Saxons, even as late as the reign of Edgar, the former being spent in the church, and employed in prayer. And the wakes, and all the other holidays in the year, were put upon the same footing with the octaves of Christmas, Easter, and Pentecost. When Gregory recommended the festival of the patron saint, he advised the people to erect booths of branches about the church on the day of the festival, and to feast and be merry in them with innocence. Accordingly, in every parish, on the returning anniversary of the saint, little pavilions were constructed of boughs, and the people indulged in them to hospitality and mirth. The feasting of the saint's day, however, was soon abused; and even in the body of the church, when the people were assembled for devotion, they began to mind diversions, and to introduce drinking. The growing intemperance gradually stained the service of the vigil, till the festivity of it was converted, as it now is, into the rigour of a fast. At length they too justly scandalized the puritans of the last century, and numbers of the wakes were disused entirely, especially in the east and some western parts of England; but they are commonly observed in the north, and in the midland counties.

This custom of celebrity in the neighbourhood of the church, on the days of particular saints, was introduced into England from the continent, and must have been familiar equally to the Britons and Saxons; being observed among the churches of Asia in the sixth century, and by those of the west of Europe in the seventh. And equally in Asia and Europe, on the continent, and in the islands, these celebrities were the causes of those commercial marts which we denominate fairs. The people resorted in crowds to the festival, and a considerable provision would be wanted for their entertainment. The prospect of interest invited the little traders of the country to come and offer their wares; and thus, among the many pavilions for hospitality in the neighbourhood of the church, various booths were erected for the sale of different commodities. In larger towns, surrounded with populous districts, the resort of the people to the wakes would be great, and the attendance of traders numerous; and this resort and attendance constitute a fair. Basil expressly mentions the numerous appearance of traders at these festivals in Asia; and Gregory notes the same custom to be common in Europe. And as the festival was observed on a feria or holiday, it naturally assumed to itself, and as naturally communicated to the mart, the appellation of feria or fair. Indeed, several of our most ancient fairs appear to have been usually held, and have been continued to our time, on the original church holidays of the places; besides, it is observable, that fairs were generally kept in church-yards, and even in the churches, and also on Sundays, till the indecency and scandal were so great, as to need reformation. See Burn's Eccl. Law.

Lake WAKE, a ceremony used at funerals in the Highlands of Scotland. The evening after the death of any person, the relations and friends of the deceased meet at the house, attended by bagpipe or fiddle; the nearest of kin, be it wife, son, or daughter, opens a melancholy ball, dancing, and greeting, (i. e. crying violently) at the same time, and this continues till day-light; but with such gambols and frolics among the younger part of the company, that the loss which occasioned them is often more than supplied by the consequences of that night. If the corpse remains unburied for two nights, the same rites are renewed. Thus, Scythian-like, they rejoice at the deliverance of their friends out of this life of misery.

WALKS, in gardening. For the arrangement of this article in Gardening, see the Treatise, Part I. Article II. Sect. II.

WALL, in architecture, &c. a work of stone, brick, or the like, making the principal part of a building; as serving both to enclose it, and to support the roof, floors, &c. For further particulars relative to this branch of architecture, see the System, under the article STRUCTURE.

WALNUT-Tree, juglans, in botany, a genus of the *monoecia polyandria* class. There are several varieties of the common walnut, which are distinguished by the following titles: the large walnut, the thin-shelled walnut, the French walnut, the late ripe walnut, and the double walnut; but these all of them vary when raised by seeds, so that the nuts from the same tree will produce plants, whose fruit will differ; therefore there can be no dependence upon the trees which are raised from nuts, till they have produced fruit; so that those persons who plant the trees for the fruit, should make choice of them in the nurseries when they have the fruit upon them, to prevent their being deceived. The common walnut is propagated in many parts of England for the fruit, and the trees were formerly cultivated for their wood, which was in very great esteem, till the quantity of mahogany, and other useful woods, which have of late years been imported into England, have almost banished the use of it. In order to preserve the fruit, it should remain upon the trees till it is thoroughly ripe, and drops from the trees; then laid in heaps for two or three days, when the husks will easily part from the shells; they should then be dried well in the sun, and laid up in a dry place, where vermin cannot come to them; by which means they will remain good four or five months. But there are some persons who put the walnuts into a gentle oven, where they let them remain four or five hours to dry; and then put them in oil-jars, or any other close vessels, mixed with dry sand, by which means they will keep good six months. The heat of the oven dries the germ, and prevents their sprouting; but if the oven be too hot, it will occasion them to shrink. The bark of the walnut-tree is a strong emetic, either green, or dried and powdered; the green nuts are cordial, alexipharmic, and said to be of great use in all contagious, malignant distempers, and the plague itself; and they are one of the principal ingredients in treacle water. The nuts preserved are stomachic, and good to be eaten in a morning in time of pestilential distempers, to prevent infection. Two or three ounces of the oil, expressed from the ripe kernels, is a very good medicine for the stone or gravel. The shells powdered or burnt are accounted restraining, though but seldom used. Walnuts have a singular quality of promoting the menses when suppressed, and all other medicines fail. The effluvia of walnut-trees are said to be hurtful to the head. Mr. Boyle assures us, they caused the head-ach in himself. Works abr. vol. i. p. 436.

WALRUS, in the System of Mammalia, a species of the genus *trichecus*. For description of the Genus, &c. see TRICHECUS.

WAR, a contest or difference between princes, states, or large bodies of people; which not being determinable by the ordinary measures of justice and equity, is referred to the decision of the sword. Hobbes's great principle is, that the natural state of man is a state of warfare; but most other politicians hold war to be a preternatural and extraordinary state. The sole prerogative of making war and peace belongs, by the English constitution, to the king. Levying war against the king in his realm is a species of treason. See TREASON.

WAR is a great evil; but it is inevitable, and oftentimes necessary. If he who first reduced to rules the art of destroying his fellow-creatures, had no end in view but to gratify the passions of princes, he was a monster, whom it would have been happy to have smothered at his birth: but if his intention was the defence of persecuted virtue, or the punishment of successful wickedness, to curb ambition, or to oppose the unjust claims of superior power, mankind ought to erect altars to his memory. War, in the last case, is the most necessary and useful of all the sciences: the various kinds of knowledge which ought to furnish the mind of a soldier are not without great difficulty to be attained. Of most other sciences the principles are fixed, or at least they may be ascertained by the assistance of experience; there needs nothing but diligence to learn them, or a particular turn of mind to practise them. Philosophy, mathematics, architecture, and many others, are all founded upon invariable combinations. Every man, even of a narrow understanding, may remember rules, apply them properly, and sometimes draw just consequences from them; but the study of war is of another kind. Experience can so seldom be referred to rules, that nothing but a mind enlightened by diligent study can make a due application of rules to circumstances.

Most

Most artists may join practice to theory, and make one perfect by the help of the other. The warrior has not always the like assistance; he spends part of his life in forming plans, of which humanity does not suffer him to witness the execution; and when he has an opportunity of judging from experience of the solidity of his principles, the operations are so rapid, the motions so diversified, the actions so confused, that he has scarcely time for a glimpse of those things which require the most calm and close consideration.

In learning of every kind, theory is the completion; in the study of the military science, it is only the introduction. Many a man, depending on his rules, has found that the marches, the camps, the dispositions, the manœuvres, performed with exact and strict order in the closet, have not only been very difficult, but even impracticable in the field. A disposition good in a mountainous country, would be bad in an open one; a disposition proper for one open country may fail in another, for want of foreseeing that a manœuvre, which in one case may have been the cause of winning a battle, may in another occasion its loss; the circumstances of time and place almost always throws the best constructed systems out of order. It is therefore only by dint of study, and by the contemplation of cases incessantly varied, that the want of practice can be supplied, or action at least made less difficult. A military man who would be master of his profession, has no hours to lose; in peace, he ought to study with the greatest diligence; in time of war, he will see his principles open themselves of their own accord; his ideas are then more distinct; he acts with clearness and certainty in all cases he has foreseen, and applies his rules to all those which now occur for the first time, and which till then had escaped his thoughts. Who does not know that bravery, courage, and comprehension, are useless, and often fatal, to a military man who wants knowledge of his business? Having no previous helps from study, it often happens that the braver he is, the more he is liable to mistakes, and the less able to foresee or avoid them.

The science of war branches out into so many particulars; it takes in so many different parts; there are so many reflections necessary to be made, so many circumstances and cases to be brought together; that it is only by a continual application, grounded upon the love of his duty, and an inclination to his profession, that any man can attain it. To march an army in every sort of country; whether open, woody, or mountainous; to know how to form a camp in all those countries, with which the general must be thoroughly acquainted in order to do it with security; to make a proper disposition for battle, whether with a view to the posture of the enemy, or to the situation of the country; to foresee events which depend in a manner upon chance; to be capable of making a good retreat on proper occasions; to direct the forages without fatiguing or exposing the troops; to send out detachments with precaution; to conduct the convoys in safety; to know how to canton an army; to establish magazines in places, both safe and within reach of the army, so that it shall never be in want of subsistence; these are the great ends of the military science. The Alexanders of Parma, the Spinolas, the Gustavuses, the Weimars, the Condés, the Turennes, the Montécucullis, the Vendomes, the Marlboroughs, the Eugenes, and all the great men who have gone before us, would never have been the subject of our admiration, if they had neglected this study in any of its branches. It is by courage, genius, and capacity; by having an head always cool, and an eye at once quick and exact; by a nice knowledge of the country, by skill in the choice of officers, and by strict discipline kept up in his army, that a general is enabled to take such just measures as will frustrate the designs of the enemy. It is commonly thought sufficient for a military man to know how to obey; and it is also supposed that the success of a day cannot be dubious, if a general joins the confidence of the soldiers to all the foregoing qualities. It is true, that, in cases of perplexity, many generals have in a great measure owed to their own capacity, and the confidence their soldiers have reposed in them, the advantages they have gained over the enemy; but is the officer who loves his duty, and who would make himself master of it, under the less obligation to know what qualification his station requires? That he ought to have such or such a quality, in such or such a circumstance? that here only bravery is necessary, there only courage? and that he is not always obliged to have both at the same time?

These two virtues, which are often confounded in the same subject, merit a particular distinction; they are not so closely united, but they are often to be found one without the other. Courage seems fittest for a general, and all those who command; bravery more necessary for a soldier, and all who receive orders; bravery is in the blood, courage in the soul; the first is a kind of instinct, the second a virtue; the one is an impulse almost mechanical, the other a noble and sublime conception. A man is brave at a particular time, and according to circumstances; he has courage at all times, and upon all occasions: bravery is so much the more impetuous, as it is less the result of reflection; courage, the more it is the effect of reason, becomes more intrepid. Bravery is inspired by the force of example, insensibility of danger, and the fury of action; courage is infused by the love of our duty, the desire of glory, and zeal for our king and country: courage depends on reason, but bravery on the constitution. Achilles, such as Horace describes him from Homer, implacable, cruel, despising every other right but that of force, presents nothing to the idea but the hardness of a

gladiator. But the Roman general, whose death would have produced the ruin of the army, the great Scipio, when covered by the bucklers of three soldiers, to avoid a shower of arrows which the enemy directed against him, approaches in safety the walls he besieged, and standing only a spectator of the action, and contenting himself with giving them orders, exhibits the idea of true courage. Bravery is involuntary, and depends not at all upon ourselves; whereas courage (as Seneca observes) may be taught and acquired by education; but yet nature must sow the first seeds of it. It would be easy to make the difference of these qualities better understood, by running over all the cases in which they make their appearance, were it not for the fear of going too far in so copious a subject. It is said of a magistrate who exposes his life and fortune in defence of the laws, that he has virtue. Cicero, sheltering himself from the hatred of Cataline, undoubtedly wanted bravery, but certainly he had an elevated firmness of mind (which is in reality courage) when he disclosed the conspiracy of that traitor to the senate, and pointed out all his accomplices; or when he pleaded for Deiotarus against Cæsar, his friend and his judge.

Coolness is the effect of courage, which knows its danger, but makes no other use of that knowledge than to give directions with greater certainty: courage is always master of itself, provided against all accidents, and regulated by the present occasions; never confounded by any danger so as to lose sight of the motions of the enemy, or of the means by which he may be most effectually opposed. At the battle of Cannæ, when Gisco seemed to be much astonished at the superiority of the enemy's number, Hannibal answered him coolly, "There is, Gisco, a thing still more surprising, of which you take no notice." Gisco asked him what it was: "It is (replied Hannibal), that in all that great crowd there is not one man whose name is Gisco." Plutarch observes, that this coolness of Hannibal greatly animated the Carthaginians, who could not imagine that their general would joke at so important a time, without being certain of overcoming his enemies. Although bravery and courage are the most essential qualifications of a subordinate officer, yet he should not be deficient in those which are required in a general, and which have been already mentioned; obedience to the orders delivered to him is no longer a virtue than whilst he comprehends and knows the intention of them. War, says a celebrated author, is a business which, like all others, must be learned; it supposes some qualities to be born with us, and demands others which are to be acquired; but since all these qualities must have the original source in genius, a man who proposes war for his profession should never engage in it without having consulted his natural bent, or without knowing the particular turn and power of his mind. Ability, whether in a general or an officer, is the effect of his genius, quickened by a natural liking to his business. But some are by their birth engaged in the profession of arms before time has permitted them to consult their genius and their powers; are these men to quit it if they perceive that they are not endowed with every talent that profession requires? Undoubtedly no; because they may acquire them. Study and application will supply the defect of genius; docility may serve instead of talents, the love of glory be equivalent to a liking for their business, and the virtues of their fathers should always be present to their thoughts. When a man has no ancestors to imitate, he is, as may be said, at liberty to raise a reputation of more or less lustre: by being descended from celebrated ancestors, he is obliged to follow their example, and may often improve upon their virtues. Claudius reproached Cicero with being the first of his race. But you, answered Cicero, are the last of your's. An illustrious descent is oftentimes a burden; if it adds splendour to the man of virtue, it always disgraces him who knows not how to support it.

A quick eye is natural in some, and in them it is the effect of genius; others acquire it by study or experience; he who knows how to command himself, and has courage enough to keep himself cool on the most urgent occasions, has the readiest and quickest eye. A quick hot-headed man, however brave, sees nothing; or if he does, it is confusedly, and generally too late. It is this quick eye which enables him to judge of an advantageous post, of a manœuvre to be made, and of a good disposition for the troops, whether with respect to that of the enemy, or to the situation and nature of the country. There is a quickness of eye which depends upon the enemy, and another independent of him: it depends upon the enemy when he has made such a disposition, that to attack him, another must be made upon the spot which renders his defective and weak in some parts: or when, being advantageously posted, the general obliges him to change his position, by making him fearful of being taken in flank, or being surrounded; or when it is so contrived as to render the troops on the right useless by attacking the left, without their being able to assist it. It is independent of the enemy, when a commander, being at a distance, knows how to take an advantageous position, and how to choose a camp strong by situation; when he sees at once what distances there are upon the right and left of the troops that may prevent their being either molested or surrounded, and observes the posts necessary to be occupied for their safety; when he marches with a detachment, and diligently surveys the ground by which he may retreat if he should be attacked and repulsed by superior forces, taking care that he may not be surrounded, and that the enemy may not be able to oppose to him

pro-
the
the
be-
ating
age.
ves;
sired
It
un-
their
ious
for-
ster-
bra-
is in
or to
lead-

but
with
ided
ever
the
op-
uch
an-
ing,
It
one
s of
ma-
out
and
ffi-
in
to
he
ce-
ed;
ers
ve
o-
his
er
he
s.
e-
ir
ot
ly
ll
s,
d
r
y
y
s
s
s

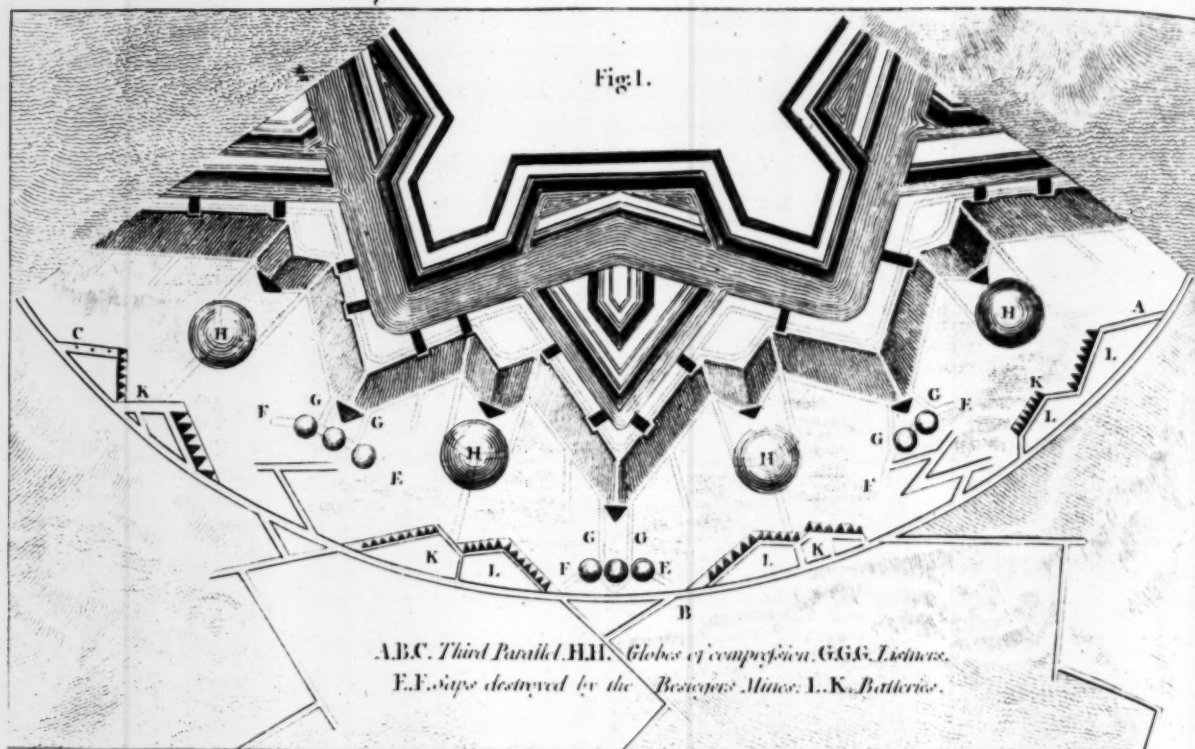


Fig. 1. Represents the Method of placing Mines in a Siege.

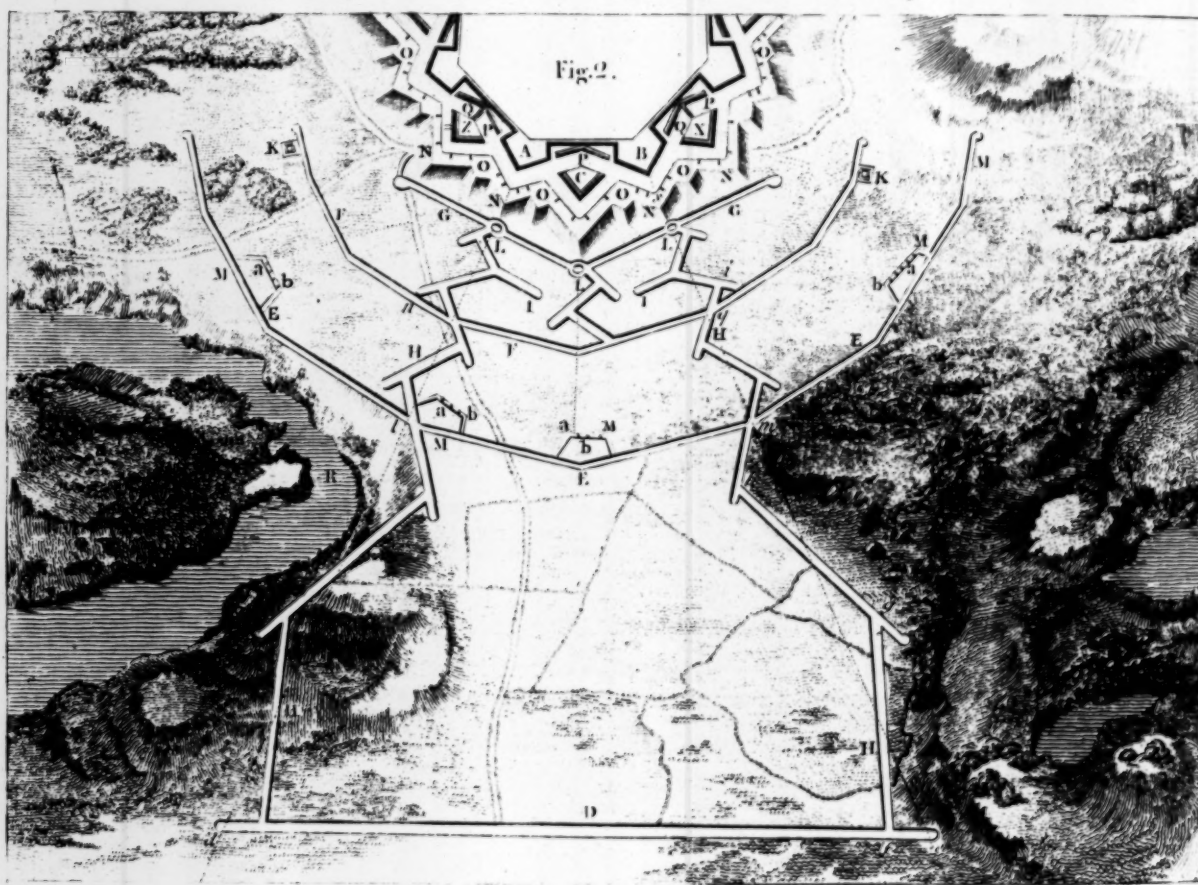


Fig. 2. Representation of a fortified Place besieged.

- | | | |
|---|---------------------------------------|--------------------------------------|
| A.B. Two Bastions. | H. The Approaches. | O. Places of Arms in the covert way. |
| C. Ravine. | I. Places of Arms. | P. The Ditch. |
| D. Line of Communication of the Attack. | K. Square Redoubt to prevent Sallies. | Q. Bridge of communication. |
| E. First Parallel. | L. Towers in the third Parallel. | R. A River. |
| F. Second Parallel. | M. Batteries. | S. Rising Ground. |
| G. Third Parallel a Place of Arms. | N. Glacis. | a. Cannon. b. Mortars. |

him a front more extensive than his own. The quick eye is no other than that penetrating genius which lets nothing escape it. A general who knows how to unite this quality with perpetual coolness, never is in want of expedients; he will see how those events, which to any other would be the preface of his own defeat, may end in the overthrow of his enemies. The army of Cyrus, in the presence of that of Cræsus at Timprea, took a clap of thunder for a bad omen: this impression escaped not the quick eye of Cyrus; but the coolness which on this occasion he knew how to preserve, suggested to him an interpretation which removed his soldiers' fears. "My friends," cried he, "Heaven declares for us; come on, I hear the sound of victory: Great Jupiter, we follow thee."

The choice of the general officers depends upon this genius, which discovers every thing; they ought to be the right-hand of the general, and as capable of commanding the army as himself. Whatever good dispositions a general may make, they must prove ineffectual if not seconded by the general officers under his command; he cannot be every where, neither can he foresee all exigencies that may arise. He is obliged to give only general orders; it is therefore the business of those who command under him to know how to take the advantage of a wrong movement of the enemy; to take upon them to attack, or sustain the troops which are engaged; and, as circumstances vary, to make them advance towards the enemy, either to keep him back, or to attack him. Yet we must except the reserve, which ought never to march without an order from the commander in chief. But the qualities already mentioned would be useless, if order and discipline were not severely observed: the most numerous and best composed army would soon become little else than a body of rangers, who being only united by the hope of booty, would separate as soon as that motive ceased; and trusting each to his own head or indulging his own humour, would be cut in pieces party by party: so that if the general does not keep up subordination (the soul and strength of discipline) his army will be nothing more than a troop of Tartars acting more from the hope of plunder than the desire of glory. What art and what genius is there not requisite to maintain this subordination? Too much severity disgusts the soldier, and renders him mutinous, discourages him and makes him desert; too much indulgence sinks him into indolence, and makes him neglect his duty: licentiousness causes that subordination to seem burdensome, which should never in any degree be given up: he loses that respect and often that confidence, which he should have with regard to his officer; and indulgence often makes a well disciplined body become a set of sluggards, who march against their will, and who, on the most pressing emergencies, think only on their own safety.

The ability, foresight, and prudence of a general, gains him the entire confidence of the soldier and officer; the soldier indeed judges but by instinct, and is determined only by the event; but his judgment is not less infallible; that of an officer is equally just, but he is determined only by full conviction; he puts event out of the question, and places his confidence in nothing but courage and prudence. Confidence is again to be acquired by affability to those who are subordinate to us, and by supplying their wants before they are complained of; these two motives for confidence afford a plentiful and certain harvest of laurels to the general. M. Luxembourg, M. Turenne, Prince Eugene, Marshal Saxe, and many others, have partly owed the advantages they have gained over their enemies to the confidence of the soldiers, who, loving their general, considered it as their duty to please him, and had no joy in victory but as they shared it with him.

Besides these qualities which are essential to a general, and which all who would attain that rank ought of course to have, there are still many others necessary to make a great man. A hero is always a good member of the community; he considers humanity as his first duty; he is just, open, and unbiassed; his temper may be fiery, but this ardour is always regulated by prudence; he gives advice with the same openness as he would ask it; and never asks but of those whose experience, which he estimates rather by their actions than their age, makes them capable of giving such as may be trusted; he is haughty only to his enemies, free to his equals, affable to his inferiors, brave without either arrogance or rashness, and easy of access to all.

The general ought to be acquainted with the interests and force of princes, a science very necessary in judging of the power of princes upon whom war is made, that he may fall sooner upon the country of him who can obstruct his projects, than upon a prince, who, by the situation of his dominions and force, can make no opposition. In a word, a general who would merit the title of a great man, ought to unite in himself all civil, military, and political excellence. It is by this that he will easily attain to make war with success; nothing will escape him; he will know without difficulty the genius of every country, and of the nations which compose the enemy's army, the abilities of the generals who command, and the nature of the troops under them. Without these precautions he would never think that he could act upon certain grounds; he knows he may venture a motion with some troops that he would not dare attempt with others that are equally brave. One nation is vehement, fiery, and formidable in the first onset; another is not so hasty, but of more perseverance: with the former, a single instance determines success; with the

latter, the action is not so rapid, but the event is less doubtful. No man is born a general, although he brings into the world with him the seeds of those virtues which make a great man; Cæsar, Spinola, Turenne, the great Conde, and some others, shewed, even in their earliest years, such qualities as ranked them above other men; they carried within them the principles of those great virtues which they drew forth to action by profound study, and which they brought to perfection by the help of practice: those who came after them, with perhaps fewer natural talents, have by study rendered themselves worthy of being compared to them. Cæsar and all conquerors had this advantage, that they were able to make their own opportunities, and always acted by their own choice. A man may be a good general without being a Marlborough or a Turenne; such geniuses are scarcely seen once in an age; but the more they are raised above the rest of mankind, the more they ought to excite emulation. It is by endeavouring to surpass the intellects of the second rate; it is by striving to equal the most sublime, that the imitation of them is to be attained. This passion in a soldier, is neither pride nor presumption; it is virtue, and it is by this only that he can hope to be serviceable to the state, and add to the glory of his king.

How much soever the honour of commanding armies may be fought after, it degrades him who is not worthy of it: this rank, so much desired, borders on the two extremes of glory and ignominy. A military man who labours to make himself capable of commanding, is not to be blamed; his ambition is noble; by studying the art of commanding, he learns that of obeying and of executing. But it is astonishing in the highest degree to see soldiers thinking only on preferment, and neglecting the study of their business. It is perhaps less surprising if we see others, without having been tried, proposing to themselves to command in chief; because such attempts suppose in the projector an absurd temerity, founded on a profound ignorance of the talents he ought to have, and the virtues which he has not. Such boldness is the character of a man whose mind is too narrow to perceive his danger. We should rather approve the timidity that suffers itself to be defeated by terror, since it shews at least that he knows to what hazards he is exposed: both one and the other are blameable: modesty is an essential quality of a soldier; it gives splendor to virtue, it argues diffidence of himself, and desire of arriving at perfection. Mardonius, Xerxes's general, proposed himself to the king to command his armies; this conceit of his own talents ought to have been answered by a refusal; the innumerable troops which he led were defeated by a small number of Greeks, and his presumption served but to increase the misfortune of his prince. Cincinnatus, endowed with every quality both of a great man and a great soldier, was holding his plough when the Romans came to intrust the fate of the republic to him: he set out; and Rome was delivered from her enemies.

The title of general would be less tempting, if proper attention was paid to the qualities it requires, and the duties it imposes: it would then appear a very honourable, but painful burden. The most firm and intrepid genius might be discouraged, merely by thinking that on the conduct of a general depends the fate of a state, the glory of his prince's arms, and his own reputation. But yet the reward that follows such irksome labours ought to animate men to undertake them. Obstacles, however numerous they may be, are not insurmountable, since so many great men have got the better of them: difficulties should stir up a soldier's emulation, but should never terrify him: he should endeavour to copy such great originals, should he should not be able to equal them.

Mining is one of the most essential parts of the attack and defence of places: so much artillery is used, that nothing above ground can withstand its effects; the most substantial ramparts and parapets can resist but a short time; and the outworks, though numerous, serve only to retard, for a time, the surrender of the place.

History informs us, that mines were made long before the invention of gunpowder; for the ancients made galleries, or underground passages, much in the same way as the moderns, from without, under the walls of places, which they cut off from the foundation, and supported them with strong props: then they filled the intervals with all manner of combustibles, which being set on fire, burnt their props, and the walls being no longer supported, fell, whereby a breach was made. The besieged also made underground passages from the town under the besiegers' machines by which they battered the walls to destroy them, which proves necessity to be the inventor of mines, as well as other useful arts.

The place where the powder is lodged, is called the chamber of the mine, or fourneau. The passage leading to the powder is called the gallery. The line drawn from the centre of the chamber, perpendicular to the nearest surface of the ground, is called the line of least resistance. The pit or hole made by springing the mines, is called the excavation. The fire is communicated to the mines by a pipe or hose, made of coarse cloth, whose diameter is about 1½ inch, called a *saucisson* (for the filling of which near half a pound of powder is allowed to every foot) extending from the chamber to the entrance of the gallery, to the end of which is fixed a match, that the miner who sets fire to it may have time to retire, before it reaches the chamber. To prevent the powder from contracting any dampness, the *saucisson* is laid in a small trough, called an *auge*, made of boards 3½ inches broad, joined together lengthwise, with straw in it, and round the *saucisson*, with a wooden cover nailed upon it. Some authors call the end of the

faucillon that comes within the work, and which is to be set fire to; the foyer or focus; but by most people, this is generally understood to be the centre of the chamber.

Galleries and chambers of mines, which are made within the fortification, before the place is attacked, and from which several branches are carried to different places, are generally 4 or 4½ feet wide, and 5 or 5½ feet high. The earth is supported from falling in by arches and walls, as they are to remain for a considerable time. But when mines are made to be used in a short time, then the galleries are but 3 or 3½ feet wide, and 5 feet high. The earth is supported by wooden frames or props. The gallery being carried on to the place where the powder is to be lodged; the miners make the chamber, which is generally of a cubical form, large enough to hold the wooden box, which contains the powder necessary for the charge; the box is lined with straw and sand-bags, to prevent the powder from contracting dampness. The chamber is sunk something lower than the gallery, if the soil permits; but where water is to be apprehended, it must be made higher than the gallery; otherwise the besieged will let in the water and spoil the mine.

In loading and stopping mines, the gallery and chamber being ready to be loaded; a strong box of wood is made of the size and figure of the chamber, being about ¼ or ½ larger than is required for containing the necessary quantity of powder. A hole is made in the side next the gallery, near the bottom, for the faucillon to pass through, which is fixed to the middle of the bottom, by means of a wooden peg to prevent its loosening from the powder; or that, if the enemy should get to the entrance, they may not be able to tear it out. This done, the powder is brought in sand-bags, and thrown loose in the box, and covered also with straw and sand-bags. Upon this is put the cover of the box, pressed down very tight with strong props: and to render them more secure, planks are also put above them, against the earth, and wedged in as fast as possible. Then the auger is laid from the chamber to the entrance of the gallery with some straw at the bottom, and the faucillon laid in it with straw over it: lastly, it must be shut with a wooden cover nailed upon it. Great care must be taken in stopping up the gallery, not to press too hard upon the auger, for fear of spoiling the faucillon, which may hinder the powder from taking fire, and so prevent the mine from springing. The gallery is stopped up with stones, earth, and dung, well rammed six or seven feet further from the chamber than the length of the line of least resistance.

The globes of compression, as represented in the plate annexed, *fig. 1.* letters H, H, are large globes of earth homogeneous in all its parts, and a certain quantity of powder lodged in their centre so as to produce a proper effect without bursting the globe; by setting fire to the powder it is evident, that the explosion will act all round, to overcome the obstacles which oppose its motion; and as the particles of the earth are porous, they will compress each other in proportion as the flame encreases, and the capacity of the chamber encreases likewise: but the particles of earth next to the chamber will communicate a part of their motion to those next to them, and those to their neighbours: and this communication will thus continue in a decreasing proportion, till the whole force of explosion is entirely spent, and the particles of earth beyond this term will remain in the same state as they were at first. The particles of earth that have been acted upon by the force of explosion will compose a globe, which the miners call a globe of compression.

From several experiments made with various charges, it appeared that the greatest diameter of an excavation may not only be made double, but triple or quadruple; contrary to the general opinion. From these experiments we are convinced, that the diameter of the excavation could be made greater than was imagined; but for what reason was not hitherto known till Mr. Belidor demonstrated it, in the Memoirs of the academy of Sciences, at Paris, in the year 1762.

To explain the reasons on which the principles of mines are grounded; it is necessary to consider, not only the resistance which the weight of the earth and the cohesion of the parts make against the force of explosion, but likewise the pressure of the atmosphere, which is so great as to counterbalance a column of water of the same base, whose altitude is 33 feet; which answers nearly to a height of a middling soil of about 22 feet; so that if the line of least resistance of a mine be 10 feet, the force of explosion must not only overcome the weight of 10 feet of earth above it, but 32 feet, properly speaking. It is, however, to be observed, that this weight resists the force of explosion no longer than till the mine bursts, and the explosion gets a communication with the air, because then the pressure of the air ceases.

In order to apply this method of attacking the countermines in a place besieged; it is supposed the first and second parallels made the third parallel, as represented in the plate which refers to this subject, *fig. 1.* letters A, B, C, distant about 360 feet from the palisades of the covert way; and from thence the trenches are carried on in the capital of the ravelin, and in those of the adjacent bastions of the front attacked; and after this batteries, L, are made of cannons and mortars, to enfilade by ricochet the covert way, and the ramparts parallel to it, to destroy their defences. During this time, the sappers carry on the saps towards the places of arms in the covert-way, both salient and re-entering; to establish the heads E, F, near the ends of the listners G, G, before the salient angles; and the miners proceed under

ground to place chambers overcharged between the extremities of the listners of the re-entering angles. We suppose they have taken the precaution to sink their shafts as deep as the countermines: that the chambers may be nearly on a level with the galleries, and that the shafts are placed in the trenches, K, which lead from one battery to the other, not to interfere with any other works. From the bottom of these shafts they make the galleries K, L, of about 120 feet long. This will be a work of about four or five days to the establishing their chambers which should be finished at the same time, that they may be sprung together; by this time the sappers will be got to the heads E, F, to induce the besieged to spring some of their mines to destroy them.

Supposing that they have sprung two or three mines at each side; as soon as this is done, the miners enter into the excavations to discover the galleries; which they must do at the same time while the sappers form a lodgment in the excavation. When the galleries are found and cleared, they stop up their entrances to keep in the smoke till they want to make use of them. On the other hand, all the globes of compression H H, are fixed, and from their excavations search is made on the right and left, to discover the listners G, G; so that if the measures have been rightly taken, fourteen entrances into the countermines will be found, by which it will be out of the power of the besieged to resist equally every where: should there be but half that number practicable, it would be sufficient to get possession of all their mines, of which only those that are convenient to advance the siege, are to be changed into trenches.

Another essential article in the article of war, is the conduct and management of a siege, which is to surround a fortified place with an army, and approach it by passages made in the ground, so as to be covered against the fire of the place. The first operation of a siege is investing or blocking up the avenues of a place, so as to prevent all ingress and egress. The body of troops investing a town, should at least be as strong again as the garrison; they should be divided into several parties, in order to take possession of all the avenues leading to the place, and thereby prevent all communication. By day they should keep themselves out of cannon shot: but as soon as it is dusk, they must approach much nearer, the better to be able to support each other and to straiten the town.

Places fortified after the modern manner, consist chiefly of bastions and curtains, and sometimes of demi-bastions, according to the situation of the ground; of cavaliers, ramparts, ditches, counter-scarps, covert-ways, half-moons, ravelins, horn-works, crown-works, esplanades, tenailles, &c. &c. For definition of these several articles, with the most approved methods of their construction according to the respective plans of Vauban and Muller, the reader is referred to the System of FORTIFICATION throughout.

Fig. 2: which refers to this subject, represents the plan of a regular fortification besieged, with a full explanation of its component parts; which with the observations and references we have made on, and to the several articles appertaining to the System of FORTIFICATION, it is presumed will sufficiently elucidate the subject.

The description of the above plate would have been given under the System of FORTIFICATION, as having a more immediate reference to that part: but at the early period at which it was introduced in the work; it was intended to have comprised under the head WAR; a complete treatise comprehending fortification, projectiles, &c. &c. But this plan not appearing so eligible as the mode we have since adopted, we chose to give them in a more detached point of view. And as the plate was referred to this head, to prevent confusion we thought it better to give a description of it in this place.

For the component parts which form the art of war, the reader is referred to the Treatise on MILITARY and NAVAL AFFAIRS; the System of Projectiles, which includes Gunnery, Fortification, Navigation, &c. which state and explain the particulars respecting the different departments of the army and navy; such as the rise and progress of the military state in Britain; military discipline, arrangement, rank, tactics, and manual exercise: also the maritime state of Britain, management and regulations of the navy; naval tactics, or the methods of arranging a fleet for an engagement, as well as the manner of an engagement, together with a general display of the construction of ships. To these several subjects is annexed a plate illustrative and explanatory both of the theory and practice, so as to comprise in the whole the most essential parts of this art, both military and naval.

WAR, *Civil*, or *Intestine*, is that between subjects of the same realm; or between parties in the same state. In this sense we say the civil wars of the Romans destroyed the republic; the civil wars of Granada ruined the power of the Moors in Spain; the civil wars in England began in 1641, and ended in the king's death, 1648.

WAR-CRY, was formerly customary in the armies of most nations, when just going to engage. Sometimes they were only tumultuous shouts, or horrid yells, uttered with an intent to strike terror into their adversaries; such as is now used by the Indians in America; called the *war-hoop*.

WARBLER, the English name of the genus *motacilla*, in the System of ORNITHOLOGY. See MOTACILLA, for representation of the male and female, see Plate III. Genus 41.

W A R

WARD is a word used in our law-books, in divers significations. Thus; a ward in London, is a part of the city, committed to the special charge of one of the Aldermen of the city. There are twenty-six wards in London, which are as hundreds, and the parishes thereof as towns. A forest is also divided into wards; so also are most of our hospitals. A prison is also sometimes called a ward. The heir of the king's tenant, who held by knight's service, or in capite, was also called a ward, during his non-age. But this sort of wardship is taken away by the statute 12 Car. II. cap. 24.

WARDEN, *guardian*, one who has the charge or keeping of any person, or thing, by office. Such is the warden of the Fleet, who is the keeper of the Fleet prison, and has the charge of the prisoners there; especially such as are committed from the court of chancery for contempt. Such also are the warden of the fellowships, warden of the marshes, wardens of peace, warden of the west marshes, warden of the forest, warden of the alnage, warden of the king's wardrobe, &c. Warden, in an university, is the head of a college; answering to what in other colleges we call the master thereof. Warden, or *Lord WARDEN of the Cinque Ports*, is the governor of those noted havens, who has the authority of an admiral, and sends out writs in his own name. See *CINQUE Ports*.

WARDMOTE, in London, is a court so called, which is kept in every ward of the city; answering to the *curia comitia*, in ancient Rome.

WARDPENNY, *wardpeni*, was formerly a customary due paid to the sheriff, or other officer, for maintaining watch and ward. It was payable at the feast of St. Martin; and is still paid within the manor of Sutton-Colfield, in Warwickshire; and that with some very singular ceremonies.

WARRANT, an act, instrument, or obligation, whereby a person authorizes another to do something, which he had not otherwise a right to do.

WARRANT, in law, is a precept under the hand and seal of some officer to bring any offender before the person granting it. A warrant may be granted in extraordinary cases by the privy council, or secretaries of state; but ordinarily by justices of the peace. This they may do in any cases where they have a jurisdiction over the offence, in order to compel the person accused to appear before them. And this undoubtedly extends to all treasons, felonies, and breaches of the peace; and also to all such offences as they have power to punish by statute. Sir Edward Coke lays it down, that a justice of the peace cannot issue a warrant to apprehend a felon upon mere suspicion, nor even till an indictment be actually found; but this opinion has been combated by Sir Matthew Hale, who maintains, that a justice of peace hath power to issue a warrant to apprehend a person accused of felony, though not yet indicted; and that he may also issue a warrant to apprehend a person suspected of felony, though the original suspicion be not in himself, but in the party that prays his warrant. But in both cases it is proper to examine upon oath the party requiring a warrant, as well to ascertain that there is a felony or other crime actually committed, without which no warrant should be granted; as also to prove the cause and probability of suspecting the party against whom the warrant is prayed. This warrant ought to be under the hand and seal of the justice, should set forth the time and place of making, and the cause for which it is made, and should be directed to the constable, or other peace officer; or it may be to any private person by name, requiring him to bring the party either generally before any justice of the peace for the county, or only before the justice who granted it: the warrant in the latter case being called a special warrant. A general warrant to apprehend all persons suspected, without naming particularly, or describing any person in special, is illegal and void for its uncertainty; for it is the duty of the magistrate, and ought not to be left to the officer, to judge of the ground of suspicion; and a warrant to apprehend all persons guilty of the crime therein specified, is no legal warrant; because the point, upon which its authority rests, is a fact to be decided upon in a subsequent trial; namely, whether the person apprehended thereupon be really guilty or not. It is therefore, in fact, no warrant at all; for it will not justify the officer who acts under it; whereas a warrant, properly penned (even though the magistrate who issues it should exceed his jurisdiction) will, by statute 24 Geo. II. cap. 44. at all events indemnify the officer who executes the same ministerially. A practice, indeed, had obtained in the secretaries office, ever since the Restoration, grounded on some clauses in the acts for regulating the press, of issuing general warrants to take up (without naming any person in particular) the authors, printers, and publishers, of such obscene or seditious libels as were particularly specified in the warrant. When those acts expired in 1694, the same practice was inadvertently continued, in every reign, and under every administration, except the four last years of Queen Anne, down to the year 1763; when such a warrant being issued, its validity was disputed, and the warrant was adjudged by the whole court of king's bench to be void. After which the issuing of such general warrants was declared illegal by a vote of the house of commons. *Com. Journ.* 22 April, 1766.

When a warrant is received by the officer, he is bound to execute it, so far as the jurisdiction of the magistrate and of himself extends. A warrant from the chief or other justice of the court

W A S

of king's bench, extends all over the kingdom; and is tested or dated England, and not any particular county. But the warrant of a justice of peace in one county must be backed, that is, signed by a justice of the peace in another, before it can be executed there. Formerly, regularly speaking, there ought to have been a fresh warrant in every fresh county: but the practice of *BACKING* warrants had long prevailed without law, and was at last authorized by statutes 23 Geo. II. cap. 26, and 24 Geo. II. cap. 55. And now, by statute 13 Geo. III. cap. 31. any warrant for apprehending an English offender who may have escaped into Scotland, and *vice versa*, may be indorsed and executed by the local magistrates, and the offender be conveyed back to that part of the united kingdoms, in which such offence was committed. *Blackst. Comm.* book iv. p. 287, &c.

WARRANT of Attorney, is that whereby a man appoints another to do something in his name, and warrants his action. It seems to differ from a *letter of attorney*, which passes underhand and seal of him that makes it, before credible witnesses; whereas *warrant of attorney*, in personal, mixed, and some real actions, is put in course by the attorneys for the plaintiffs or defendants. Though a *warrant of attorney*, to suffer a common recovery by the tenant, or vouchee, is to be acknowledged before such persons as the commission for the doing thereof directs.

WARREN, *WARENNA*, a franchise, or place privileged either by prescription, or grant from the king, to keep beasts and fowl of warren in: as rabbits, hares, partridges, pheasants, &c. A man that has the franchise of warren is in reality no more than a royal game-keeper, but no man, not even a lord of a manor, could by common law justify sporting on another's soil, or even in his own, unless he had the liberty of *free-warren*. This franchise is almost fallen into disrepute, since the new statutes for preserving the game. There are, indeed, many instances of eager sportsmen in ancient times, who have sold their estates, and reserved the *free warren*, or right of killing game to themselves; by which means it comes to pass that a man and his heirs have sometimes *free-warren* over another's ground. The word *warren* is now generally applied to a piece of ground set apart for the breeding and preserving of rabbits.

WART, *verruca*, a little round hard excrescence, arising on the flesh like a pea. Warts are more frequent on the hands than any other part. There are divers sorts; the most usual are called *porraceæ*; as having heads like leeks, and consisting of little threads, resembling the roots thereof. Another sort is called *myrmecia*; this is a little round callous eminence on the hands of young children; rising suddenly, and disappearing again. A third sort is the *acrochordon*. Warts, if only rooted in the cutis, are easily taken away; but if they arise from the tendons underneath, there is scarce any extirpating them without great danger. Strong vinegar, charged with as much common salt as it will dissolve, is a very proper application to them. A plaster may also be composed of sal ammoniac and galbanum, which being kneaded up together and applied, seldom fails of destroying them. Borelli commends water wherein sal ammoniac has been dissolved; which Dr. Mapletost, formerly professor of physic at Gresham College, makes no scruple to say, is the only sure remedy he knows of in all medicine.

WASH, the distiller's name for the fermentable liquor made by dissolving the proper subject for fermentation and distillation in common water.

WASP, *Vespa*, in entomology, a genus of the hymenoptera order of insects; the characters of which are these: the mouth has maxillæ without any proboscis; the upper wings are plicated; the sting is pointed and concealed; the eyes are lunar; and the body naked and smooth. Linnæus enumerates 28 species. For classification, see the System, Order V.

M. Reaumur (*Hist. Acad. Sci. Paris*, 1719.) and Dr. Derham (*Phil. Trans.* No. 382. p. 53, or *Abr.* vol. viii. p. 404.) agree in distinguishing three sorts of wasps, viz. the queens or females, the males, and the common labouring wasps, called mules, which, according to Reaumur, are neither males nor females, and consequently barren. The queens, of which there is a great number, are much longer in the body, and larger than any other wasp; they have a large heavy belly, corresponding in size to the prodigious quantity of eggs with which they are charged. The males are less than the queens, but longer and larger than the common wasps, which are the smallest of the species: they have no stings, with which both the queens and common wasps are furnished. There are in one nest two or three hundred males, and as many females; but their number depends on the size of the nest; and Dr. Derham observed that the males were bred, or at least mostly resided in the two cells or partings, between the combs, next to the uppermost cell. The antennæ or horns of the male wasps are longer and larger than those of either of the other sorts; but the chief difference, says Dr. Derham, consists in their parts of generation, which are altogether different from those of other wasps. The mules are the labourers belonging to the nest, and are employed in procuring materials for the nests, and in constructing them, and also in furnishing the other wasps, and young, with provisions. M. Reaumur has observed, that when the females that have survived the winter, begin at the return of spring to lay their eggs, they first lay those which hatch mules, and at this time they build cells of a smaller size to lodge the eggs from which

which they are produced; they afterwards build larger cells, and fill them with the largest eggs, which are those of the males and females. This writer says, that the copulation of the males and females is visible, and he has given a particular account of it; observing that it is performed in October, like that of all other flies.

The wasps construct regular combs, and rear their young in the cells of these combs, in the manner of bees. A wasp's nest is commonly round, and made of materials resembling fine paper. The common covering of it, which is formed of several leaves or layers, with intermediate spaces, is pierced by two holes at a distance from one another, one of which is used for the entrance of the wasps, and the other only for their exit. The eggs of the wasp are of an oblong form, and resemble those of a common fly, but they are larger; they are always fastened to the angles of a cell, never to the sides of it. They are usually placed single; it is very rare to find two in one cell; and, if they are laid so, it seems that only one succeeds; for there is never found more than one worm in a cell. The cells are left open till the nymph is at its full growth; then the wasps cover it over with a thin lid, under which the worm undergoes its transformation; and as soon as it arrives at the wasp state, it eats its way through this thin cover and comes to work with the rest.

WATCHING, WAKEFULNESS, among physicians, denotes a disorder whereby a person is disabled from going to sleep. It is occasioned by a continual and excessive motion of the animal spirits in the organs of the body, whereby those organs are prepared to receive readily any impression from external objects, which they propagate to the brain, and furnish the soul with divers occasions of thinking. This extraordinary flux of spirits may have two causes: for, 1. The sensible objects may strike the organ with too much force; in which case, the animal spirits being violently agitated, and those agitations continued by the nerves to the brain, they give a like motion to the brain itself; the necessary consequence of which is, that the animal must wake. Thus, a loud shriek, pains, head-ach, gripes, coughing, &c. cause waking. Add, that the mind being oppressed with cares, or deeply engaged in thinking, contributes to the same; since, as it acts by the ministry of the spirits, any cares or meditations that keep those in motion, must produce watchfulness. Of this kind are the inveterate wakings of melancholic persons; some of whom have been known to pass three or four weeks without a wink of sleep. 2. The other cause is in the spirits themselves, which have some extraordinary disposition to receive motion, or to persist in it; as from their too great heat, or that of the brain in fevers, &c. Hence it is that the disorder is most frequent in summer, in the heat of youth, &c. Long fasting has the same effect; the want of food subtilizing the spirits, and drying the brain. The same is likewise an ordinary symptom in old age, by reason the pores of the brain, and the nerves, having been much widened by the continual passage of spirits, for a great number of years, the spirits now pass and repass through them with too much ease, and need not any extraordinary motion to keep the mind awake.

WATER, in physiology, a clear, insipid, and colourless fluid, coagulable into a transparent solid substance at 32° of Fahrenheit's thermometer, and volatile in every degree of heat above that. Many different kinds of waters are commonly spoken of, such as Chalybeate waters, sulphureous, saline, putrid waters, &c. but all these differ from one another only in having various substances mixed with them, from which, when perfectly freed, the water is always the same; so that it has not improperly been reckoned one of the four elements. By some late experiments of Messrs. Lavoisier, Watt, Cavendish, Priestly, and Kirwan, it appears, that water consists of dephlogisticated air, and inflammable air or phlogiston intimately united; or, as Mr. Watt conceives, of dephlogisticated air and phlogiston, deprived of part of their latent heat.

No pure WATER in all Nature.

Water, if it could be had alone, and pure; Boerhaave argues, would have all the requisites of an element, and be as simple as fire; but there is no expedient hitherto discovered for procuring it so pure. Rain water, which seems the purest of all those we know of, is replete with infinite exhalations of all kinds, which it imbibes from the air; so that if filtered and distilled a thousand times, there still remain faeces. Farther, the rain-water, gathered from the roofs of houses, is a lixivium of the salt of tiles, slates, or the like; impregnated with the dungs and faeces of the animals, birds, &c. deposited thereon, and the exhalations of numerous other things. Add, that all the rain-water gathered in cities, must at least be saturated with the smoke of a thousand chimnies, and the various effluvia of numbers of persons, &c. Besides this, there is fire contained in all water; as appears from its fluidity, which is owing to fire alone. As what is in the air necessarily mixes itself with water, it hence appears impossible to have such a thing as pure water. If you percolate it through sand, or squeeze it through pumice, or pass it through any other body of the like kind, you will always have salt remaining. Nor can distillation render it pure; since it leaves air therein, which necessarily abounds in corpuscles of all sorts. The waters that flow within, or upon the surface of the earth, contain various earthy, saline, metallic, vegetable, or animal particles, according to the substances over or through which they pass. The purest of all waters we can any way arrive at, is that distilled from

snow, gathered in a clear still pinching night, in some very high place; taking none but just the outer or superficial part thereof. By a number of repeated distillations, the greatest part of the earth, and other faeces may be separated from this: and this is what we must be contented to call pure water. Boerhaave says, that he is convinced nobody ever saw a drop of pure water: that the utmost of its purity known, only amounts to its being free from this or that sort of matter; and that it can never, for instance, be quite deprived of salt; since air will always accompany it, and air always contains salts.

The general and most effectual method of freeing water from any heterogeneous substance is distillation. Thus it may be perfectly purified from almost every falling substance whatever; and thus sea-water may be rendered perfectly fresh and wholesome. It must be observed, however, that all distilled water acquires an empyreumatic smell and taste by this operation; so that it makes but disagreeable drink until it has stood for some time. Another disadvantage which attends water newly distilled, is its want of fixed air; which, however, it soon recovers by exposure to the air for some time. If water is actually putrid, it cannot be made fit for use by simple distillation. In this case a quantity of lime is necessary, which extracts a volatile alkali, but destroys the putrid substance. After the water is once distilled in this manner, it may be more fully purified by adding some vitriolic or other acid to neutralize the alkali, and redistilling it with this addition. The substance from which it is most difficult to free water is any volatile oil. This rises in distillation, and will also pass through every kind of strainer. The only cure in this case therefore, is to expose the fluid for a considerable time to the air, when the oil will fly off or become effete and fixed, so that it cannot rise in distillation; after which the water may easily be purified.

Whether or not it is possible to convert water into earth, is a question which has much engaged the attention of philosophers. Mr. Boyle relates, that a friend of his by distilling a quantity of water an hundred times, found at length, that he had got six-tenths of the first quantity in earth: whence he concludes, that the whole water, by farther prosecuting the operation, might be converted into earth. Others have made experiments to the same purpose, and seemingly with the same success: but the deception is now found out. Water has the power of corroding the hardest bodies, even glass itself, by long digestion, especially when assisted by heat; and hence those who have made the experiments just mentioned have been themselves deceived, by supposing the earth which really came from the containing vessel to come from the water.

WATER in all Places and Bodies.

Water seems to be diffused every where, and to be present in all space where there is matter. There are few bodies in nature that will not yield water: it is even asserted, that fire itself is not without water. A single grain of the most fiery salt, which, in a moment's time, will penetrate through a man's hand, readily imbibes half its weight of water, and melts even in the driest air imaginable: thus salt of tartar, placed near the hottest fire, will attract or imbibe water; and, by that means increase considerably its weight, in a small time: so, in the driest summer's day, a pewter vessel with ice in it, brought up from some cold subterraneous place, in the hottest room, will immediately be covered over with little drops of water, gathered from the contiguous air, and condensed by the coldness of the ice. It is surprising to consider the plenteous flock of water which even dry bodies afford. Oil of vitriol, being exposed a long time to a violent fire, to separate all the water, as much as possible, from the same, will afterwards, by only standing a few minutes in the air, contract fresh water so fast, as soon to afford it as plenteously as at first. Hartshorn kept forty years and turned as hard as any metal, so that, if struck against a flint, it will yield sparks of fire, yet, being put into a glass vessel, and distilled, will afford one-eighth part of its quantity of water. Bones dead and dried twenty-five years, and thus become almost as hard as iron, yet by distillation, have afforded half their weight of water. And the hardest stones, ground and distilled, do always discover a portion thereof. But hitherto no experiment shews, that water enters as a principle into the combination of metallic matters, or even into that of vitrifiable stones.

Eels, by distillation, yielded Mr. Boyle some oil, spirit, and volatile salt, besides the caput mortuum; yet all these were so disproportioned to the water, that they seemed to have been nothing but that coagulated; the same strangely abounds in vipers, though they are esteemed very hot in operation; and will, in a convenient air, survive, for some days, the loss of their heads and hearts. Human blood itself, as spirituous and elaborate a liquor as it is reputed, so abounds in water, that out of seven ounces and a half, the same author, by distillation, drew near six ounces of phlegm; before any of the other principles began to rise.

Whether WATER be the common matter of all bodies?

From considerations somewhat of this kind, Thales, and some other philosophers, have been led to hold, that all things were made of water: which opinion, probably, had its rise from the writings of Moses; where he speaks of the Spirit of God moving on the face of the waters. But Mr. Boyle does not conceive the water here mentioned by Moses as the universal matter to be our elementary water; we need only suppose it an agitated congeries of a great variety of

of seminal principles, and of other corpuscles fit to be subtilized and fashioned by them; and it may yet be a body fluid like water, in case the corpuscles it was made up of, were by their Creator, made small enough, and put into such an actual motion, as might make them roll and glide easily over one another. However, Basil, Valentine, Paracelsus, Van Helmont, Sendivogius, and others, have maintained the same principle; viz. that water is the elemental matter, or stamen, of all things, and suffices alone for the production of all the visible creation. Thus, Sir Isaac Newton: "All birds, beasts, and fishes, insects, trees, and vegetables, with their several parts, do grow out of water, and watery tinctures, and salts; and, by putrefaction, they all return again to watery substances."

Helmont endeavours to prove this doctrine from an experiment; wherein, burning a quantity of earth till all the oil was consumed, and then mixing it up with water to draw out all the salt; and putting this earth, thus prepared, into an earthen pot, which nothing but rain-water could enter; yet a willow, planted therein, grew up to a considerable height and bulk, without any sensible diminution of the earth; whence he concluded, that the water was the only nutriment of the vegetable kind, as vegetables are of the animal.

The same thing is inferred by Mr. Boyle, from a parallel experiment; and the whole is countenanced by Sir Isaac Newton; who observes, that water standing a few days in the open air, yields a tincture; which, like that of malt, by standing longer, yields sediment and a spirit; but, before putrefaction, is fit nourishment for animals and vegetables. But Dr. Woodward endeavours to shew the whole to be a mistake; water containing extraneous corpuscles, some of which, according to him, are the proper matter of nutrition: the water being still found to afford so much the less nourishment, the more it is purified by distillation. So that water, as such, does not seem the proper nutriment of vegetables; but only the vehicle thereof, which contains the nutritious particles, and carries them along with it, through all the parts of the plant. Helmont, however, carries his system still farther; and imagines, that all bodies may be re-converted into water. His alkaliest, he affirms, adequately resolves plants, animals, and minerals, into one liquor, or more, according to their several internal differences of parts; and the alkaliest, being abstracted from these liquors, in the same weight, and with the same virtues as when it dissolved them, the liquor may, by frequent cohobations from chalk, or some other proper matter, be totally deprived of their seminal endowments, and return, at last, to their first matter; which is insipid water. Spirit of wine, of all other spirits, seems freest from water: yet Helmont affirms, it may be so united with water, as to become water itself. He adds, that it is materially water, only under a sulphureous disguise. And as to salt, salt of tartar, well calcined, being laid to liquify in the air, will deposit an earth: and if it be then committed to distillation, will yield a considerable quantity of insipid water: inasmuch, that if it be urged with a vehement fire, the salt will almost all vanish, and nothing saline remain, either in the water, or the earth. Whence Helmont concludes, that all salts might be converted into water. Add, that sea-salt, recovered from its own acid spirit, and oil of tartar, resolve into water, as much as oil of tartar. Lastly, oils run, in great measure, into water; and, it is probable, might be converted wholly into the same.

No Standard for the Weight and Purity of Water.

Water scarce ever continues two moments exactly of the same weight; by reason of the air and fire contained therein. Thus a piece of pure limpid ice, laid in a nice balance, never continues in equilibrio. In effect, the expansion of water in boiling shews what effect the different degree of fire has on the gravity of water. This makes it difficult to fix the specific gravity of water, in order to settle its degree of purity; but this we may say in the general, that the purest water we can procure is that which, according to the experiments of Mr. Hawkbee, whose determination has been usually followed, is 850 times as heavy as air: or according to the experiments of the Hon. Mr. Cavendish, the thermometer being at 50° and the barometer at 29½, about 800 times as heavy as air. However, we cannot have any tolerable standard in air; for water being so much heavier than air, the more water there is contained in the air, the heavier, of course, must the air be: as, in effect, the principal part of the weight of the atmosphere seems to arise from the water in it.

Properties and Effects of WATER.

Water is found the most penetrative of all bodies, after fire, and the most difficult to confine; so that a vessel, through which water cannot pass, may retain any thing. Nor is it any objection, that syrups and oils will sometimes pass through bodies which hold water; this not being owing to the greater subtilty and penetration of their particles, but to the resin where-with the wood of such vessels abounds, to which oils and syrups are as menstrua; so that, dissolving the resin, they make their way through the spaces left thereby: whereas water, not acting on resins, is retained in them. And yet water gradually makes its way, even through all woods, and is only retainable in glass and metals; nay, it was found by experiment at Florence, that when shut up in a spherical vessel of gold, and then pressed with a great force, it made its way through the pores even of the gold; so that the most solid body in nature is permeable to water under certain circumstances.

Water is even found more fluid than air; a body being reputed more fluid than another, when its parts will find way through small pores: now air, it is known, will not pass through leather, as is evident in the case of an exhausted receiver covered there-with; whereas water passes with ease. Again, air may be retained in a bladder, but water oozes through. In effect, it is found, that water will pass through pores ten times smaller than air will. It must not be omitted, however, that Mr. Homberg accounts for this passage of water through the narrow pores of animal substances, which will not admit the air, on another principle; viz. its moistening and dissolving the glutinous matter of the fine fibres of the membranes, and rendering them more pliable and tractile; which are things that the air, for want of a wetting property cannot do. As a proof of this doctrine, he filled a bladder, and compressed it with a stone, and found no air to come out; but placing the bladder thus compressed in water, the air easily escaped. Hist. de l'Acad. An. 1700, p. 45.

Water, then, may even hence, viz. from its penetrative power, be argued to enter the composition of all bodies, both vegetable, animal, and fossil; with this particular circumstance, that it is easily, and with a gentle heat, separable again from bodies it had united with: which cannot be said of any other body. Fire, indeed, will penetrate more than water; but it is difficult to procure it again from the bodies it is once fixed in; as is evident in red lead, &c. This property of water, joined with its smoothness and lubricity, fits it to serve as a vehicle for the commodious and easy conveyance of the nutritious matter of all bodies; being so fluid, and passing and repassing so readily, it never stops up the pores, and leaves room for the following water to bring on a new supply of nutritious matter. And yet the same water, as little cohesive as it is, and as easily separated from most bodies, will cohere firmly with some others, and bind them together in the most solid masses; though it appears wonderful, that water, which will be shewn an almost universal dissolvent, should, nevertheless, be a great coagulator.

Water, we see mixed up with earth, or ashes, gives them the utmost firmness and fixity. The ashes, e. g. of an animal, incorporated with pure water into a paste, and baked with a vehement fire, become a coppel; which is a body remarkable for this, that it will bear the utmost effort of a refiner's furnace. It is, in effect, upon the glutinous nature of water alone, that our houses stand; for take but this out of wood, and it becomes ashes; or out of tiles, and they become dust. Thus, a little clay dried in the sun, becomes a powder: which, mixed with water, sticks together again, and may be fashioned at pleasure; and this dried again by a gentle fire, or in the sun, and then baked in a potter's oven by an intense fire, becomes little other than a stone. So the Chinese earth, whereof our porcelain vessels are made, which hold all liquors, and even melted lead itself, is diluted and wrought up with water. To say no more, all the stability and firmness seen in the universe have been ascribed by some writers to water alone. Thus, they say, stone would be an incoherent sand, did not water bind it together; and thus, again, of a fat gravelly earth, wrought up with water, and baked or burnt, we make bricks, tiles, and earthen vessels, of such exceeding hardness and closeness, that water itself cannot pass through them. And these bodies, though to appearance perfectly dry, and destitute of water, yet, being pulverized, and put in a retort, and distilled, yield an incredible quantity of water.

The same, it is said, holds of metals; for the parings or filings of lead, tin, antimony, &c. by distillation yield water plentifully; and the hardest stones, sea-salt, nitre, vitriol, sulphur, &c. are found to consist chiefly of water, into which they resolve by force of fire. The *lapis calcarius*, or lime-stone, being exposed to the fire, affords a prodigious quantity of pure water: and the more of this water is extracted, the more friable does it become, till, at length, it commences a dry calx, or lime, wherein, in lieu of the water so expelled, the fire, in the course of calcination, enters; and this is expelled again, in its turn, by pouring on cold water. Yet the same water and calx tempered together, produce a mass scarce inferior, in point of solidity, to the primitive lime-stone. Many, if not most, of the effects here ascribed to water in uniting and consolidating the parts of various bodies, have been attributed by modern chymists and philosophers to the gas, or fixible air, which enters into their composition; which escapes when they are dissolved, and which is capable in certain circumstances, of being again restored to them, see LIME.

Mons. Lavoisier, and others, who have lately adapted the antiphlogistic system, maintain, that water must consist of inflammable and dephlogisticated air, since it may both be composed from them, and resolved into them again: But Dr. Priestley has shewn, that their experiments do not authorize the conclusion that has been drawn from them: and he observes, that in what manner soever dephlogisticated and inflammable air be made to unite, they compose some acid, and in no case pure water. See Experiments and Observations on different Kinds of Air, abridged, vol. iii. p. 545, &c.

The changes water is liable to, and the different forms it appears under, are very numerous: sometimes as ice, then as a vapour, then as a cloud, shower, snow, hail, fog, &c. We may add, that the purest waters soonest freeze; hence ice is purer than the water that remains unfrozen; on this principle, virous and some saline

W A T

liquors may be freed from a part of their sulphureous water by gentle congelation.

Sea-WATER.

Sea-water, is an assemblage of bodies, wherein water can scarce be said to have the principal part; it is an universal colluvies of all the bodies in nature, sustained and kept swimming in water as a vehicle. Dr. Lister considers it as the fund, or source, out of which all bodies arise. He gives, in some measure, into the opinion of Thales and Van Helmont; and imagines the sea-water to have been the only element created at the beginning, before any animal, or vegetable, or even before the sun himself. Fresh-water he supposes to have risen accidentally after the creation of these, and to owe its origin to the vapours of plants, the breath of animals, and the exhalations raised from the sun. De Font. Med. Ang. Dr. Halley is of another opinion. He takes it for granted, that the saltiness of the sea arises from the saline matter dissolved and imbibed by the rivers in their progress, and discharged with their waters into the ocean; and consequently, that the degree of saltiness is continually and gradually increasing. On this hypothesis he even proposes a method for determining the age of the world; for two experiments of the degree of saltiness, made at a large interval of time, will, by the rule of proportion, give the time wherein it has been acquiring its present degree. Phil. Trans. No. 344.

Besides common alimentary salt, the sea-water contains other salts, which are found in the bittern, or bitter brine, remaining after the sea-salt is extracted. First, it contains a bitter purging salt, known in the shops under the name of Epsom-salt. This was first extracted from the Epsom, Dulwich, and other purging waters, but it is now made only from the bittern at Newcastle, and other places; and it is chiefly to this bitter salt that the sea-water owes its bitter taste, though that has been supposed to proceed from bituminous matter contained in it, and often found on its surface, or lodged upon the rocks by its motion. Another salt is also found in bittern, which is called a muriatic calcareous salt, its acid principle being spirit of sea-salt, and its basis an earth nearly allied to quicksilver. This salt remains in the bittern after the purging salt has been extracted from it, and though it is a neutral salt, it cannot be made to shoot in crystals, but may be procured in a dry form by fire; but it is very difficultly kept in this form, being of all other salts, the most ready to imbibe the watery particles of the air, and run per deliquium. Beside these salts, the bittern contains a considerable portion of a fixed mineral alkali. These principles are all found in boiling the sea-water into salt. But beside these there must be many other substances, which escape our search in this manner, such as the feeds and excrements of innumerable plants and animals, and the tinctures which those plants and animals impart to it in their decay. These, together with divers saline and sulphureous particles, will naturally fall under the observation of those who shall attempt a perfect analysis of sea-water by the nicer methods of chymistry; a thing yet much wanted in the learned world. The substances are found in different quantities and proportions, according to the nature of the waters; but the quantity of common salt is always greater than that of any other. Of this the quantity in different seas varies, according to the greater or less evaporation, and accession of fresh water, from about one-fiftieth to near one-twentieth of the weight of the water. The Baltic sea is very weakly impregnated with salt; the English and German seas more strongly, and the Mediterranean still more; and the water on the coast of Mosambique is supposed to be much saltier, even than this. Mem. Acad. Par. 1711.

The author of the Chymical Dictionary, states the quantity of common salt contained in sea-water, to be to the quantity of water as 3 or 4 to 100; so that the water is far from being saturated with the salt; for water is capable of dissolving near a fourth part of its weight of common salt. Sea-water has generally been observed to contain more salt in hot than in cold climates. All these waters have a saline, and more or less of an acrid bitterish taste: their colour is greenish, and they become fetid by keeping. The acrimony and bitterness of these waters are generally attributed to the bituminous matters supposed to be contained in them: but the author of the Chymical Dictionary affirms, that he has made many experiments on large quantities of these several waters, and never could find any sensible quantity of bitumen. The bitterness, therefore, of these waters, he says, ought to be attributed to the Glauber's salt, which is bitter, and especially to the marine salt with earthy basis, which is very bitter and acrid. Sea-water occasions a very singular nausea, which is frequently attended with vomiting. This nauseous ingredient (says Bergman, Phys. and Chem. Ess. vol. i. p. 191.) is not to be found at all, or but very little, in sea-water taken up at the depth of sixty fathoms; the reason of which probably is, that the immense quantity of fish, worms, and other animals, which inhabit the ocean, dying, are gradually carried up to the surface, and there, by the assistance of the air, are destroyed by putrefaction; and the putrefactive process is much assisted by the salt, which, at the surface, is present precisely in the quantity necessary to promote that operation.

Methods of making Sea-WATER Fresh and Potable.

Many attempts have been made for rendering sea-water fresh and potable: they have, in general, being little else, than different modes of distillation; though many of the authors of them, either

W A T

from an ignorance of the real nature of sea-water, or from a design of rendering their process mysterious, have mixed different ingredients with the water, either before or after its distillation. The method of obtaining fresh-water, from the distillation of sea-water, was practised by Sir R. Hawkins, in the reign of queen Elizabeth, who thus obtained water that was wholesome and nourishing. See Purchas's Collect. of Voyages, book vii. chap. 5.

In 1761, Dr. Lind discovered, that sea-water distilled, without the addition of any ingredients, afforded a water as pure and wholesome as that obtained from the best springs; and in 1762 an account of this discovery was read to the Royal Society, and soon after published by authority of the lords of the admiralty. The practicability of this operation was also evinced by the author of the Chymical Dictionary. In 1765, Mr. Hoffman introduced a still of a new construction, with a secret ingredient. About the same time experiments were made with a still of the common construction, and Mr. Dove's ingredient. The manner of procuring fresh-water, by the simple distillation of sea-water, seems at present to have attained a great degree of perfection, both in France and England. M. de Bougainville, in his Voyage round the World, has borne ample testimony to the utility of the machine for distilling sea-water, which was made public in 1763, by M. Poissonnier, its inventor; and Lord Mulgrave, in his Voyage towards the North Pole, in 1773, has done equal justice to the method of obtaining fresh water from the sea by distillation, which was introduced into the English navy in 1770, by Dr. Irving; for which he obtained a parliamentary reward of 5000l.

In order that the reader may have a clear notion of Dr. Irving's method, let us suppose a tea-kettle to be made without a spout, and with a hole in the lid, in the place of the knob; then the kettle being filled with sea-water, the fresh vapour which arises from the sea-water as it boils, will issue through the hole in the lid; into that hole fit the mouth of a tobacco-pipe, letting the stem have a little inclination downwards: then will the vapour of fresh-water take its course through the stem of the tube, and may be collected by fitting a proper vessel to its end. This would be an apt representation of Dr. Irving's contrivance; in which he has adapted a tin, or iron, or copper tube, of suitable dimensions, to the lid of the common kettle used for boiling the provisions on board a ship; the fresh vapour, which arises from boiling sea-water in the kettle, passes through this tube into a hoghead, which serves as a receiver; and in order that the vapour may be readily condensed, the tube is kept cool by being constantly wetted with a mop dipped in a tub of cold sea-water. For a particular account of the advantages attending this method of distillation, contrasted against the defects and inconveniences of the other methods that have been proposed, see Voyage towards the North Pole, Append. p. 205, &c.

It appeared from the testimony which was delivered to the lords of the Admiralty by many respectable officers, who were eye-witnesses of an experiment made on board the Arrogant at Spithead, in January, 1771, that eighty gallons of sea-water did, in twenty-five minutes, after being put into the copper and a fire made, distil in the proportion of twenty-five gallons per hour into fresh water, perfectly well tasted, and of less specific gravity than the best spring-water in that neighbourhood; and the said officers gave it as their opinion, that five hundred gallons of fresh water might be distilled in the space of twenty-four hours, with the same quantity of fuel in proportion to the time as it required in the ordinary business of the ship. Every ship's kettle is divided into two parts by a partition in the middle; one of these parts is only in use when peas and oat-meal are dressed, but water is at the same time kept in the other, to preserve its bottom. Dr. Irving has availed himself of this circumstance; and by filling the spare part of the copper with sea-water, and sitting on the lid and tube, he has shewn, that sixty gallons of fresh water may be drawn off, during the boiling of either of the above-mentioned provisions, without the use of any additional fuel. He recommends also the preserving of the water which may be distilled from the coppers in which peas, oat-meal, or pudding, are dressed, as both a salutary beverage to the scorbutic, and the most proper kind of water for boiling of salt provisions. Dr. Irving particularly remarks, that only three-fourths of the sea-water should be distilled, as the water distilled from the remaining concentrated brine is found to have a disagreeable taste; and as a farther continuance of the distillation is apt to be injurious to the vessels. For an account of several experiments made on some of the best distilled water, prepared by Dr. Irving from sea-water, by Dr. Watson, see his Chem. Ess. vol. ii. p. 168, &c.

Dr. Priestley has suggested a proposal to give to this distilled water the briskness and spirit of fresh spring water, and at the same time of rendering it, perhaps, a remedy or preventative against the scurvy, by impregnating it with the gas or fluid called fixed air, obtained by mixing chalk with oil of vitriol. We have many accounts of the methods of obtaining fresh water by dissolving frozen sea-water. Bartholine in his book De Nivis Usu, says, that if the ice of sea-water be thawed, it loses its saltiness, as, he adds, has been lately tried by a professor in our university: accordingly the thawed ice of sea-water is often used in Amsterdam for brewing. Captain Cook, in his Voyage round the World, was furnished with fresh water from the melting of the ice which was found floating in the sea; and this water, he says, was not only fresh, but soft and

W A T

and wholesome. Sea-water has been found of excellent use against stumorous swellings and obstructions of the glands, and different cutaneous foulnesses. It has been given also in the true marine scurvy, and found to promote the cure, when assisted by proper vegetables. The dose of sea-water is from half a pint to a pint, which may be repeated every morning for some months. In these doses it gently purges the belly, promotes also the other excretions, and somewhat warms and strengthens the habit; in large ones, it excites vomiting. In scrophulous complaints, and for removing glandular swellings, the bark is sometimes advantageously joined with it. It is also serviceable in purging off gross humours, that have been the consequence of intemperance, or an inactive life; and in cleansing the intestines of viscid mucus, and worms.

This water, at first, is apt to occasion great thirst, which abates with the continued use of it, and may be palliated by sleeping immediately after it is drank. In some constitutions it produces immoderate heat, and when used externally, an itching of the skin; and therefore in all inflammatory cases, and habits prone to phlogoses, it is hurtful. These symptoms should be removed, previous to the use of it, by bleeding, purging, and a proper cooling treatment. In many cases bathing in sea-water may be joined to the internal use of it; both as a general corroborant, and as a topical discutient and antiseptic. Accordingly it is excellent in the scrophula or king's evil, in hard swellings, in the bite of a mad dog, in the rickets, in the dry leprosy and itch, in paralytic and scorbutic complaints, and many other cases. Lewis's Mat. Med. Elliot on Min. Wat. p. 190. Drinking sea-water with wine is said to prevent people from being sick at sea. It is said, that thirst may be allayed by bathing in warm sea-water, the pores imbibing the water, and carrying it to the intestines, but not suffering the dissolved salt to accompany the water.

Hard, or Crude WATER,

Is that in which soap does not dissolve uniformly, and is curdled. The dissolving power of hard water is less than that of soft; and hence its unfitness for bleaching, dyeing, boiling leguminous vegetables, and for many other purposes of economy and arts. One cause of the hardness of water is, that it contains some salt that may be decomposed by soap, the alkali of which uniting with the acid of the salt, the oil of the soap separates, and the soap is said to be curdled. Hardness of water proceeding from this cause may be discovered and remedied by adding some drops of a solution of fixed alkali. The salts capable of rendering water hard are not only selenites, which is a very frequent cause of the hardness of water, but any earthy or metallic salt that may be contained in the water, as all these are capable of being decomposed by fixed alkali. Such are the marine salt with basis of magnesia, or of calcareous earth, vitriolic salt with basis of magnesia, called Epsom salt, green vitriol, and a nitrous salt with an earthy basis, to which Dr. Home attributes the hardness of several waters examined by him. The hardness of water has been attributed by some persons to common salt. But Dr. Home, in his Essay on Bleaching, has shewn, that neither pure common salt, nor any other salt with basis of fixed alkali, give any hardness to water, but that this quality may be given to water by the common salt which is generally sold, because this contains some part of the earthy salts of sea-water, or of the water of salt springs. The gas, which waters frequently contain, is another cause of the hardness of water. This gas unites with the alkali of soap, renders it mild, and thus weakens its union with the oil. By exposure of the water some time in open vessels, this gas exhales; by which means water is rendered soft, and any calcareous earth or iron which may be dissolved in the water merely by means of the gas, as Mr. Cavendish and Mr. Lane have shewn, (Phil. Transf. 1767 and 1769,) is precipitated. See the System of AEROLOGY, Sect. X.

By boiling, the hardness of water proceeding from gas may be cured, but that from earth or metallic salts cannot be remedied in this way. Hard waters are remarkably indisposed to corrupt, and even preserve putrescible substances for a considerable length of time: hence, as Dr. Home observes, they seem to be best fitted for keeping at sea, especially as they are so easily softened by a little alkaline salt.

Rain WATER

Is the water of the sea, purified by a sort of distillation; or rather, it is the watery vehicle, separated from the saline, and other matters residing therein, by evaporation. Rain water is next in purity to snow-water, especially when collected with the same precautions, after the rain has continued for some time, so as to clear the air from insects, or other light bodies, that float in it. Neither this water nor snow-water discover any heterogeneity in the common trials with acids, alkalies, soap, blue vegetable juices, or metallic solutions; till great part of the aqueous fluid has been separated by evaporation. Rain water, by being impregnated during its passage through the air with a considerable quantity of phlogistic and putrescent matter, is rendered superior to any other in fertilizing the earth. Hence also it is inferior for domestic purposes to spring or river water, even if it could be readily procured; but such as is got from spouts placed below the roofs of houses, the common way of procuring it in this country, is evidently very impure, and becomes putrid in a short time.

W A T

River or Running WATER

Is next in purity to snow or distilled water; and for domestic purposes superior to both, in having less putrescent matter, and more fixed air. Indeed, if the stream, in descending from its spring, chance to flow over strata, or beds, wherein there is salt, sulphur, vitriol, iron, or the like, it dissolves and imbibes part thereof. Otherwise, spring-water becomes purer and better as it runs; for, while the river drives on its waters in an uninterrupted stream, all its salts, with the vegetable and animal matters drained into it, either from exhalations, or from the ground it washes, gradually either sink to the bottom, or are driven to the shore; and hence, the ancient poets and painters represent the deities of springs and rivers, as combing and carding their waters. Such water, however, is to be chosen as runs in a clear stream through a rocky or stony channel; such as passes over mud, clay, or mossy ground being impregnated with some part of these substances. River waters generally putrify sooner than those of springs. During the putrefaction, they throw off a part of their heterogeneous matter, and at length become sweet again, and purer than at first.

Spring WATER

Is commonly impregnated with a small portion of imperfect neutral salt, extracted from the different strata through which it percolates. Some contain a vast quantity of stony matter, which they deposit as they run along, and thus form masses of stone; sometimes incrustating various animal and vegetable matters, which they are therefore said to petrify. Spring-water is much used for domestic purposes, and on account of its coolness is an agreeable drink; but on account of its being generally somewhat hard, is inferior to that which has run for a considerable way in a channel. The saline matter of these waters is most commonly nitrous or muriatic, that is, composed of the nitrous or marine acids, united with earths: on adding to them, by little and little, a solution of any alkaline salt, the liquor becomes turbid and milky, more and more, till the acid, completely neutralized by the alkali, parts with all the earth, which on standing settles to the bottom. The water thus corrected, though really no purer than at first, is found perfectly soft for economical uses, and much less, if at all, detrimental to health; its pungent, austere, earthy salt, being now converted into a mild neutral one.

Putrid WATER.

Water putrifying by stagnation is extremely dangerous to health. Thus in the holds of ships, the bilge-water, if the ship is tight, and the water not pumped out often, soon becomes so extremely poisonous, as frequently to suffocate those seamen, who, as the pumps are subject to be clogged with filth, venture down to cleanse them; and also to affect persons at a distance with violent head-achs, cold sweats, and frequent vomitings, which continue more or less, in proportion to the distance from the well of the ship when the injury was received, and the degree of putrefaction in the water and air. Phil. Transf. No. 463. p. 63. To prevent the above mentioned inconveniences, many schemes have been thought of, particularly the machines of Dr. Hales, and Dr. Defaguliers; the first by an instrument, which he calls the VENTILATOR, and may not improperly be called the ship's lungs; and the latter by a machine, which is an improvement of the Hessian bellows. Putrified water being thus noxious, a method of preventing its putrefaction would be very desirable, and this seems now to be found in the use of lime. For a copious account of this method, see *Putrefaction of WATER*.

Putrid water in ditches is often used as an object for the microscope, and seldom fails to afford a great variety of animalcules. For a description of the animalcules, and the mode of applying them, see MICROSCOPIC OBJECTS.

Uses of WATER.

The uses of water are infinite; in food, in medicine, in agriculture, in navigation, in divers of the arts, &c. As a food it is one of the most universal drinks in the world; and if we may credit many of our latest and most judicious physicians, one of the best too. For this use, that which is purest, lightest, most transparent, simple, colourless, void of taste and smell, and which warms and cools fastest, and wherein herbs and pulse boil and yield their virtues soonest, is best. It is esteemed a good quality in water, to bear soap, and make a lather therewith. This our river waters readily do; but the pump and spring waters are found too hard for it; yet may this be remedied in them, by barely letting them stand for four or five days.

As a medicine, it is found, internally, a powerful febrifuge; and excellent against colds, coughs, the stone, scurvy, &c. Externally, its effects are not less considerable. In agriculture, and gardening, water is allowed absolutely necessary to vegetation; whence Varro places it in the number of the divinities he invokes in his first book *De Re Rustica*. *Etiam, says he, precor, Lympha, quoniam sine aqua omnis misera est agricultura.* Many naturalists have even maintained water to be the vegetable matter, or the only proper food of plants; but Dr. Woodward has overturned that opinion, and endeavoured to shew, that the office of water in vegetation is only to be a vehicle to a terrestrial matter, whereof vegetables are formed; and that it does not itself make any addition to them. All water, he allows, contains more or less of this terrestrial matter; spring and rain water near an equal quantity; and river water more than either of them. Water is of the utmost use in chemistry;

mistry, being one of the great instruments by means whereof its operations are all performed. It acts in various manners and capacities; as a menstruum, a ferment, a putrefacient, a vehicle, a medium, &c.

Mineral Waters

Are those which contain such, and so many particles of different natures from water, as thence to derive some extraordinary property beyond what common water has; or mineral waters are those which have contracted some peculiar virtue, by passing through beds of minerals, as alum, vitriol, sulphur, &c. or by receiving the fumes thereof. Or, they are such, in which gas, or sulphureous, saline, or metallic substances, are discovered by chymical trials: and as many of them are employed successfully in medicine, they are also called medicinal waters. The substances generally found in medicinal waters are almost always combinations of vitriolic acid, and those of marine acid, together with the several matters that these acids are capable of dissolving.

The kinds of mineral waters are various, as are the kinds of compositions of the minerals with which they are impregnated. Some are *simple*, as only containing mineral particles of one sort; others *mixed*, of two, three, four, or more sorts. Hence we have,

1. *Metallic waters*, in different parts; as *gold, silver, copper, tin, leaden, and iron waters*.

2. *Saline waters*, viz. *nitrous, aluminous, vitriolate, and those of common salt*.

3. *Bituminous, sulphureous, antimonial, carbonaceous, and amber waters*.

4. *Earthy and stony waters*; viz. *lime, chalk, oker, cinnabar, marble, and alabaster waters*.

To which some add *mercurial waters*.

This division of mineral waters is taken from their essences; that is, from the mineral particles they contain. Dr. Falconer, from a review of the impregnation of mineral waters, divides them, as in the following table, into those impregnated with

Saline Bodies.	Simple.	Acid.	1. Vitriolic acid per se.
		Alkali.	2. Fossile alkali per se.
	Compound.		3. Volatile alkali per se.—Very dubious.
			4. Glauber's salt.
Inflammable Bodies.	Oil.		5. Vitri. ammon. very dubious.
			6. Common salt.
	Sulphur.		7. Sal. ammon. very dubious.
			8. Oil fossile per se.
Metallic Bodies.	Simple.		9. Oil in form of soap.
			10. Sulphur per se.
	Compound.		11. Hep. Sulph. with an alkali.
			12. Hep. Sulph. c. calce viva.
Earthy Bodies.	Base Metals.		13. Vitriolic acid in form of blue vitriol.
			14. Fixt vitriolic acid in form of green vitriol.
	Semi-metals.		15. Vol. vitriolic acid, as in many chalybeates.
			16. Hep. sulph. with an alkali.
Aerial Bodies.	Common Air.		17. Hep. sulph. with quicklime.
			18. Fixable air.
	Fixable Air.		19. Vitriolic acid in form of white vitriol.
			20. Calcareous earth in solution, by being deprived of fixable air.
	Inflammable Air.		21. ———, by being united with it in over-proportion.
			22. Calcareous, in form of selenites.
			23. Magnesia.—Spurious Glauber's salt.
			24. Earth of alum—in form of alum.
	Common Air.		25. In solution, or mixture?
			26. In diffusion.
	Fixable Air.		27. Q. in solution, diffusion, or mixture?
			28. Probably only in diffusion.

For a further account of mineral waters, see the sequel under this Article.

As to the use of mineral waters, the learned Heister observes, that in general they are found to agree much better with persons in the middle stages of life than with the very old or very young. If any general rule can be given in this case, it is that people should not take them when younger than eighteen, or when older than sixty. Young people, especially such as are under ten years old, should by no means be allowed to drink the chalybeate waters, because of the tender state of their viscera; and older people than those of sixty are never found to receive any benefit from them, unless they are of very robust constitutions, or have been long accustomed to the drinking of them. In some cases, however, particularly in hystics, young people may be allowed to drink the milder kinds mixed with an equal quantity of milk, and often find great benefit from them.

In confirmed consumptions and ulcers of the lungs, the stronger chalybeate waters are found to do no sort of service, but rather

hurt; but in cases where the ulcers are but beginning, the drinking of the weaker ones with milk has been known to do great good. In spittings of blood arising from ulcerations of the lungs, the stronger cold chalybeate waters do nothing but harm; but in the same cases, where the milder kinds are taken warm, and mixed with an equal quantity of milk, they are found to be very beneficial. They must never be taken in cases of dysenteries, in confirmed dropsies, nor where there is a stone in the bladder or kidneys; but in cedematous swellings of the legs and feet they are often found highly useful. In venereal cases, whether recent or of long standing, they do not cure, but they dispose the body more readily to be cured; but in a simple gonorrhoea, where there is no venereal taint, they have been often known to cure, when all other methods have failed.

Preparations for taking them.

All people who are of a plethoric habit ought to be bled before they begin to take them; for by this means there is a freer access given them into the vessels, and they become much more able to correct the whole mass. Persons who are not of a plethoric habit have no occasion to bleed before they take them, but all ought to take a gentle purge to clear the primæ viæ; and to this purpose nothing is more proper than the common purging salts of Epsom, or Glauber's; but all the drastic purges are carefully to be avoided on this occasion, such as scammony, resin of jalap, and the like. If there be indications for vomiting in the patient, such as pains, and a sensation of weight at the stomach, with bitterness in the mouth, nausea, and reachings to vomit, then it is extremely proper to give, a day or two before the beginning of the course of the waters, a gentle dose of ipecacuanha.

Time most proper.

The best hour of drinking them is early in the morning; six or seven o'clock is very proper, because they then have time to finish their operation before dinner, but earlier than this is not so proper; and those who go to the wells or springs at three or four in a morning, are exposed to all the injuries of a cold and damp air, which prevents perspiration, and often brings on coughs and other disorders of the breast and head. It was formerly a custom to drink them in an afternoon, but this is at present left off, as found to produce many disorders of the stomach; and such as are desirous of having the utmost effects of the waters, content themselves at this time of the day with drinking them at home in small quantities, and mixed with wine.

Season most proper.

The summer is the season in which the mineral waters are to be drank with the greatest advantage. The months of June, July, and August, are more proper for the taking of them than any other time of the year; but upon urgent occasions, the course of them may be begun in May, and continue till September; and in some extraordinary cases, the use of them may be allowed even in winter.

Method of taking them.

It is always proper to begin the use of them by small quantities, and gradually increase them to larger. Thus the first day it may be proper to drink about a pint and a half at four draughts; the second day a quart may be drank; and on the third or fourth, three pints; after this the quantity may be increased to two quarts a day, and more than this is not proper to take, unless the person be of a very robust habit; for many people have injured themselves by taking too large quantities. The quantity that is taken as the most the strength will bear, whether it be two, three, or four pints, is to be continued every day for a fortnight or three weeks, or longer, if the nature of the disease requires it; and when the course is to be finished, it must be done in the same manner in which it was begun, by taking less and less every day, till the use is gradually worn off, and no purge or other medicine is necessary afterwards.

The mineral waters in general operate in some constitutions by stool, and in others by urine singly; but in most they operate both ways together. These are both very proper ways of excretion; and whichever nature chooses the waters should pass off by, it is to be judged proper and salutary, and by no means to be checked. If the discharge by urine be plentiful, and the bowels are moved but once a day, it is very well in many constitutions; but where, as in some constitutions, it happens that the waters actually act as astringents in the bowels, this is to be prevented, and a small dose of the common purging salts is to be taken in the first draught of the waters every morning.

In the taking of them, it is to be observed, that they are not to be poured down as it were all at once; for the stomach is often loaded and injured by this; but the first glass should be suffered to pass off, and then, after walking about for ten minutes or longer, a second is to be taken, and so on; and no draught should exceed half a pint in quantity; so that the taking the whole quantity in this manner should be the business of an hour and a half or two hours. After this it is proper to use moderate exercise by walking, or otherwise, till dinner time; and in the mean time, if the waters should pass off by urine or stool, this must be by no means repressed. People who have very weak and tender stomachs, or who have disorders of the breast, and drink the waters in a rainy season, should have them gently warmed before they take them: this is best done by setting a glass of them in a vessel of hot water, and they are only

to be suffered to stand thus till moderately hot, and then immediately drank off; for if heated to too high a degree, they easily lose their virtues by evaporation.

All persons are to regulate the quantity of the waters they drink by the strength of their own constitution; however small a quantity they perceive to be enough, and to operate in the manner they expect, they are to be contented with that, and never to tease nature to make her bear more. It is a certain rule in regard to all mineral waters, that they are much the best when drank at the place, though some of them bear carriage much better than others. It is a necessary caution, that the motion of the body be never violent in the time of taking the waters; for if it produces sweat, it always obstructs, in some degree, their operation by urine or stool; and if flatulencies are troublesome at the time, it would be proper to take candied orange-peel, or some other carminative.

Violent exercise is wrong; but different constitutions will bear different degrees of it; and those of cold and pituitous habits should use considerably more than others. The season of the year is also to be regarded; for the same degree of exercise that is good in a cooler, is too much in a hotter air. The greatest caution, in the course of taking these waters, is to avoid too much sitting still, either after the taking of them, or after meals; for the water remaining in the body, or the food remaining undigested, from these causes, the consequence is, that the patient is subject to flatulencies, colics, diarrhoeas, and pains of the stomach. Sleeping immediately after meals is also improper, as it occasions at this time disorders of the head, and many other complaints.

Mineral waters may be distributed according to their medical properties and effects, under the following denominations.

Chalybeate WATERS

Are those which, beside iron held in solution by means of fixed air, &c. usually contain sea-salt, the fossil alkali, a purging salt, or other substance. See *Mineral Waters supra*.

The learned Mr. Monro has an enquiry into chalybeate waters, in which he considers them with regard to their medical use, in order to discover what their real or comparative strength is, how they bear carriage, and how long they retain their virtues; that physicians may judge which of them is most proper in the various diseases and circumstances of patients; which must be drank at the fountain head, and which may be conveniently drank at a distance from it. For the result of his enquiry, see *Med. Ess. Edinb. vol. iii. art. 7. Abridg. vol. i. p. 126; &c.*

Chalybeate waters have a brisk, acidulous, or vinous taste, when fresh, and tinge the stools with black. Some of them are rarely observed, and some scarcely ever, to give any black tinge to the faeces, though drank in large quantity; a phenomenon, says Dr. Lewis, which, perhaps, may be ascribed to their depositing of their iron in the first passages in an indissoluble and inactive state, rather than to the cause which some have assigned, their carrying it entire into the blood.

These waters taken inwardly strengthen the constitution in general, increase the tone of the fibres, quicken the circulation, and restore a proper consistence to the blood when in a too thin and watery state. And hence they are found to invigorate the whole frame. They are good in diseases arising from weakness; in spasmodic diseases arising from too great irritability and relaxation of the nervous system, in the fluor albus, and gleet; in female obstructions; in hysterical and hypochondriacal disorders; in loss of appetite and digestion; and in a variety of other complaints. These waters are taken to the quantity of two or three pints or more in a day, divided into different doses; and require the same caution in their use, as the artificial chalybeates. Of these waters there are those of Islington, Malvern, Harrowgate, Llandrindod, Tunbridge, Buxton, Spaw, &c. These waters may be imitated by impregnating water, in which iron filings, or wire, have been infused with fixed air; or they may be made according to the directions under *Pyramont and Spa Waters*.

Chalybeate Purging WATERS

Contain a greater proportion of purging salt than any other solid matter, and, therefore, when taken in sufficient quantity, e.g. several pints, they operate by stool; and they have this advantage of other purges, that they do not exhaust the strength. If taken in less quantity as alteratives, they operate chiefly by urine. Of these there are the waters of Scarborough, Cheltenham, Bagnigge, Pyramont, Nevil Holt, Jessop, &c. These waters may be imitated by adding to a gallon of water impregnated with fixed air, two or three ounces of Epsom or other purging salt, and a little sea-salt.

Sulphureous WATERS

Are those which are impregnated either with actual sulphur, or with a phlogiston and an acid, which are the principles of sulphur, whence they derive their sulphureous smell. They usually contain, besides, either the fossil alkali, sea-salt, a purging salt, iron, an earth, or other matter, and commonly several of these in different proportions. It has been a subject of controversy, whether these waters contain sulphur. Dr. Hoffman seems much to doubt of its existence in the greater number of them; and Dr. Lucas has affirmed, that it is not to be found in the form of sulphur in any water whatever; not even in that of Aix-la-Chapelle, where a true and perfect sulphur is found on the upper parts of the conduits through which the water passes; for he says, that, strictly speaking, these

waters do not contain sulphur substantially dissolved in them, but are impregnated with a phlogiston and an acid, the principles of sulphur, which, being in a volatile state, are sublimed, meet on the surface of the conduits, and there unite into a true and perfect sulphur, which did not naturally exist in the water. However, Dr. Rutty maintains the existence of sulphur in mineral waters; and Dr. Shaw and Dr. Short are said to have found sulphur in Harrowgate water.

Notwithstanding the testimony of such eminent persons, the more recent opinion of a physician, whom Dr. Monro consulted in 1768, is against the existence of sulphur in such waters; to this purpose, he says, that he has never observed any appearance of sulphur in the Harrowgate waters, nor any scum at the top of the well; and that he could not find any person in the neighbourhood who remembered the appearance of real sulphur sublimed, upon taking up the stones at the bottom of the well, as mentioned by Dr. Neale.

Dr. Watson, in 1780, examined these waters, and found a crust adhering to the circular stone, contiguous to the surface of the water, a portion of which, being scraped off, and put on a hot iron, burned with the flame and smell of sulphur; whence it may be inferred, that something is sublimed from the water, which either of itself is sulphur, or which, in conjunction with the air, or some other principle, constitutes sulphur. This ingenious writer mentions the following experiment, which throws no considerable light on the impregnation of sulphureous waters in general. The acid of vitriol does not act upon the common Derbyshire lead ore, except when it is assisted by heat; it then dissolves it, and a great escape of air is observed; he made this air, discharged from the ore, pass through a high bended tube into a bottle full of pump-water; the water, in a little time, acquired the fetid smell of Harrowgate water; its taste was the same as that of such sulphureous waters as contain no salt; it was perfectly transparent, but in the course of twenty-four hours became cloudy, and lost most of its smell; it did not suffer any precipitation by the addition of the acid of vitriol; silver was blackened by being put into this water, and by being exposed to the vapours which arose from it; from all these circumstances, it may properly enough, he thinks, be called an artificial sulphureous water.

The same phenomena were observed by using black jack instead of lead ore; and air of the same kind may be separated from other substances, and by other means, as well as by the acid of vitriol; and it seems very probable, that the waters usually called sulphureous are impregnated with this kind of air, which has been separated in the bowels of the earth, from particular minerals, especially sulphureous ones; and it has been remarked of Harrowgate water, that as it springs up it is clear and sparkling, and throws up a quantity of air bubbles.

Dr. Watson suggests the following simple method of impregnating common water with the sulphureous properties of Harrowgate water: put into a phial, holding four or five ounces, some pounded lead ore, and pour upon it some acid of vitriol; wrap a few folds of wet linen round one end of a bended tube; insert this end into the neck of the phial so closely, that no air may pass out of the phial except through the tube; the end of the tube being at some distance from the surface of the acid. Put the other end of the tube into a bottle full of water; and by setting the phial on the hot bar of a grate, or by some other means heat the acid, which, as soon as it is heated, will begin to act on the lead ore, and a great quantity of air will be discharged, which will pass through the tube into the water in the bottle, and in a few minutes the water will be impregnated with the sulphureous properties of Harrowgate water. In order to make the resemblance complete, the salt which sulphureous waters severally hold should be added in due proportion to the water impregnated with the air.

There is another way in which the impregnation of waters with sulphur may be supposed to arise, which will account for the saline taste as well as the smell of the water. Water extracts from the ashes of sea-wrack burned to a black coal, not only a great quantity of common salt, but something else also, by which, without losing its transparency, it acquires both the smell and sulphureous taste of Harrowgate water, and by which it is enabled, like that water, to blacken silver and white paint. This something Dr. Watson is sensible may be what the chymists call liver of sulphur, or an union of sulphur with fixed alkali; no sulphur, however, can be precipitated from the water by the acid of vitriol, though that acid turns it, as is the case with Harrowgate water, a little cloudy.

The air extracted from iron, by the acid of sea-salt, impregnates water with a smell resembling that of Harrowgate water, but its difference both from the natural and the artificial sulphureous waters may be easily distinguished, especially after the water has stood a few hours exposed to the air. See *Watson's Ess. vol. iii. Ess. 6.* See also *Falconer's Ess. on Bath Wat. vol. i. p. 103, &c.* It appears from the experiments and observations of Bergman, that a real sulphur is contained in sulphureous waters, in a state of perfect solution; and that it may be precipitated from them by the nitrous and dephlogisticated marine acids, and likewise, but more slowly, by the atmospheric air. Hence, as air, as well as the nitrous acid, has the property of decomposing these waters: when the natural sulphureous waters come in contact with the external air, the latter, according to Bergman, seizes the phlogistic principle

which kept the sulphur dissolved in water; and thus in time are formed those sulphureous cruils, which, as well as even the presence of actual sulphur in these waters, have been the subjects of so much controversy among the chymists.

Dr. Macbride has suggested a method of impregnating a spring with sulphur, in its pure state in the way of solution. He made a solution of sulphur in water by means of quick-lime, and by injecting currents of fixed air upon the surface of it, found the calcareous earth to precipitate, leaving the sulphur to dissolve in the water. Bergman (Phil. and Chym. Ess. vol. i.) informs us that the process of imitating the warm sulphureous waters consists simply in adding the vitriolic acid to hepar sulphuris, and impregnating water with the peculiar species of air that arises from this mixture. This hepatic air (part of which is fixed air, proceeding from the salt of tartar) is very readily absorbed from water; to which it gives the smell, taste, and other sensible qualities of the sulphureous waters. A Swedish cantharus of distilled water will absorb about sixty inches of this hepatic air; and on dropping it into the nitrous acid, it will appear that a real sulphur is contained in a state of perfect solution in this water, to the quantity of eight grains.

The saline or other contents peculiar to the sulphureous water to be imitated, must be added to the artificial hepatic water. Instead of the liver of sulphur, the operator may use a mixture of three parts of filings of iron, and two parts of sulphur melted together. The liver of sulphur, for impregnating water with sulphureous air, and thus imitating the sulphureous mineral waters, may be prepared by mixing together equal parts of brimstone and of clean pot-ashes, or quick-lime well burnt, and placing them in a crucible, or unglazed dish, over a gentle fire; stir them up with a stick till they are incorporated into a blood-red mass; and put it, while warm, into a bottle which is to be kept well closed. Then to make the sulphureous water, put a sufficient quantity of this substance, with oil of vitriol and water, into that part of the apparatus used for making Pyrmont water, and proceed as in impregnating water with fixed air; the sulphureous air will arise; the water in the middle vessel will be impregnated with it, will smell strongly sulphureous, and resemble the celebrated waters of Aix la Chapelle, &c. The water thus impregnated may be heated by putting it into a close vessel, placed in one that contains boiling water; and it is then a warm sulphureous water.

If it be not immediately used, it should be preserved in stone or glass bottles, well corked and cemented, and placed with the corks downwards in a cellar. As the cold sulphureous waters contained both fixed and sulphureous air, a mixture of liver of sulphur and chalk may be put into the vessel with the oil of vitriol, by which means both these airs will be produced, and the water of course will be impregnated with them.

Sulphureous waters are diuretic and strongly diaphoretic, and are, therefore, good in cutaneous diseases, used both internally and externally. They are also good in chronic obstructions; and in disorders proceeding from acidity, from worms, &c. Of these are those of Harrowgate, Llandryndod, Moffat, Aix la Chapelle, Bath, Matlock, &c. The sulphureous purging waters differ from the former, as they contain a purging salt as the principal solid ingredient, and therefore operate by stool. They are good in the same disorders as the alterative sulphureous waters, and also for foulnesses of the bowels, &c. Some of the Chalybeate purging waters are also sulphureous.

Symptoms attending the taking of these WATERS.

These are of many kinds, and differ greatly from the same waters drank at the same season, in persons of different habits and constitutions. One of the most common is a binding of the bowels; and from this there often arise pains in the bowels, colic, and vomitings, with other the like disorders. People of melancholy, hypochondriac, and hysterical habits, are more subject than any others to this complaint from them: this is a symptom easily removed by any of the mild cathartics, and nothing in particular is more proper for that purpose than a decoction of senna, tamarinds, and rhubarb, to be taken a few spoonfuls at a time, as occasion shall require. A small dose of the cooling salts may also be taken, but all the hot and resinous purges are apt to occasion hypercathartes. On the other hand, some are thrown into a diarrhoea by them, and this is often a salutary symptom: and while the patient's strength is unhurt, and he is not found to suffer any great inconvenience from it, this is by no means to be checked; for very often the patient is greatly relieved by a copious discharge of the noxious humours this way, and, by a continuance in the same course, becomes absolutely cured by this means: but when the person is perceived to be greatly weakened by this symptom, and it is attended with nausea, vomitings, and pains in the bowels, it must be carefully checked or restrained. This is often done by drinking the same waters in a smaller quantity, and warm instead of cold; but if this does not prove sufficient, small draughts of cinnamon-water are to be allowed, and, if necessary, small doses of diacordium every night. In cases where the waters take this turn violently, it is proper to abstain from them for some days, and then to take to them again with great caution, and in small quantities.

Some persons, on their first entering on a course of the mineral waters, are thrown into vomitings by them; and these are sometimes salutary, sometimes merely symptomatic. If it be salutary,

the person is always the better for it, and the noxious humours are very happily attenuated and discharged this way by the waters: in this case, all the caution necessary is not to drink too much of them at a time, and sometimes, at intervals, to take a little of some bitter tincture. But if, on the contrary, the patient is greatly weakened by this vomiting, the method is to drink smaller quantities, and to eat and drink more sparingly at meals. Sometimes this symptom arises from a redundancy of bile, or of pituitous humours from the stomach and bowels not having been emptied by a purge before the entering on the course; in this case a gentle purge is to be given, and after that the common strengthening and bitter stomachics, and the waters are afterwards to be cautiously taken in small quantities.

When the patient is attacked with violent colic pains, and the common method of eating candied orange-peel, and the carminative feeds, does not take effect, a gentle purge is to be given to evacuate the humours which occasion them, and after this, tincture of cardamon seeds, or some other such carminative, usually takes effect. In cases where the pains are more violent and obstinate, a glyster of camomile flowers, boiled in milk, with a little sugar, may be given at times, and the waters afterwards must be drank in small quantities and always warmed.

If an immoderate flux of the menses or hæmorrhoids should happen during the time of taking the waters, it will be proper to abstain from the use of them on that occasion for a few days; but if these evacuations are in a moderate degree, the waters may be continued, only taking them in a smaller quantity, and not quite cold. Sometimes intermittent fevers come on while persons are drinking the waters; but these are not to be regarded as any very bad case; for if the use of the waters be continued, and the carminatives and bitters of the common kind taken at times with them, they are usually soon cured. Pains of the gout, rheumatism, sciatica and teeth, also sometimes return upon people accustomed to them, while they are in a course of the waters; but these are not to be greatly regarded; for they usually go off again very easily, only by continuing the use of the waters, and require no peculiar care; only, during the time the pains last, some comforting cordial may be taken at times; and if they are violent, a few drops of laudanum may be taken every night going to rest, or a few grains of the storax pill. See Heister's Compend. Medic. Pract. cap. 20.

Hot WATERS, called *Thermæ*, arise from the admixture of sulphureous particles and fumes, &c. Of these, the hottest is that of Japan, which, it is said, no fire can bring water to equal; and which keeps hot thrice as long as common water boiled. The cause of the heat of these waters may be, in some instances, subterraneous fire; in other cases the heat arises from the mineral ingredients with which they are impregnated in their passage; and the same may be said of those waters that are cooler than the common temperature of the atmosphere.

Thus it is known, that quick-lime, the pyrites stone, and other substances, thrown into water will make it warm: on the contrary, salts of various kinds make it colder than before. The warm waters possess many of the virtues and properties of cold waters, which are impregnated in the same manner; but they are in many cases preferable, as by their warmth they are more agreeable to the stomachs of weak persons, and promote perspiration. The warm waters are also used as warm baths; which, by restoring the fibres, are useful in many disorders arising from rigidity, spasm, &c. Hence is derived their great use in rheumatism, inflammations, colicness, &c. The cure is commonly assisted by the internal use of those waters at the same time. For complaints at a particular part of the body, the part is either fomented with the warm water, or the water is pumped upon the diseased part. There are also contrivances for converting these waters into steam or vapour; hence called vapour baths. Baths are likewise made of the mud formed at the bottoms of these waters, and they have been serviceable in removing pains and aches; and paralytic and other complaints; the mud being either rubbed on the part, or the part immersed in it. When the mud is collected in quantity in a reservoir for these purposes, it is called the mud-bath.

Boiling, or Bubbling WATERS, are produced either by a current of air, or else by a sulphureous, or a nitrous spirit, mixed with the water in the earth: if it be sulphureous, the water is hot; if nitrous, cold. For all the waters that boil, as if hot, are not so; but some few are cold: we read both of thermæ and acidulæ that boil. See **Boiling SPRINGS**.

Poisonous WATERS are occasioned by their creeping through arsenical, antimonial, and mercurial earths; or being impregnated by their fumes. Such are the lacus Asphaltites, and divers waters about the Alps, &c. which immediately kill those who drink of them; but these are most of them filled up with stones; which is one reason why so few are known.

Saline WATERS are generated two ways; either they are derived from the sea, by some subterraneous passage; or they are generated from mineral salts, which they meet with in their passage before they arrive at their springs.

Acidulous, or Saline WATERS, contain the fossile alkaline salt. This salt, as the waters are taken from the fountain, is saturated, or rather super-saturated, with fixed air. Hence the waters do not then manifest any alkaline quality; on the contrary

trary, they curdle with soap, and are termed **ACIDULE**. This fixed air, however, being very volatile, soon exhales when the water is heated, or stands for some time exposed, and then the alkali manifests itself. For the general virtues of this water, see **SELTZER Water**. Of these waters there are those of Seltzer, Tilbury, &c. These waters may be imitated, or even excelled, by simply impregnating water with fixed air; and the solid ingredients may be added in the proportions directed under **SELTZER water**.

Saline Purging WATERS are impregnated with sea-salt, and also with a purging salt; either the calcareous Glauber's or the Epsom. They differ in strength: some of them purge sufficiently in the quantity of a pint, while 2, 3, 4, 5, or 6 pints of others are necessary to produce that effect. Some again are so weak as to require the addition of Glauber's salt or other purgative. In small quantities they act as diuretics and alteratives. They are good in scrophulous and scorbutic complaints, ulcers, and other diseases, which make their appearance on the skin, and are likewise used at baths and fomentations in these and other disorders. The virtues of the preceding class of waters depend, in a great measure, on the presence of their fixed air. The waters of this class seem to derive their virtues principally from the saline matters which they contain. Of these waters there are those of Lymington, Dulwich, Holt, Streatham, Kilburn, Bagnigge, Acton, Epsom, Llandrindod, Seidlitz, Sea-water, Dog and Duck, Sydenham, &c. A purging water, answering, perhaps, all the intentions of these, may be made by impregnating three ounces of Epsom, Rochelle, or Glauber's salt, in a gallon of water with fixed air.

Vitriolic WATERS are impregnated with green vitriol or copperas, and strike a black colour with galls. They are chiefly used outwardly for washing old sores, and frequently with good effect. In some cases, they are taken inwardly in small doses, and then they prove emetic and purgative. But this, says Dr. Lewis, is a practice too hazardous to be followed. See **VITRIOLIC Waters**.

Aix-la-Chapelle WATERS arise from several sources, which supply eight baths constructed in different parts of the town. In smell, they resemble the washings of a foul gun; their taste is saline, bitter, and urinous; their heat is upwards of 100° of Fahrenheit's thermometer; their general operation is by stool and urine, and they also promote perspiration. As an alterative, it is, in general, best to begin with a quarter or half a pint in the morning, and afterwards increase the dose to pints, as may be found convenient. When it is required to purge, it should be drank in large and repeated draughts. With regard to bathing, it is best to begin with the temperate baths, and to increase the heat gradually. These waters are efficacious in diseases proceeding from indigestion, and foulness of the stomach and bowels, in rheumatism, in the scurvy, scrophula, and diseases of the skin, in hysteric and hypochondriac disorders, in nervous complaints and melancholy, in the stone and gravel, in paralytic complaints, &c. They ought not to be used in hectic cases with heat and fever, in putrid disorders, for where the blood is dissolved, or the constitution much impaired. An artificial water of this kind may be made by impregnating half a dram of sea-salt, a dram of soluble alkali, a scruple of clean chalk, and a gallon of water with sulphureous air. As the properties and effects of the British medicinal waters are so generally interesting, we shall here introduce all those which have not been noticed in the course of the alphabet.

Bath WATERS.

Bath waters, are the warm chalybeate waters of Bath in Somersetshire, which have long been used both internally and externally, and extolled for their medical efficacy in a great variety of disorders. Of the six baths, which are supplied from different springs with waters of the same nature, the principal are the king's bath, the queen's bath, the hot bath, and the cross bath. The temperature of these waters has been variously estimated: Dr. Falconer states the heat, as they are commonly drank, of the king's bath at 116°, of the hot bath at 116°, of the cross bath at 112°, and that of the queen's bath about the same with the cross bath.

The water, when viewed in the baths, has a greenish colour; but in a phial, it appears transparent and colourless, and it sparkles in the glass. It has a light saline, agreeable pungent, and light chalybeate taste. Dr. Falconer thinks that the king's bath possesses the two last qualities in the greatest degree, though others ascribe their prevalence to the hot bath; and the chalybeate impregnation is most observable in the waters of the king's bath. Both the chalybeate taste and pungency go off entirely on the cooling of the water, but are retained for the longest time by the water of the hot bath; and in this case, the saline taste becomes more manifest. Some have ascribed a sulphureous smell to these waters, especially when the baths are filling: but Dr. Falconer could not discover any particular smell either in the waters themselves, or in the vapours arising from them.

As the water rises from the pump, it contains fixed air, or other volatile acid, in a sufficient quantity to curdle milk and dissolve iron; it is also highly impregnated with sea-salt.

Dr. Falconer infers from a variety of experiments, that Bath water contains the following ingredients, viz. saline bodies, some of which are simple, as vitriolic acid per se, the existence of which, however, is very dubious, and others compound, as common salt in a small quantity; inflammable bodies, as hepar sulphuris cum

calce viva, in large quantity; metallic bodies, as iron, in the proportion of one thirty-seventh and a half of a grain in a pint of the water, and lead, which he suspects to be an accidental impregnation; earthy bodies, as selenites, in large quantity; and aerial bodies, as common air, probably both in solution or mixture of diffusion, and mephitic air in large quantity.

The primary qualities of the Bath waters, enumerated by Dr. Falconer, are the following: they are stimulant, astringent, diuretic, diaphoretic, antispasmodic, and antiseptic. This stimulant quality is manifest in their heat, brisk, and poignant taste, and, if largely taken, inebriating effects; as well as by their effect in accelerating and raising the pulse, increasing the heat of the body, exciting the secretions; and besides they possess, as he apprehends, a stimulus of a peculiar nature, principally affecting the nervous system, and not to be measured altogether by the pulse, heat, or increase of secretions. This stimulus is indicated by the glowing sensation in the stomach perceived in drinking them, the sudden increase of strength often procured by their means, and the pain of the head consequent on taking too large a quantity. This stimulant quality is least observable in the cross bath water, and most considerable in that of the king's bath; and it is ascribed by Dr. Falconer principally to their impregnation with fixed air. The astringent quality of Bath waters is evinced by the costiveness commonly attendant on them; and their effects in restoring the tone of the stomach and bowels may be probably owing to this quality. The king's bath is most remarkable for this quality, and the hot bath is generally thought to have the least of it.

The diuretic quality of these waters, which Dr. Falconer attributes principally to their fixed air, is well known; and they possess this quality, that of the cross bath being thought to be the most considerable, with no peculiar stimulus in either the secretory or excretory organs of urine. The diaphoretic quality of Bath waters seems to be owing to the same cause with the former; and Dr. Falconer apprehends it is more prevalent in the king's and hot baths than in the cross bath. Their antispasmodic quality, possessed in the greatest degree by the hot bath, is obvious in their efficacy in several spasmodic and nervous cases: and Dr. Falconer thinks it is chiefly owing to the aerial part of their impregnation, which seems to possess qualities at once stimulant and sedative, which is the foundation of most antispasmodics.

The antiseptic quality of these waters has been demonstrated by experiment, and this is also ascribed to fixed air, which is known to be a powerful preventer and corrector of putrefaction; both which qualities seem to be possessed, in some degree, by the Bath waters; the king's and hot baths being more largely impregnated with fixed air than the cross bath, possess this antiseptic quality in a much greater degree than the other.

Bath waters possess also several secondary qualities: in this respect they are attenuant, antacid, cathartic, expectorant, sialagogue, and emmenagogue.

As stimulants, these waters are indicated in cachectic disorders; as the chlorosis incident to women, obstructions of the viscera, oedematous swellings succeeding fevers, or fits of the gout: in paralytic disorders, arising from the bilious colic, fumes of metallic substances, or fits of the gout or rheumatism; and also in such paralytic complaints as occur in weak habits, and in consequence of low diet, damp situations, &c. These waters are also of special service in the apoplexy, lethargy, and other similar disorders. Their efficacy, as stimulants, is also very considerable in all disorders that depend on the inertia of the organs of digestion, and in restoring the stomach to such a degree of tone as enables it to send the food from the noble parts into the extremities.

The Bath waters, as astringents, are indicated in debility and laxity of the moving fibres, as the rickets; in weaknesses succeeding large evacuations either of blood, stool, or perspiration; in restraining evacuations by stool and by the urinary passages, as in the diarrhoea and diabetes, and also that disposition to perspiration which sometimes attends people of a lax and irritable habit, and likewise the fluor albus, and involuntary seminal evacuations.

The diuretic power of these waters renders them peculiarly serviceable in dropical disorders, many of which have been cured by them in their last stage; also in leprosy, scrophulous, and scorbutic complaints; and in discharging gravelly concretions from the kidneys and bladder.

By their diaphoretic quality, they stop or moderate habitual laxities of the bowels; and relieve violent reachings: they are serviceable in the diabetes, partly by changing the tendency of the fluids from the urinary to the perspiratory secretions; and have been found an efficacious remedy in that kind of dropy which arises from the check given to perspiration by sudden changes of climates: they are also of great service in cutaneous eruptions, occasioned by obstructed perspiration, and generally affecting the face; in that kind or stage of the rheumatism, which is not attended with any considerable degree of fever or inflammation; and in allaying the pain and carrying off the paroxysms of the gout.

Bath waters, by their antispasmodic quality, are of the greatest service in hysteric and hypochondriac complaints, arising from a weak stomach and digestion; in the hysteric colic and bilious vomiting; in the colic of Poitiers, commonly called the dry belly-ach; in isterical complaints, by relaxing the spasmodic constriction of

W A T

of the biliary ducts and opening a passage for the bile, and promoting the discharge of gall-stones; and in removing those menstrual obstructions which occur at an early period of life, and in hysterical constitutions: they are also, by their antispasmodic property, often peculiarly serviceable in the gout, when it attacks the stomach.

The efficacy of these waters in cutaneous eruptions, attendant on a scorbutic habit of body, may probably be owing, in some degree, to their antiseptic quality correcting the putrid tendency of the humours of the body; and also in cachectic complaints, and many other cases of debility, which these waters relieve.

In some cases, however, Bath waters are hurtful; as in hectic fevers; in suppurations of the lungs; in all cases of inflammation; in hæmorrhages; in plethoric habits; in confirmed obstructions of the abdominal viscera; and in cases, where the solids are very tender and friable, and the fluids very thin and acrid, which sometimes take place in a high degree of the scurvy.

It may be observed, in general, and with allowances for different constitutions and other circumstances, with regard to the choice of these waters, that in disorders to which the stimulant, astringent, and antiseptic qualities of the waters are adapted, it will be most proper to make trial of the king's bath water: those for which their diaphoretic and antispasmodic qualities are recommended, will be most likely to find relief from hot bath water: and where large dilution is required, as in some glandular cases, and the urinary secretion is to be promoted, the use of the cross bath will be most advisable.

As the fixed air and chalybeate impregnation of these waters are liable to be soon dissipated and destroyed, it will be most advisable, in cases where their stimulant and astringent effects are desired in their full extent, to drink them at the fountain-head.

In leprosy and cutaneous disorders, where the effects of the waters depend not so much on the stimulant as on the diaphoretic and diuretic qualities, which are more permanent, they may be drank more at leisure and at a distance from the pump, when their heat is abated: but the water should never be suffered to stand so long as to cause any precipitation, which would alter its nature.

In all cases where the Bath waters are meant to act as restoratives, they are best drank fresh at the spring; and their effects may be moderated by lessening the quantity. Dr. Falconer is of opinion that these waters can serve very few useful purposes in medicine, when used at a distance from the spring; their impregnation with fixed air being thus destroyed, and the chalybeate and sulphureous ones nearly so.

These waters being of a heating nature, it is usual, previous to a course of them, to cool the body by gentle purges, by a low diet, and if necessary by bleeding.

As to the quantity to be taken of these waters, it was formerly much greater than in the present practice. Guidott mentions three pints a day as the smallest quantity commonly taken, and recommends, in some cases, even eight pints a day. But the quantity which he advised as the smallest, is now scarce ever exceeded. Dr. Falconer thinks that, in general, these waters, when exhibited with a view to their stimulant or astringent qualities, might be properly taken by adults from two thirds of a pint to two pints in a day: but with reference to their diuretic, diaphoretic, or antispasmodic qualities, and when the patient is advanced in life, and of an inert habit, and they are used at a moderate season of the year, he would not advise to exceed from 1 pint to 2½ or 3 pints in 24 hours.

In cases where the waters are used as diluents, and for washing out the lymphatic system, as in many glandular and cutaneous disorders, when there is no danger of an inflammatory complaint, the season moderate, and the less stimulant water used, as that of the cross bath or even hot bath, and some of its stimulant qualities allowed to evaporate; the water may be safely drank from 1 to 3 quarts, or even more in a day. However, it is always best to begin with small quantities, as half a pint, or ¾ of a pint in a day, and increasing to any quantity that may be thought proper. And the quantity taken should be divided into small doses, and taken at proper intervals. It has been the general custom to drink the whole quantity prescribed before dinner; viz. ¾ of it before breakfast, between eight and ten, and ¼ at noon. Some have repeated them again in the interval between dinner and supper; and a glass of the water has been beneficially taken going to bed.

As to the season of the year best adapted to the use of Bath waters, this was formerly confined to the summer months; and since that time the colder seasons have been preferred. Dr. Falconer thinks they are more likely, in general, to produce good effects in a warm than a cold season; especially in cases where their stimulant and diaphoretic qualities are likely to be serviceable. In cases where they are meant to act as restoratives in debilitated habits, in which their astringent and antispasmodic effects, joined to a moderate degree of stimulus, would be desirable, a more moderate season would be advisable.

Dr. Falconer is of opinion, that the Bath waters when required to act as stimulant, as in weak low cases, especially of the paralytic kind, are in greatest perfection in the warmest seasons, as in the latter part of June, July, and the beginning of August; when a moderate degree of stimulus is required, and their diaphoretic effects desired to be promoted, the latter part of May and beginning of June, and from the latter part of August to the end of September,

W A T

are more proper; and when they are used with an intent to promote the urinary evacuations, as mild diuretics, in gravelly complaints and urinary obstructions, the months of March, April, and beginning of May, and the month of September and beginning of October would be preferable.

The usual season is in April, May, and June; and in August, September and October. The course of drinking these waters, as stimulants should be, in general, from three weeks to two months; when given with a diaphoretic, antispasmodic, or antiseptic intention, they may be continued, with occasional intermission, from six weeks to three months; as diluents in glandular disorders, and as gentle diuretics, they may be drank, with occasional intermission, from two to six months.

The course of drinking these waters is usually continued for a month or six weeks; and the quantity toward the close should every day be diminished, as it was increased at first. The patient in the use of these waters, should live upon a light diet, easy of digestion; use proper exercise; go early to bed, and rise betimes in the morning.

These waters are also used externally in a variety of disorders with good effect; either by bathing or pumping, as occasion may require, especially if used inwardly at the same time. The efficacy of bathing in paralytic cases has been long and generally acknowledged; it has also been of great service by its stimulant quality in the chlorosis, in cachectic disorders, in the jaundice, in the hypochondriac disease, and in cases of barrenness; as antispasmodic, it has been very efficacious in the colica Pictonum, hysterical colic, asthma, jaundice, menstrual obstructions, preventing abortion, nervous diseases, as the epilepsy, St. Vitus's dance, the hysterical and the hypochondriac disease, the nervous head-ach, particularly the hemiplegia, spasmodic vomiting, nervous atrophy, muscular contractions, and paralytic contractions of the extremities: as diaphoretic, the Bath waters have been much celebrated in the common rheumatism, where the inflammatory disposition is very slight, and yet the pain and other symptoms grievous and of long duration; especially towards the decline of the paroxysm; and in those rheumatic pains which sometimes accompany the colica Pictonum; in every variety of the gout, and the complications of it with many other disorders: in the scurvy, provided that bathing be not used if the putrid disposition should be so strong as to form external ulcers; in the venereal disease; in the colic; in habitual diarrhoeas; in the diabetes; and in the leprosy; as diuretics, Bath waters are useful in liver complaints: in cutaneous disorders; in the calculus; as expectorants they have been also of service in gouty coughs, by promoting a beneficial discharge. The external use of these waters is improper in continued fevers, local inflammations, both internal and external, in hæmorrhages, in immoderate menstrual discharges, in plethoric habits, in diarrhoeas attended with fever, or an extreme degree of irritability, in obstructions of the viscera, and in cases of extreme weakness.

As to the choice of the several baths, Dr. Falconer observes, that as a stimulant, in paralytic cases, the hottest part of the king's bath or the hot bath is preferable; as an antispasmodic, in the tetanus, hypochondriac complaints, and other nervous diseases, the cooler parts of the king's bath or the queen's are more proper; when a mild diaphoresis is desired, the queen's or cross baths are most effectual.

The time of stay in the bath is at present from ten or even five minutes to an hour. As a stimulus, e. g. in the palsy, the common time is from fifteen minutes to half an hour; as an antispasmodic, a longer stay is in general advisable: when the baths are used with a diaphoretic intention, a pretty long stay is generally thought necessary, in order to procure a copious evacuation by sweat. After bathing the patient goes to bed for a short time to compose himself and cool gradually, rather than for the sake of promoting any evacuation by the skin.

The time of the day for bathing has, in the public baths, been by immemorial custom fixed between the hours of five and nine in the morning; however, the abbey baths may be had at any hour of the day, filled with fresh water for every person that uses them, of nearly the same heat and quality with the king's bath water.

Formerly, the use of the Bath waters, as well externally as internally, was confined to the summer months: but for many years past, the colder, or rather more moderate seasons, as the spring and autumn, have been preferred.

It is the common practice to bathe from one to three, or four times a week; but the time of its being continued and the frequency of its being repeated must depend on the nature of the case.

During a course of bathing, attention should be had to the regimen, to the tranquillity of the mind, to exercise, and to a moderate laxity of the bowels.

When the complaint is local, pumping is generally preferred to bathing: in this case, the water is hotter than that of the bath: the stream of water is generally directed to the limb or part affected, and sometimes to that part of the spine, where the nerves that supply the place affected issued forth. In this way the Bath waters are used with great success in the palsy, in reducing dislocations of the vertebrae, in relieving contractions of the limbs, in discharging incipient white swellings, in nervous cases, in fits of the gout, and rheumatic complaints; and in the tinea capitis, or scald-head.

Pumping

W A T

Pumping and bathing are often used at the same time; the mud and scum of these waters have been also applied, with good effect, by way of poultice, in hard swellings, weak joints, contractions of the limbs, scald heads, running ulcers, &c. and herbs are sometimes boiled with them in the Bath water, to a proper consistence, for such purpose. See Falconer's *Ess.* on the Bath Waters, vol. i. and vol. ii. passim.

Bristol Waters.

Bristol waters are obtained from springs, known by the name of the hot wells. These waters at their origin are warm, clear, pulchrid, and sparkling; and if left to stand in a glass, covers its inside with small air-bubbles. They give no scent, and are soft and agreeable to the taste. They raise the thermometer from about 79 to 80°. They contain an earthy matter, suspended by means of fixed air, together with sea-salt, and a species of Glauber's salt, in small quantities.

Dr. Guiddott asserts that the Bath and Bristol waters are of the same virtues, but in a different degree; that both are impregnated with the same principles, but the Bath waters containing a much greater share of them, are therefore capable of doing that in a little time which those of Bristol could only do in a much longer. But this seems to be far from a true state of the case. The Bristol waters are supposed by many to be a modern discovery, and their use but of late date, but this is a very erroneous opinion. Dr. Vener, more than a century ago, has written professedly of them, and given them their true character, and proper commendations in all the diseases in which they are at this time found effectual, the diabetes only excepted, in which their use has not been known so long. They were not indeed, much frequented at that time, nor for some years afterwards; but that was merely from the want of the necessary accommodations at the place. Dr. Maplet, in the year 1639, wrote largely of their virtues, particularly in disorders of the urinary bladder and kidneys, and adds great praises of their external efficacy in curing cancerous ulcers; but, with all this praise, they never came into an universal repute, till their character was established by Dr. Mead and Dr. Lane.

These waters have been recommended in a variety of disorders; in consumptions and weakness of the lungs; in cases attended with hectic fever and heat (in which, beside other properties, they differ from the Bath waters); in uterine and other internal hæmorrhages, and immoderate discharge of the menses; in old diarrhoeas and dysenteries; in the fluor albus; in gleet; in the diabetes, for which some have extolled them as a specific; and in other cases, where the secretions are too much increased, and the humours too thin; in the stone and gravel; in the strangury; in colliquative sweats; in scorbutic and similar cases; in cholics; in the gout and rheumatism; in loss of appetite and indigestion; and in many other diseases. The usual method of drinking these waters is a glass or two before breakfast, and at about five in the afternoon: on the next day, three glasses before breakfast, and as many in the afternoon, which quantity is to be continued during the patient's stay at the wells. A quarter or half an hour is allowed between each glass. A course of these waters requires no other preparation, than to empty the bowels by some gentle purge; and, if heat or fever requires, to take away a few ounces of blood. Costiveness should be avoided. Externally they are useful in sore and inflamed eyes; in scrofulous and cancerous ulcers, and in other similar cases. They are cooling, and quench the thirst; they are best drank at the spring head; but will bear carriage tolerably well. The time of drinking the Bristol waters medicinally is from April to September. Elliot on Min. Wat. p. 114.

Buxton Waters.

The waters of the medicinal springs near Buxton, in the Peak of Derbyshire, resemble those of Bristol. These waters are the hottest of any in England, except those of Bath.

The Buxton waters break out in many places thereabouts; what is called Buxton bath takes in several warm springs. Thirty-two yards north-east of this, is St. Anne's well, which is chiefly supplied from a spring on its north side. Twenty yards south-east of St. Anne's, in another close, is a place where a hot spring and a cold one rise in the same receptacle. About sixty-three yards south-east of this, is that called Bingham's well, called also Leigh's water, from the great benefit a neighbouring gentleman of that name received from it. A little way east of this is another; and in the streams in the level that carries the water from the bath, there rises another very plentiful one; and about four yards farther east there arise three or four other small ones. From this account, it may easily be conceived that there can be no great difference between the waters of these several springs, though on trials they seem to yield different portions of salts and sediments: at the utmost, their difference can be only in degree. They contain calcareous earth, together with a small quantity of sea-salt, and an inconsiderable portion of a purging salt: but no iron can be discovered in them.

These waters, taken inwardly, are esteemed good in the diabetes; in bloody urine; in the bilious colic; in loss of appetite, and coldness of the stomach; in inward bleedings; in atrophy; in contraction of the vessels and limbs, especially from age; in cramps and convulsions; in the dry asthma without a fever; and also in

W A T

bartenness. Inwardly and outwardly, they are said to be good in rheumatic and scorbutic complaints: in the gout; in inflammation of the liver and kidneys, and in consumptions of the lungs; also in old strains; in hard callous tumours; in withered and contracted limbs; in the itch, scabs, nodes, chalky swellings, ring-worms, and other similar complaints. As to the difference of age and sex in patients, there is little caution required in the drinking of them, except that they should be taken more sparingly by young people, between the ages of twenty-three and thirty, if very full of blood and juices, and by women with child in their first and last months. As to the method of using them, except the body be collic, and the first passages furred up with gross humours, it is not only unnecessary, but hurtful, to prepare the body for them, as it is called, by purging; or at least by any stronger purges than manna, cream of tartar, and the like. The heat of Buxton waters, in frosty weather, is equal to that of common river-water with which two-fifths of boiling water have been immediately mixed. Beside the hot water, there is also a cold chalybeate water, with a rough iron taste. See Short's *Hist.* of Mineral Waters. Elliot on Min. Waters, p. 118.

Cheltenham Waters.

Cheltenham waters are some of the best and most noted purging chalybeate waters in England: the springs of which are at Cheltenham near Gloucester. The dose is from one pint to three or four: they operate with great ease, and are never attended with gripings, tenesmus, or straining at stool. They are best taken a little warm: they create an appetite; are excellent in scorbutic complaints: and have been used with success in the gravel.

Tunbridge Waters.

Tunbridge waters are the most famous chalybeate waters in England. The wells are situated about five miles from the town of Tunbridge in Kent. This is a brisk, light water, has a ferruginous taste, and contains also a little sea-salt: exposed to the air, it soon loses its virtues; as it does also in a few days in bottles. It is sometimes usual to mix with the first glass of the water, taken in the morning, either a little common salt, or some other purging salt, in order to make it operate by stool: with a foul stomach it is apt to cause a vomiting. The Tunbridge water is chiefly resorted to in June, July, and August; and is recommended in all the disorders in which the celebrated Spa waters of Germany are serviceable: as it possesses the same virtues, though in a weaker degree.

Matlock Waters.

Matlock waters are warm waters supplied by several springs at Matlock, in Derbyshire, in their nature resembling Bristol water, except that they are very slightly impregnated with iron, and in their virtues similar to those of Bristol and Buxton. The baths are recommended in rheumatic complaints, cutaneous disorders, and other cases where warm-bathing is serviceable.

Harrowgate Waters.

Harrowgate waters are the waters issuing from four springs at Harrowgate in Yorkshire: as they spring up, they are clear and sparkling, and throw up a quantity of air-bubbles; they have a strong scent of sulphur, and a salt taste, as they contain a considerable quantity of sea-salt, together with a little purging salt; they are purgative, the dose being about three or four pints; when drank in smaller quantities, they are a good alternative, and serviceable in the scurvy, king's evil, and diseases of the skin. They may also be used outwardly at the same time, by way of bath or fomentation. They have been found efficacious in destroying worms; and recommended in the gout, jaundice, spleen, green-sickness, and other disorders arising from obstructions. They are used externally for removing old aches, strains, paralytic weakness, &c. and for the cure of ulcers, scabs, the itch, &c.

Malvern Waters.

Malvern waters issue from two noted springs at Malvern, in Worcestershire: they are light and pleasant chalybeates, and almost entirely free from an earthy matter: three quarts of the holy well water being evaporated, left behind scarcely the fourth part of a grain of sediment. These waters are recommended as excellent in diseases of the skin; in leprosy, scorbutic complaints, the king's evil, glandular obstructions, scald heads, old sores, cancers, &c. they are also of use in inflammations and other disorders of the eyes; in the gout and stone; in cachectic, bilious, and paralytic cases; in old headaches and female obstructions. These waters are used externally by washing the part several times in a day, and afterwards covering it with cloths dipped in the water, and kept constantly moist. Those who bathe are said to go usually into the water with their linen on, and to dress upon it wet, without any inconvenience. These waters, when first drank, are apt to occasion a nausea in some; they purge others briskly for several days; but they operate by urine in all. They should be drunk freely for some days before they are used externally.

Islington Water.

Islington water is a light chalybeate water, reckoned one of the best of the kind about London. The iron in this water is held in solution by means of fixed air; and when the air has escaped and precipitates, if the water be left to putrify, the fixed iron dissolved by the putrefaction again dissolves the iron, and causes it to be suspended in the water: it then recovers its chalybeate

W A T

beate taste, and property of tinging with galls, both which it had lost before.

This water is recommended in indigestion and loss of appetite, in lowness of spirits, nervous, hysteric, and hypochondriacal complaints, and relaxed constitutions, and raises the spirits. It is good in the fluor albus, in weakness from miscarriage, in obstructions of the liver, the kidneys, &c. It is also serviceable in diseases of the skin, in scorbutic complaints, in the gravel, and in paralytic disorders. It operates chiefly by urine, and may be drank to the quantity of several half-pints, or even pints, according to the constitution of the patient. This water deserves to be esteemed and frequented.

Dulwich WATERS.

Dulwich waters contain a purging salt, together with sea-salt. They are purging and diuretic: useful in complaints arising from obstructions, as those of the liver, spleen, and other viscera; recommended in the green sickness, jaundice, scurvy, difficulty of urine, and gravelly complaints; they are said to strengthen the stomach, and create good digestion: they are also said to strengthen the nervous system, and to be serviceable in palsies, apoplexies, and other nervous disorders, in which cases it is best to take them warm. The course of drinking these waters is usually twenty days; three pints a day are to be drank at first, and the quantity increased to eight pints by the tenth day, and afterwards diminished in the same manner.

Witham WATER.

Witham water, in Essex, is a chalybeate water of considerable strength, and is also impregnated with sea-salt; but must be drank at the fountain, as it will not bear carriage. It is very diuretic, and has been successfully prescribed in hectic fevers, in weakness occasioned by long disease, in lowness of spirits, nervous complaints, want of appetite, indigestion, habitual colic and vomiting; in agues, the jaundice, and incipient dropsy; in the gravel, and in asthmatic and scorbutic disorders.

Carlbad WATERS, called Caroline Baths.

Are waters of Carlbad in Bohemia, which are hot, and impregnated with the fossile alkali; they are recommended, externally and internally, in female obstructions; relaxed habits; glandulous obstructions; disorders arising from viscid fluids, &c.

Holt WATERS.

Holt waters are mineral waters at Holt, near Bradford, in Wiltshire: which contain a purging salt, together with a large quantity of earth; they are a very mild purge, the dose usually required being two quarts: in less quantity they are alterative and diuretic; they are good as a diluent, cooler, and strengthener, and create an appetite. Rags or sponge dipped in them, and applied externally, are said to cure scrofulous ulcers, attended with carious bones; an internal course being observed at the same time. They are also of service in old running ulcers of the legs, and other parts; in cutaneous foulnesses, though attended with hot corrosive humours; in the piles, in cancerous ulcers, and in soreness of the eyes: but in these cases they must be used both internally and externally.

Jeffop WATER.

Jeffop water is a strong purging water at Jeffop's well, near Cobham in Surrey, with a nauseous taste, and slightly chalybeate. This, says Dr. Lewis, is one of the strongest purging waters in the kingdom; a pint left in evaporation yielded seventy-two grains of salt; whereas Kilburn and Cheltenham waters yielded only sixty-four grains: that of Aſhon not fifty, and that of Epsom less than forty. About a quart of this water purges briskly without griping, and operates likewise by urine. It enlivens the spirits: but loses its virtues by being kept. In less doses it acts as an alterative; and is a good antiscorbutic.

Epsom WATERS.

Epsom waters have a slight saline taste; they are purgative when drank to the quantity of two or three pints: they also operate by urine; in less quantity, or about the third part of a pint taken three times a day, they are a mild alterative. They are esteemed good for washing old sores. See Epsom Salt.

Nevil Holt WATER.

Is a mineral water at a place called Nevil Holt, in Leicestershire, which is very clear as it falls from the spout, and void of smell; it has a brisk, austere, bitter, but not disagreeable taste, and abounds in fixed air; exposed to the air, it soon becomes turbid, and spoils. Drank to the quantity of several pints, it proves purgative, and operates without griping; it operates also by urine, and sweat. In putrid disorders, it is a powerful antiseptic. As an alterative, it must be taken in small doses, from a few spoonfuls to a quarter or half a pint several times in a day: and a little brandy may be added to it, if it is cold on the stomach. This water is esteemed an excellent remedy in old dysenteries and diarrhoeas, internal hæmorrhages, the fluor albus, gleet, the gravel, rheumatism, and for the worms; it is good in atrophies, bloated constitutions, dropical complaints, scorbutic disorders, want of appetite, and other cases; but in inflammatory complaints, and with an acidity of the humours, it is injurious. Externally, it is a speedy cure for fresh wounds, inflamed eyes, and hectic ulcers, &c. especially if taken inwardly, at the same time.

W A T

Sydenham WATER.

Sydenham water is a purgative water at Sydenham, near London, of the same nature with Epsom water, but weaker.

Llandrindod WATERS.

Llandrindod waters are waters issuing from three mineral springs near Llandrindod, in the county of Radnor, South Wales. These springs are the saline purging water, the sulphureous water, and the chalybeate rock-water.

The saline purging, or pump-water, may be used as a purge twice in a week: it is directed to be drank at the fountain-head by half pints till it begins to operate; the patient riding or walking about between each draught: it operates also by urine. As an alterative, about three pints are directed to be drank in a day: a pint and a half before breakfast, at three draughts, with the interval of a quarter of an hour: the other pint and a half at three draughts, one an hour before dinner, another about six in the evening, and the third going to bed. This course should be continued several weeks; and the most proper season is the summer. It is also used as a bath and fomentation. It is recommended, both internally and externally, in the scurvy, leprosy, tetters, king's evil, and all cutaneous foulnesses. It is also prescribed in the gravel, hypochondriacal disease, indigestion, and in other complaints.

The sulphureous water, called also the black stinking water, is to be drank in small doses at first, from a pint to a quart, in the morning at repeated draughts: the quantity may be increased as the stomach will bear. This water is also used outwardly as a bath or fomentation. It is recommended in the king's evil, scurvy, leprosy, and all cutaneous diseases; in the jaundice, hypochondriacal and other disorders arising from obstruction; in the gravel, rheumatism, gout, bloody flux, hectic fever, weaknesses of the limbs, want of digestion, &c.

The chalybeate or rock water, is limpid and transparent, when taken from the fountain, but on standing soon loses these qualities, together with its chalybeate taste. Mixed with sugar and rough cyder as it is taken up from the spring, it excites a brisk fermentation. It is recommended in such chronic disorders as proceed from laxity of the fibres, and weakness of the muscular system; in weakness of the nerves, paralytic complaints, and the like; in scorbutic cases, moist and convulsive asthma; obstinate agues, obstructions of the lower belly, wandering, slow, nervous fevers, and disorders arising from obstruction.

Moffat WATERS.

Moffat waters are mineral waters of considerable efficacy at Moffat, in the county of Annandale in Scotland. They arise from two springs on the declivity of a hill, which yield about 1360 gallons of water daily. These waters have a sulphurous taste, and smell of the washings of a gun-barrel; their colour is milky or bluish. The season for using them is between the middle of April and the end of September; but they may be drank all winter, and if the rains be moderate, the strength of the water is not found to be impaired. The water of the upper spring being too foul for drinking, is made use of for bathing, and is for this purpose made somewhat warmer than tepid. The quantities of water usually drank are pretty large, exceeding sometimes a gallon. It is usual to join purgatives, and that in great doses, frequently repeated, with the use of the waters; but this is thought unjustifiable by some. The water is alterant and diuretic: its purging is owing to the large quantities drank, or to some singularity in the constitution, as a weak state of the stomach and intestines. Few medicines are said to be superior to these waters in disorders of the stomach and bowels. It has also proved useful in nephritic, nervous, and hysteric colics, melancholy, barrenness, female weaknesses and disorders, as also in old gleet, either natural, or caused by venereal disorders. In rheumatic and scorbutic complaints it is advantageous, and in cutaneous eruptions. It is said seldom to fail in scrofulous disorders. It is warmed and used by way of bath to particular parts, and even to the whole body: the hot steam has been successfully used for relaxing hard swelled parts, and stiff joints. In such complaints it is used both internally and externally. This water gives no marks of a chalybeate nature with galls, nor of acidity with tincture of roses, or syrup of violets; neither does it produce any effervescence with oil of tartar *per deliquium*, or spirit of sal ammoniac. It seems to contain a subtle volatile sulphur, but in small quantity, since it soon loses its remarkable smell and taste, when exposed to the air, and that acid liquors can neither separate nor precipitate it. Upon evaporation there is found a dirty salt mixed with earth. This salt seems not to be nitre, nor sal ammoniac, but common salt; but by a slow evaporation of a solution of sea-salt, crystals not unlike those of the salt of Moffat water have been obtained. *Med. Ess. Abs.* vol. i. p. 99; *Ibid.* p. 101; *Ibid.* p. 103, seq. where other experiments on these waters may be seen.

Montrose WATERS.

Steel spas are very numerous in the country about Montrose in Scotland: the principal of these are at Aberbrothoc, Kincardin, and Peterhead. That of Aberbrothoc is in greatest esteem. *Medic. Ess. Abs.* vol. i. p. 106, 107; *Ibid.* p. 111. Beside these, there is a well near Montrose, the water of which is of a whitish

whitish colour, soft taste, and faintly discovering the mineral quality. This water is of a different nature from the steel springs. The alkali prevails in its salt; it resembles the Scarborough water, and no salts come up to any analogy with those of the Montrose waters, and those of Scarborough, but nitre and sea-salt.— See Med. Ess. vol. iii. art. 8; Abr. vol. i. p. 112, seq.; where various experiments with those waters are enumerated, and a comparison instituted between them and the Scarborough waters. The water of this Montrose well is universally diuretic; being drank from two to three pints, it purges; and half the quantity succeeds with some. It has been found very useful in stranguries and stoppages of urine, scorbutic disorders, flatulencies, spasmodic colic, and spitting of blood. In rheums and strains it has been of good use by way of cold pump, where persons could not bear such use of ordinary cold water. Med. Ess. vol. iii. art. 9; Abr. vol. i. p. 122, seq. For a more particular account of the nature, qualities, and various kinds of mineral waters, we refer to the Treatises of Dr. Munro, Dr. Rutty, Dr. Short, Dr. Falconer, and Dr. Elliot on this subject. See also Chym. Dist. art. WATER; and Lewis's Mat. Med. art. AQUA; and Bergman's Chym. Ess. vol. i.

WATER of Crystallization.

Water of crystallization is a denomination given to the water attracted by the particles of a salt during its crystallization. This is contained in different quantities in different salts, and adheres to them with different degrees of force; though it is easily separated from most of them, the moderate heat of the atmosphere being sufficient to evaporate it from many. When this water of crystallization is evaporated from any salt, the figure of the crystals is destroyed; the salt from being a solid transparent substance becomes an opaque powder. But though a salt, in losing its water of crystallization, loses its crystalline form, it does not thereby lose part of its saline quality: for the water which is separated from it is pure water; and the salt by being re-dissolved in water and re-crystallized, will not only regain its former figure, but the whole of its weight.

Mercurial WATERS.

Mercurial waters, a name given to a solution of mercury, in nitrous acid, diluted with a greater or less quantity of common water. This liquor produces good effects as an escharotic, and even as a caustic, in some diseases of the skin that are external, local, and especially venereal. There is also a mercurial water made with four ounces of quicksilver to two quarts of spring water boiled to one quart. This is reckoned an efficacious medicine in several cases, as the worms and the itch in children, by Dr. Cheyne and others.

WATERS in Medicine, Pharmacy, and Chymistry, &c. called also artificial and medicated waters, are a kind of liquors procured or prepared by art from divers bodies, principally of the vegetable tribe; having various properties, and serving various purposes. These are either simple or compound.

Simple WATERS.

Simple waters are those procured from some one vegetable body, by means of common water. A simple water is not supposed to be the mere water, or phlegm of the body it is drawn from, as is evident both from the taste and smell thereof. The intention of making such water is, to draw out the virtues of the herb, feed, flower, root, or the like; so as it may be more conveniently given in that form than any other. But the phlegm, or watery part of any medicinal simple, is no better than common water distilled: so that all those ingredients, which in distillation raise nothing but phlegm, as may be discovered from the scent and taste of what comes over, are not fit for the still. On this principle, a great part of the waters retained in the dispensaries will appear good for nothing, at least not worth distilling. The means whereby this separation is effected, are either *evaporation*, *infusion*, *decotion*, or *distillation*. The first is performed by exposing the vegetable in a cold still, to a gentle heat, like that of a summer's sun; and catching the effluvia which exhale from it. The effect of this operation is a water, or fluid matter, which is the most volatile, fragrant, and aromatic part of the plant: and that wherein its specific virtue resides. And thus it is, that the finest aromatic or odoriferous waters of vegetables are to be procured. The second means, viz. *infusion*, is performed by putting the vegetable in hot rain-water, below the degree of boiling; keeping it to this degree by an equable heat, for the space of half an hour; and then drawing it off. The only waters procured this way, in much use in the modern practice, are those of frogs-spawn, and oak-buds. The third means, viz. *decotion*, only differs from the second in this, that the water is kept to the degree of boiling. The fourth means, viz. *distillation*, is performed by infusing the subject in an alembic, with a gentle warmth, for some time; and then increasing the heat, so as to make it boil; and lastly, catching and condensing the steam or vapour arising therefrom. This process furnishes what we call the distilled waters, of so much use in medicine, &c. The vegetable subjects best fitted for it, are the vapid and odorous, or those of the aromatic tribe; as angelica, aniseed, balm, carraway, coriander, cumin, dittany, fennel, hyssop, marjoram, mint, roses, rosemary, saffron, sage, scurvy-grass, thyme, cinnamon, citron, juniper, lime, myrtle, orange, peach, &c. The medicinal virtues of waters prepared after this man-

ner are the same as those of the respective plants, &c. they are drawn from. Thus the distilled water of mint is stomachic; that of wormwood, vermifugous, &c. The Materia Medica, it may be observed, affords no remedies in this way, but for the intentions either of cordials, emmenagogues, diuretics, or diaphoretics. Were it practicable to raise a balsamic, cathartic, or opiate in this manner, yet would those properties be much more conveniently brought forth by other processes; so that nothing is to be looked for in a distilled water, but such subtle and light parts of a medicinal simple, as may fall in with the forementioned intentions: indeed, very little comes over under that division, weighty enough to affect even the urinary secretions.

The simple waters of chief virtue, are the following: viz. *dill-water*, *aqua anethi*; *angelica-water*, *aqua angelica*; *mint-water*, *aqua mentha*; *rosemary-water*, *aqua anthos*; *orange-flower-water*, *aqua napha*; *black-cherry-water*, *aqua cerasor*, *rig*; *parsley-water*, *aqua petrosellini*; *chamomile-water*, *chamam.*; *penroyal*, *pulegii*; *fennel-water*, *aqua faniculi*; *damausk-rose-water*, *aqua rosarum dam.*; *hyssop-water*, *aqua hyssopi*; *rue water*, *aqua ruta*; *juniper-water*, *aqua juniperi bacc.*; *elder water*, *aqua sambuci flor*; *lovage-water*, *aqua lovistici*; *carminative water*, *aqua carminativa*, &c.

It may be here proper to note, that whatever properties any simple has from the grossness or solidity of its parts, which make it act as an emetic, cathartic, or astringent, the residue, left after distillation, will remain in full possession thereof. Thus the purging syrup of roses is as well made after the damausk-rose-water is drawn off, as if the flowers were put into infusion; because nothing of a cathartic quality rises with the water. In the distillation of simple waters, a good general rule is this: take as much of the dried herb, as when cut small will fill two-thirds of the still to be used; pour upon this as much rain-water as will make the plant float commodiously, leaving, however, a fourth of the still empty; digest this awhile in a gentle heat, and then give fire enough to work the still, and draw off so long as the water appears thick or milky, and tastes of the herb. It is a principal caution in this operation to remove the receiver before the more pellucid, acid, faint, and dead water comes over, as it will at length do, and by mixing with the rest will spoil the whole, by giving it a vapid or faint taste, and sometimes a degree of acidity or vitriolic stipticity, or emetic quality; for part of the essential salt of the plant now rising, corrodes the head of the still, and carries over with it some particles of the metal: for which reason, such waters should be either distilled with a glass head, or a pewter one, or else the last running carefully watched, and not suffered to come over and mix with the first; for want of this caution, children and persons of tender habits, have been often vomited, purged, &c. contrary to the intention of the prescriber, by a simple water.

The simple waters distilled by this method may often be too strong to give alone, but then it is easy to let them down to a proper strength with common water; which is beyond all comparison better than to mix them with their own faints, or the liquor of their second running. Some recommend putting the fresh herbs, cut and bruised, into an alembic placed in a water-bath, without adding water to them, and distilling to dryness with a very gentle heat and well-luted vessels. There are yet, however, two methods of improving the common simple waters, which might easily be put in practice: the first is the cohobating, and carefully digesting of the plant; the second the fermenting of it. With regard to the first, if the liquor remaining in the still be expressed from the herb, and returned, along with all the water that came over, upon a fresh quantity of the same subject, and then distilled as before, the water thus obtained will be much richer, and more efficacious than before; and if the same operation be repeated two or three times, those who have not tried it cannot easily conceive how very rich a simple water may by that means be made: and this is most necessary in distilling the simple waters of roses, elder-flowers, balm, and the like subjects; which afford but little oil, and otherwise make but weak water.

The other method recommended, viz. by fermentation, is performed by adding to the plant and water, put together as for distillation, a tenth or a twelfth part of sugar or honey, or else a fortieth part of yeast; then setting the whole in a warm place to ferment for three or four days only, so that the herb may not fall to the bottom, nor the fermentation be above half finished; then the whole being committed to the still, a water may be procured, at one operation, extremely rich, or impregnated with the whole virtue of the plant; and thus may simple waters be made fit for long keeping without spoiling, the small quantity of inflammable spirit generated in the fermentation serving excellently to preserve them. Shaw's Lectures, p. 199. The waters procured in this manner contain the oil of the plant in great perfection: which makes them of considerable use in medicine, farther than those raised without fermentation; beside that they keep better and longer, the spirit in them preventing their corrupting, or growing motley.

To procure the distilled waters of vegetables, or other subjects, pure and free from all mixture of the other principles of the body it was extracted from, let the water, as distilled, be put into a funnel lined with paper, to be filtered, and the funnel being kept continually filled up, that the lighter oil may not come in contact

contact with the paper, the water will be transmitted through, in a great measure, without the oil; but there still remains some proportion of oily, and commonly of saline, matter also in it. If the saline matter be acid, the way to destroy it is by mixing chalk, or any alkaline salt, with the water, which being afterwards distilled again, will then rise pure. If the plant were alkaline, and an alkaline salt be suspended in the water, let it be made a neutral one, by mixing some acid, and then the water filtered and distilled again. By these methods the water of vegetables is procured pure; and this is the way of proving, that the chymical principle, water, is lodged in, and may be separated from, all such substances. Shaw's Lectures, p. 150.

Compound Waters.

Compound Waters, or those wherein several ingredients are used, are very numerous, and make a large article in commerce; some are prepared by the apothecaries, according to the Dispensatory precepts, for medical uses; others by the distillers, to be drank by way of dram, &c.; and others by the perfumers, &c.

They are distinguished by different epithets, taken from the Latin, Greek, Arabic, English, &c. in respect either of the specific virtues of the waters; or the parts of the body, for the cure whereof they are intended; or the ingredients they are compounded of; or their different uses, &c. The most considerable among the class of compound waters we shall here enumerate. The manner of making them, it is true, is not always the same; especially those intended for drinking; for which every one gives his own method as the best. Those we here deliver are taken from such as have the greatest reputation in preparing these things; or from those who have written best on them.

We have only three general remarks to add, with regard to those intended for drinking; 1. That such, wherein any thing is infused, as bruised fruits, pounded herbs, or ground spices, must be always passed through a filtre, to make them finer and purer.

2. That those made with brandy or spirit of wine, are usually distilled after mixing their ingredients; which renders those liquors exceeding strong and dangerous, and confirms the proverb, *Plures occidit gula quam gladius*. In effect, some of them are so penetrating, that they burn the tongue when taken.

3. That the waters which take their name from any particular things, as cinnamon, &c. have often some other ingredients joined with them, according to the taste or smell required.

In the making of compound spirituous liquors, or, as they are called by the apothecaries, cordial waters, the great care is to use a pure and well rectified spirit, as nearly insipid as possible, that the flavour of it may not mix among the flavours of the other ingredients. It is the general custom to use the proof spirit, but it would be infinitely better to use the alcohol, or totally inflammable; partly as the strength of the water would be much better ascertained that way, the proof strength determined by the crown of bubbles being very vague and uncertain, and that of the alcohol or totally inflammable spirit perfectly fixed and certain; and because this spirit is always more free from the oil of the ingredients it is made from, and on that account not only approaches more to that so much desired thing, a pure and tasteless spirit, but being free from oil of its own is the more hungry, and more ready to imbibe that of the ingredients added to it, and has no overpowering taste to give of its own. If the method of using alcohol be not chosen, let a fine, clear, and pure molasses spirit of the proof strength be used, without any further addition of water in the still, an additional quantity of water only taking up room to a very bad purpose, and prolonging and prejudicing the operation; and when alcohol is employed, it should only be mixed with an equal quantity of pure water, to reduce it to the proof strength. When the choice of a spirit is thus settled, the next thing to be regarded is the manner of digestion, for without this, many ingredients will not part with their flavour and virtues at all, and many others but very imperfectly. Cinnamon in particular, if not macerated in the spirit a long while before distillation, will not part with its heavy oil, which will therefore be left in the still, and thrown away, while the slightly impregnated spirit is saved.

When the ingredients have stood a due time in digestion, according to their several natures, the spirit is to be drawn from them, in the manner that best tends to bring over their virtues, whereon the character and expectation of the water is founded; so if the ingredients naturally abound in a heavy viscous oil, the operation should be performed with a brisker fire, than when the oil is thin, light, and ethereal. Thus strong cinnamon-water, after a sufficient digestion to loosen the oil, may be drawn over faster, or with a brisker fire, than citron-water, the spirit of mint, or the like, in which the oil of the ingredient is thin, and will easier ascend with the spirit. The capital thing in this compound distilling rests here, that a sufficient quantity of the fine essential oil of the ingredients be received into, and mixed with the spirit, while the grosser, less subtil, and less agreeable oil is thrown out. To effect this to any degree of perfection, requires that the operation be well conducted from the beginning, that the receiver be changed in due time, and that the spirit be prudently made up.

When no regard is had to these three particulars, as is usually the case among the apothecaries, the consequence is, that the cordial water becomes a thick, turbid, and milky liquor, and tastes

more like what the distillers call fairs, than like a cordial-water, and is fitter to give sickness, rather than to cure it. At least, before it can be used, it must either stand a long time to fine itself, if ever it will fine, or have its gross and terrestrial parts precipitated by art. On the contrary, when these rules are prudently observed, the water proves, without farther trouble, clean tasted, clear, brisk, pleasant, and refreshing. The distillers in general make their compound waters in a much neater manner than the apothecaries; and what has led them into the way of doing so, is their strict observance of the bubble-proof, a thing which the apothecaries seem either not to understand, or pay very little regard to.

The distillers in the making their compound waters, find that if they let the fairs run in among the clear spirits, it kills the proof, as they call it, before the time; hence they are instructed to leave the fairs out, and to make up the spirit with pure water, reserving the fairs for other uses, to which they are better adapted, as containing a copious oil; or they let the still work longer than the process for making water would require, and by this means obtain a larger quantity of oil than is commonly imagined: this they preserve separate, if the oil of only some one ingredient; and they sell large quantities of the oils of juniper, anise, and caraway, and the like, to the druggists, chymists, and apothecaries. But this is a very scandalous cheat on the buyer, for there is very great difference between a pure and clear essential oil, that is perfect and entire, and such a one as has, in this manner, been robbed of its lighter and finer parts by distillation with a spirituous menstruum. It is a general rule in this business to change the receiver as soon as the spirit runs proof, and make up the quantity with water: in this case, the whole is certain to be clear and fine; but there are some cases, as, in particular, in the distilling of cinnamon water, where a small quantity of the fairs ought to be suffered to come into the spirit: but this is to be observed by way of hint, that so much is never to be allowed of the fairs as will make the water milky; for the water should always be kept in the state of full proof, as it mellows and ripens, as they express it, much sooner in this, than in any other state. But if the custom could be universally introduced, it would be better that that all waters kept by the apothecaries should be just in the state in which they came over, that is, three-fifths of the quantity of the proof-spirit put into the still: if this was generally brought about, it would be easy for the physicians to regulate the doses in their prescriptions accordingly; every draught and julep that they entered into would be the better for it. Shaw's Essay on Distillery.

Dr. Shaw in another treatise, after observing that the apothecaries usually succeed but ill in distilling cordial-waters, lays down the four following rules; by the observation of which the art of making these waters might be brought to great perfection. The first is, to use a well cleansed spirit that is free from its own essential oil; for as the design of compound distillation is to impregnate a spirit with the essential oil of the ingredients, it ought first to be deprived of its own. The second rule is, to suit the time of the digestion of the ingredients to their tenacity, or the ponderosity of their oil: thus rhodium-wood and cinnamon require to be longer digested before they are distilled, than calamus aromaticus, or lemon-peel. Sometimes also cohobation, or the pouring of the spirit, already distilled, back upon the ingredients, proves necessary, as particularly in making the strong cinnamon-water, where the essential oil is extremely ponderous, and difficultly rises along with the spirit without this cohobation. The third rule is, to suit the degree of fire, or strength of the distillation, to the ponderosity of the oil intended to be raised with the spirit: thus strong cinnamon-water should be distilled off brisker than the spirit of mint or balm.

The fourth rule is, that a due proportion of only the finer essential oil of the ingredients be thoroughly united or incorporated with the spirit, so as to keep out the grosser and less fragrant oil. This may chiefly be effected by leaving out the fairs, and making up to strong proof with fine soft water in their stead. The addition of sugar to cordial-waters is a thing of little moment, and may therefore be omitted. If the four rules before laid down be duly observed, there is no occasion for distilling in balneo marie, nor for fining down waters with alum, whites of eggs, isinglass, or the like, for they will be presently bright, sweet, and pleasant tasted, without any farther trouble, &c. Shaw's Lectures, p. 127.

Angelica-WATER is usually prepared of brandy, angelica-root and seeds, carduus, balm, fenugreek, &c. the whole beaten together in a mortar; infused for a night in French brandy, and then distilled. It is reputed a good carminative and cordial, as also a cephalic, &c. See ANGELICA.

Aniseed-WATER. To six ounces of bruised aniseeds, add a gallon of molasses spirit, and two quarts of water; distil a gallon, and, if you require it sugared, add half a pound of clarified sugar; but many prefer it without; and strain the whole. The compound aniseed-water, commonly kept in the shops, is prepared from a mixture of equal parts of the seeds of aniseed and angelica, by drawing off a gallon of proof-spirit from half a pound of each of the seeds. Lewis.

Apricot-WATER. To a quart of water put six or eight apricots sliced, and the kernels bruised; boil the whole to extract the taste;

taste;
that is
Are
with t
matter
the v
the na
nated
impre
Car
a mort
juice
alemb
ger of
fitting
put in
plague
Cin
cinnam
cinnam
bruise
first qu
Or, ste
a half
distil
one gal
distill
Citr
be thu
orange
alcohol
two ga
off with
mixture
and ad
sition m
head of
Gent
green o
only sp
of a li
machic
jaundic
the virt
Clar
cinnam
tion, an
emetic,
lorum.
strawbe
coriand
Clov
and diff
Iced
waters,
time, p
coolers.
ing the
manner
and the
mixed
thawing
bottom
may fr
icicles,
again,
of that
freezing
See Jo
Impe
cinnam
and di
It is a p
stomach
Hun
Queen
cured,
gary-w
days in
college
over in
as soon
spirit n
and a h
ter-ba
Chal
quench
water,
Copp
N

taste; and when cold, add four or five ounces of sugar. When that is dissolved, strain it.

Aromatic-WATERS are such as are impregnated by distillation with the spirituous rectifier, or odoriferous principle of aromatic matters. If spirit of wine be impregnated in the same manner, the waters, as they have been called, ought to be distinguished by the name of *aromatic spirituous waters*. Those that are impregnated with the smell of one substance are called simple; and those impregnated by means of several substances, compound.

Carduus-WATER, is made from carduus benedictus pounded in a mortar, and put in to an alembic; then a sufficient quantity of the juice of the same plant, drawn by expression, is poured into the alembic: that the herbs swimming in the juice may be in no danger of sticking to the bottom of the circubit in distillation.—Lastly, sitting on the head, and luting the joints, distil half as much as you put in. This water is said to be sudorific; and good against the plague, malignant fevers, &c.

Cinnamon-WATER. In a gallon of spirit, distil a pound of cinnamon: add four ounces of sugar. Or thus: take a pound of cinnamon, three pounds of rose-water, and as much white-wine: bruise the cinnamon, infuse it fourteen days, then distil it. The first quart that rises is the best; then the second; then the third. Or, steep one pound of cinnamon-bark, bruised, in a gallon and a half of water, and one pint of brandy, for two days; and then distil off one gallon. For a spirituous cinnamon-water, take of cinnamon, one pound; proof-spirit and common water, of each one gallon; steep the cinnamon in the liquor for two days; then distil off one gallon.

Citron-WATER, a well known strong water, or cordial, may be thus made. Take of fine thin lemon-peel, eighteen ounces; of orange-peel, nine ounces; perfect nutmegs, a quarter of a pound; alcohol perfect, that is, the finest and best rectified spirit of wine, two gallons and a half; digest in balneo marie for one night, draw off with a slow fire; then add as much water as will just make the mixture milky (which will be about seven quarts or two gallons); and add also about two pounds of fine sugarcandy. This composition may be improved by fresh elder-flowers, hung in a cloth in the head of the still, sprinkled with ambergrise in powder, or its essence.

Gentian-WATER. Take four pounds of gentian-roots, either green or dried; mince them small, infuse them in white wine, or only sprinkle them therewith; then distil them, with the addition of a little century the less. This is frequently used as a stomachic, and is also commended for a detergent; serving in dropsies, jaundice, obstruction of the viscera, &c. but it is really of very little virtue.

Clary-WATER is composed of brandy, sugar, clary-flowers, and cinnamon, with a little ambergrise dissolved in it. It helps digestion, and is cardiac. This water is rendered either purgative or emetic, by adding resin of jalap and scammony or crocus metallorum. Some make clary-water of brandy, juice of cherries, strawberries, and gooseberries, sugar, cloves, white pepper, and coriander-seeds, infused, sugared, and strained.

Clove-WATER is prepared of brandy, and cloves bruised therein and distilled.

Iced or Frozen WATERS, are certain agreeable and wholesome waters, as orange-water, or the like, artificially frozen in summer-time, particularly in hot countries, to be used in collations, &c. as coolers. The way of making them is thus: the vessels containing the liquors designed to be frozen, are first set in a pail, in such manner as not to touch each other; then they are covered up, and the void space in the pail filled with common ice, beaten and mixed with salt. Every half-hour they clear out what water the thawing ice sends to the bottom of the pail, by means of a hole at bottom; at the same time stir up the liquors with a spoon, that they may freeze into snow; for were they to shoot in form of ice or icicles, they would have no taste. Then, covering the vessel again, they fill up the pail with more beaten ice and salt, in lieu of that dissolved and evacuated. The more expeditious the freezing is required to be, the more salt is to be mixed with the ice. See ICE.

Imperial-WATER, *Aqua Imperialis*, is a water distilled from cinnamon, nutmeg, citron-peel, cloves, calamus aromaticus, santal, and divers other simples, infused in white-wine and baum-water. It is a pleasant cordial dram, and is good against diseases of the brain, stomach, and womb.

Hungary-WATER. A distilled water so denominated from a Queen of Hungary, for whose use it was prepared, and who was cured, by the continued use of it, of a paralytic disorder. Hungary-water is directed to be made of rosemary-flowers infused some days in rectified spirit of wine, and the spirit then distilled. The college of Edinburgh directs a gallon of rectified spirits to be drawn over in the heat of the water, both from two pounds of the flower as soon as they are gathered: that of London takes the tops, and a spirit not quite so strong, putting a gallon of proof-spirit to a pound and a half of the fresh tops, and drawing off, in the heat of a water-bath, five pints.

Chalybeate-WATER, is a water wherein red-hot steel has been quenched. It is astringent, and good, like ferruginous, or iron-water, for diarrhoeas, &c.

Copper-WATER. See ZIMENT.

Nephritic-WATERS are such as strengthen the reins, and help them to discharge by urine any impurities therein. Such are those of honeyfuckle, pellitory, radish, beans, mallows, &c. The nephritic-water of Dr. Radcliff, popularly called Dr. Radcliff's water, was taken into one of the editions of the College Dispensatory. It is prepared from the kernels of black-cherries, peaches, and bitter almonds, beaten in a mortar into a paste, with Rhenish wine; and seeds of smallage, treacle mustard, gromwell, and parsley, beaten likewise, and added thereto; to the mixture are put juniper-berries, garlick, onions, leeks, pimpernel, horse-radish, calamus aromaticus, cinnamon, well-rue, mace, and nutmegs; the whole macerated in Rhenish spirit of black cherries, &c. and thus distilled. It is said to be one of the most powerful detergents and cleansers known; and good in the dropfy, jaundice, asthma, pleurisy, stone, &c.

WATER, in anatomy, &c. is applied to divers liquors, or humours in the human body. Such is the aqua phlegmatica, *phlegmatic-water*; which is a soft ferous humour contained in the pericardium, and wherein the heart swims. Anatomists are divided about it; some will not have it natural, but suppose it separated forcibly during the pangs of death: their reason is, the difficulty they meet with in tracing its passage, or how it is carried off. The latest anatomists, however, seem to agree to its being a natural and necessary humour; and one reason is, that it is found even in the pericardiums of fœtuses. It has likewise been disputed whence it should be separated. The most probable opinion is, that it is secreted by some glands about the basis of the heart; and that it distils thence, drop by drop, into the cavity of the pericardium, in such quantity as just to supply what is expended daily by the motion and warmth of the heart, and so needs no evacuation. Its use is to moisten, lubricate, and cool the heart, and prevent the inflammation that might arise from the dry friction of the heart and pericardium. So that it does the same office to the heart, that the water does to the part wherein the fœtus swims; which, without it, would not have liberty to move at all. See the System of ANATOMY, Part V. Sect. II.

Holy-WATER is a water prepared every Sunday in the Romish church, with divers prayers, exorcisms, &c. used by the people to cross themselves with at their entrance, and going out of church; and pretended to have the virtue of washing away venial sins, driving away devils, preserving from thunder, dissolving charms, securing from, or curing, diseases, &c. The use of holy-water appears to be of an ancient standing in the church: witness St. Jerom, in his life of St. Hilarion, and Gretser, de Benedict. cap. x. &c.—M. Godeau attributes its origin to Alexander, a martyr under the emperor Adrian. Many of the reformed take the use of holy water to have been borrowed from the lustral-water of the ancient Romans: though it might as well be taken from the sprinkling in use among the Jews. See Numbers, xix. 17.

Motion of WATER, in hydraulics. The theory of the motion of running water is one of the principal objects of hydraulics, and many eminent mathematicians have applied themselves to this subject. For a copious account of the nature and properties of FLUIDS, see the System of HYDROSTATICS, and HYDRAULICS, Part I. Sect. I. II. and III. throughout, and the Plate annexed to the System.

Raising of WATER, in hydraulics. The great use of raising water by engines for the various purposes of life, is well known. For the doctrine of Fluids, as respecting their motion, in raising and conveying water, &c. with a description of the several machines used for that purpose, see the System of HYDROSTATICS, and HYDRAULICS, Part II. throughout. For a representation of the several machines, see the Plate annexed to the System.

WATER-Spout, in natural history, an extraordinary meteor, or appearance, at sea, and sometimes at land, very dangerous to ships, &c. ofteneft observed in hot, dry weather; and called by the Latins *typho*, and *sipho*; by the French, *trompe*, &c. Its first appearance is in form of a deep cloud, the upper part whereof is white, and the lower black. From the lower part of this cloud there hangs or rather falls down, what we properly call the spout, in manner of a conical tube, biggest at top. Under this tube is always a great boiling and flying up of the water of the sea, as in a jet d'eau. For some yards above the surface of the sea, the water stands as a column, or pillar; from the extremity whereof it spreads, and goes off, as in a kind of smoke. Frequently the cone descends so low, as to touch the middle of this column, and continue for some time contiguous to it; though sometimes it only points to it, at some distance, either in a perpendicular, or in an oblique line.

Frequently it is scarce distinguishable, whether the cone or the column appear first, both appearing all of a sudden against each other. But sometimes the water boils up from the sea to a great height, without any appearance of a spout pointing to it, either perpendicular or obliquely. Indeed, generally, the boiling or flying up of the water has the priority, this always preceding its being formed into a column. Generally, the cone does not appear hollow till towards the end, when the sea-water is violently thrown up along its middle, as smoke up a chimney: soon after this the spout, or canal, breaks and disappears; the boiling up of the water, and even the pillar, continuing to the last, and

for some time afterwards; sometimes till the spout forms itself again, and appears anew: which it sometimes does several times in a quarter of an hour. See a description of several water-spouts by Mr. Gordon, and by Dr. Stuart, in *Phil. Transf. Abr.* vol. iv. p. 103, &c. M. de la Pryme, from a near observation of two or three spouts in Yorkshire, described in the *Philosophical transactions*, No. 281, or *Abr.* vol. iv. p. 106, concludes, that the water-spout is nothing but a gyration of clouds by contrary winds meeting in a point or centre; and there, where the greatest condensation and gravitation are, falling down into a pipe, or great tube, somewhat like Archimedes' spiral screw, and, in its working and whirling motion, absorbing and raising the water, in the same manner as the spiral screw does; and thus destroying ships, &c. Thus, June the 21st, he observed the clouds mightily agitated above, and driven together; upon which they became very black, and were hurried round; whence proceeded a most audible whirling noise; like that ordinarily heard in a mill. Soon after there issued a long tube, or spout, from the centre of the congregated clouds, wherein he observed a spiral motion, like that of a screw, by which the water was raised up.

Again, August 15, 1687, the wind blowing at the same time out of the several quarters, created a great vortex and whirling among the clouds; the centre whereof every now and then dropped down, in shape of a long, thin, black pipe, wherein he could distinctly behold a motion like that of a screw, continually drawing upwards, and screwing up, as it were, whatever it touched. In its progress it moved slowly over a grove of trees, which bent under it like wands, in a circular motion. Proceeding, it tore off the thatch from a barn, bent a huge oak-tree, broke one of its greatest branches, and threw it to a great distance. He adds, that whereas it is commonly said, the water works and rises in a column, before the tube comes to touch it; this is, doubtless, a mistake, owing to the fineness and transparency of the tubes, which do most certainly touch the surface of the sea, before any considerable motion can be raised therein; but which do not become opaque and visible, till after they have imbibed a considerable quantity of water. The dissolution of water-spouts he ascribes to the great quantity of water they have glutted; which, by its weight, impeding their motion, whereon their force, and even their existence, depends, they break, and let go their contents: which generally prove fatal to whatever is found underneath.

A singular instance hereof we have in the *Philosophical Transactions* (No. 363, or *Abr.* vol. iv. p. 108) related by Dr. Richardson. A spout in 1718, breaking on Emmot-moor, nigh Coln; in Lancashire, the country was immediately overflowed: a brook, in a few minutes, rose six feet perpendicularly high; and the ground whereon the spout fell, which was sixty-six feet over, was torn up to the very rock, which was no less than seven feet deep; and a deep gulf was made for above half a mile; the earth being raised on either side in vast heaps. See a description and figure of a water-spout, with an attempt to account for it, in Franklin's *Exp. and Obs.* p. 226, &c. Signor Beccaria, has taken pains to shew that water-spouts have an electrical origin. To make this more evident, he first describes the circumstances attending their appearance, which are the following:

They generally appear in calm weather. The sea seems to boil, and send up a smoke under them, rising in a hill towards the spout. At the same time, persons who have been near them have heard a rumbling noise. The form of a water-spout is that of a speaking trumpet, the wider end being in the clouds, and the narrower end towards the sea. The size is various, even in the same spout. The colour is sometimes inclining to white, and sometimes to black. The position is sometimes perpendicular to the sea; sometimes oblique; and sometimes the spout itself is in the form of a curve. Their continuance is very various, some disappearing as soon as formed, and some continuing a considerable time. One that he had heard of continued a whole hour. But they often vanish and presently appear again in the same place. The very same things that water-spouts are at sea, are some kinds of whirlwinds and hurricanes by land. They have been known to tear up trees, to throw down buildings, make caverns in the earth; and, in all these cases, to scatter earth, bricks, stones, timber, &c. to a great distance, in every direction. Great quantities of water have been left, or raised by them, so as to make a kind of deluge; and they have always been attended with a prodigious rumbling noise.

That these phenomena depend upon electricity cannot but appear very probable from the nature of several of them: but the conjecture is made more probable from the following additional circumstances. They generally appear in months peculiarly subject to thunder-storms, and are commonly preceded, accompanied, or followed by lightning, rain, or hail; the previous state of the air being similar. Whitiſh or yellowiſh flaſhes of light have ſometimes been ſeen moving with prodigious ſwiftness about them. And, lastly, the manner in which they terminate exactly resembles what might be expected from the prolongation of one of the uniform protuberances of electrified clouds, mentioned before, towards the sea; the water and the cloud mutually attracting one another; for they suddenly contract themselves, and disperse almost at once; the cloud rising, and the water of the sea under it falling

to its level. But the most remarkable circumstance, and the most favourable to the supposition of their depending upon electricity is, that they have been dispersed by presenting to them sharp-pointed knives or swords. This, at least, is the constant practice of mariners; in many parts of the world where these water-spouts abound; and the Doctor was assured by several of them, that the method has often been undoubtedly effectual. The analogy between the phenomena of water-spouts and electricity, he says, may be made visible, by hanging a drop of water to a wire communicating with the prime conductor, and placing a vessel of water under it. In these circumstances, the drop assumes all the various appearances of a water-spout, both in its rise, form, and manner of disappearing. Nothing is wanted but the smoke, which may require a great force of electricity, to become visible. Mr. Wilcke also considers the water-spout as a kind of a great electrical cone, raised between the cloud, strongly electrified, and the sea or the earth, and he relates a very remarkable appearance which occurred to himself, and which strongly confirms his supposition. On the 20th of July, 1758, at three o'clock in the afternoon, he observed a great quantity of dust rising from the ground, and covering a field and part of the town in which he then was. There was no wind, and the dust moved gently towards the east, where appeared a great black cloud, which when it was near his zenith, electrified his apparatus positively, and to as great a degree as ever he had observed it to be done by natural electricity. This cloud passed his zenith, and went gradually towards the west, the dust then following it, and continuing to rise higher and higher till it composed a thick pillar, in the form of a sugar-loaf, and at length seemed to be in contact with the cloud. At some distance from this, there came, in the same path, another great cloud, together with a long stream of smaller clouds, moving faster than the preceding. These clouds electrified his apparatus negatively, and when they came near the positive cloud, a flash of lightning was seen to dart through the cloud of dust, the positive cloud, the large negative cloud, and, as far as the eye could distinguish, the whole train of smaller negative clouds which followed it. Upon this the negative clouds spread very much, and dissolved in rain, and the air was presently clear of all the dust. The whole appearance lasted not above half an hour. See Priefley's *Electric.* vol. i. p. 438, &c.

This theory of water-spouts has been farther confirmed by the account which Mr. Foster gives of one of them in his *Voyage round the World*, vol. i. p. 191, &c. On the coast of New Zealand he had an opportunity of observing several, one of which he has particularly described. The water, he says, in a space of fifty or sixty fathoms, moved towards the centre, and there rising into vapour, by the force of the whirling motion, ascended in a spiral form towards the clouds. Directly over the whirlpool, or agitated spot in the sea, a cloud gradually tapered into a long slender tube, which seemed to descend to meet the rising spiral, and soon united with it into a straight column, of a cylindrical form. The water was hurled upwards with the greatest violence in a spiral, and appeared to leave a hollow space in the centre; so that the water seemed to form a hollow tube, instead of a solid column; and that this was the case, was rendered still more probable by the colour, which was exactly like that of any hollow glass tube. After some time this last column was incurvated, and broke like the others; and the appearance of a flash of lightning, which attended its disjunction, as well as the hailstones which fell at the time, seemed plainly to indicate, that water-spouts either owe their formation to the electric matter, or at least that they have some connection with it.

WATERING, in gardening, &c. the application of water to the soil of plants, &c. when not sufficiently moistened with rain, dew, &c. After sowing seed of any kind, though the ground be ever so dry, they should never be watered till they have been forty-eight hours in the ground, and the ground is a little settled about them: otherwise too great a glut of nourishment at first will be apt to burst them. Care is to be taken, that the leaves of young and tender plants be not watered at all while the weather is cold; only the ground to be wet about them. For hardy plants and seeds, if the nights be cold, water in the afternoon; otherwise in the evening. Water that comes out of pits or deep wells, should stand a day in an open vessel, before it be applied to tender plants in the spring. Dung of sheep, pigeons, or hens, or other lime, &c. infused in the water, will forward the growth of plants.

WAVE, *Unda*, in physics, a cavity in the surface of the water, or other fluid, with an elevation aside thereof. Or, it is a volume of water elevated by the action of the wind upon its surface, into a state of fluctuation. Air in motion, which is wind, in passing over the smooth surface of water, may rub as it were upon that surface, and raise it into wrinkles; which, if the wind continues, are the elements of future waves. The smallest wave once raised does not immediately subside and leave the neighbouring water quiet; but in subsiding raises nearly as much of the water next to it, the friction of the parts making little difference. Thus a stone dropped in a pool raises first a single wave round itself, and leaves it, by sinking to the bottom; but that first wave subsiding, raises a second, the second a third, and so on, in circles

W A X

circles to a great extent. A small power continually operating, will produce a great action. A finger applied to a weighty suspended bell, can at first move it but a little; if repeatedly applied, though with no greater strength, the motion increases till the bell swings to its utmost height, and with a force that cannot be resisted by the whole strength of the arm and body. Thus the small first-raised waves being continually acted upon by the wind, are, though the wind does not increase in strength, continually increased in magnitude, rising higher, and extending their bases, so as to include a vast mass of water in each wave, which in its motion acts with great violence.

This motion of the sea-water also depends greatly on the winds, and on the situation of mountains, in regard to the sea; for the winds are driven back from these with great impetuosity; and in some places this occasions a great and very irregular undulation, beside that which is produced by the immediate action of the winds on the surface of the water, in their own direct course. Waves are to be considered as of two kinds, and these may be distinguished from one another by the names of natural and accidental waves. The natural waves are those which are regularly proportioned in size to the strength of the wind, whose blowing gives origin to them. The accidental waves are those occasioned by the wind's re-acting upon itself by repercussion from hills or mountains, or high shores, and by the washing of the waves themselves, otherwise of the natural kind, against rocks and shoals; and these cases give the waves an elevation, which they can never have in their natural state.

The great Mr. Boyle has proved, by numerous experiments, that the most violent wind never penetrates deeper than six feet into the water; and it should seem a natural consequence of this that the water moved by it can only be elevated to the same height of six feet from the level of the surface in a calm; and these six feet of elevation being added to the six of excavation, in the part whence that water so elevated was raised, should give twelve feet for the utmost elevation of a wave. This is a calculation that does great honour to its author; for count Marigli measured carefully the elevations of the waves near Provence, and found that, in a very violent tempest, they arose only to seven feet above the natural level of the sea, and this additional foot in height he easily resolved into the accidental shocks of the water against the bottom, which was, in the place he measured them in, not so deep as to be out of the way of affecting the waves; and he allows that the addition of one-sixth of the height of a wave, from such a disturbance from the bottom, is a very moderate alteration from what would have been its height in a deep sea; and concludes, that Mr. Boyle's calculation holds perfectly right in deep seas, where the waves are purely natural, and have no accidental causes to render them larger than their just proportion. In deep water, under the high shores of the same part of France, this author found the natural elevation of the waves to be only five feet; but he found also that their breaking against rocks, and other accidents to which they were liable in this place, often raised them to eight feet high.

We are not to suppose, from this calculation that no wave of the sea can rise more than six feet above its natural level in open and deep water; for waves immensely higher than these are formed in violent tempests in the great seas. These, however, are not to be accounted waves in their natural state, but they are single waves formed of many others; for in these wide plains of water, when one wave is raised by the wind, and would elevate itself up to the exact height of six feet, and no more, the motion of the water is so great, and the succession of waves so quick, that during the time this is rising, it receives into it several other waves, each of which would have been of the same height with itself: these run into the first wave, one after another, as it is rising; and by this means its rise is continued much longer than it naturally would have been, and it becomes accumulated to an enormous size. A number of these complicated waves arising together, and being continued in a long succession by a continuation of the storm, make the waves so dangerous to ships, which the sailors, in their phrase, call mountains high. Marigli Hist. Phys. de la Mer.

WAVED, or WAVY, a term in heraldry, when a bordure, or any ordinary or charge in a coat of arms, has its outlines indented, in manner of the rising and falling of waves. This is also called *undy*, *undé*, or *ondé*, and denotes that the first of the family in whose arms it stands, acquired his honours for sea-services, and has this peculiar commemoration of it ordered in his arms. See the System, Sect. VI. Art. II. and Plate IV.

WAX, *Cera*, a soft, yellowish, concrete matter, collected from vegetables by the bee, and extracted from the combs, after the honey is got out, by heating and pressing them. Wax is not the excrement of this laborious insect, as the ancients, and after them many of the moderns have imagined. According to Mr. Reaumur, the farina fecundans of the flowers of plants, contained in their apices, is the matter of which the bees form the wax; they either dislodge this from its cells with their teeth, or else merely by rubbing their bodies among the stamina and apices, load themselves with the globules of it, which their hairs keep sticking upon their body, and which they afterwards brush off with their legs, and, by degrees, collect into balls or lumps, which they deposit

W A X

upon the flat and triangular piece, which makes the third joint of the hinder pair of their legs. The lumps of wax with which we see them loaded in this part, and carrying to their hives, he adds, are only the farina of flowers worked up and compressed into a mass or sort of cake. The stamina of the flowers therefore sustain certain cases, containing a powder, which is the matter of bees-wax. This powder, thus collected into lumps on the legs of the bees, is called rough wax, and is probably wax to all intents and purposes, only wanting a little beating together. Wax, therefore, so long esteemed an animal substance, will appear to be a native vegetable production.

If the bees are observed when returning to the hive loaded with their lumps of wax on their thighs; these lumps on some will be found to be white, on others yellow, on others red, and on some greenish: this is owing to the different colours of the farina, yielded by the different plants they have been at work upon. The manufacture of the bee, in moulding this into a lump, has not yet been able to alter the colour of the farina, nor even its figure; for if the lumps be examined by the microscope, they will all be found to consist of globules of a rounded or oval figure, or of whatever other shape they had when on the plant. The bees returning to their hives, after their morning excursions in the spring, are always found to contain in the cells of their palettes large lumps of wax; but those which go out in the heat of the day, return with little or none; the reason of which is, that the humidity of the farina, by means of the dew, makes it easily formed into a lump or mass, its particles naturally sticking together; whereas in the heat of the day this powder is too dry to be formed thus into a compact mass, and therefore cannot be carried home by the bee. However, it is evident, that the bee does something to the matter, of which wax is made, in order to the reducing of it into perfect wax.

It is most probable, says Mr. Reaumur, that the method in which the bees turn the farina of flowers into wax, is a very simple one; and most likely it consists only in a sort of beating the quantities of them, which they collect, till they are very thoroughly united. We have never been able yet to discover their manner of doing it; but this appears, he thinks, most like the course of nature, in the operations of other insects. If this be the case, it would be possible, perhaps, for us to imitate their method, and procure for ourselves wax out of the stamina of flowers. This would be a discovery of the utmost importance; for though at present the bees which work it for us, cost nothing in keeping, yet it is to be observed, that they are too few in number to collect so much as we might wish.

The difficulty in the way of making the wax from the substance from which the bees make it, is the possibility of its being converted into wax within the body of the animal. If this be the case, notwithstanding that we perfectly know the matter of which wax is made, we are not to wonder that we are not able to make it, any more than that we are not able to make chyle or blood out of the several substances used by us as food, and out of which we well know that it is made within our bodies. Reaumur's Hist. Inf. vol. ix. p. 382; vol. x. p. 39. &c.

Wax makes a considerable article in commerce; the consumption thereof throughout the several parts of Europe being incredible. There are two kinds, white and yellow; the yellow is the native wax, just as it comes out of the hive, after expressing the honey, &c. This colour, says Thorley, is owing to the age of the combs, and breath of the bees; wax, he says, both as it is gathered and wrought into combs, being always white: the white is the same wax, only purified, washed, and exposed to the air.

Yellow Wax. To procure the wax from the combs for use; after separating the honey from them, they put all the matter remaining in a large kettle, with a sufficient quantity of water; there, with a moderate fire, they melt it, and then strain it through a linen cloth, by a press; before it is cold, they scum it with a tile, or piece of wet wood, and cast it, while yet warm, into wooden, earthen, or metalline moulds; having first anointed them with honey, oil, or water, to prevent the wax from sticking. Some, to purify it, make use of Roman vitriol, or copperas; but the right method is to melt, scum it, &c. properly, without any ingredients at all.

The best is that of a high colour, an agreeable smell, somewhat resembling that of honey, brittle, and that does not stick to the teeth when chewed. When new, it is of a lively yellow colour; it is somewhat tough, yet easy to break; by age it loses its fine colour, and becomes harder, and more brittle. The smell also, by long keeping, and the process by which it is whitened, is in a great measure dissipated. However, wax is often sophisticated with resin, or pitch, coloured with rocou, or turmeric.

White Wax. The whitening, blanching, or bleaching of wax, is performed by reducing the yellow sort, first into little bits or grams, by melting it, and throwing it, while hot, into cold water, or else by spreading it into very thin leaves or cakes. For this purpose, some dispose the cauldron in which the wax is melted so that it may flow gradually through a pipe at the bottom into a large tub filled with water, in which is fitted a large wooden cylinder that turns continually round its axis, and upon which the melted wax falls. As the surface of this cylinder is always moistened

tened with cold water, the wax falling upon it does not adhere to it, but quickly becomes solid and flat, and acquires the form of ribbands. The continual rotation of the cylinder carries off the ribbands as fast as they are formed, and distributes them through the tub. This wax, thus granulated, or flatted, is exposed to the air on linen cloths, where it remains, night and day, having equal need of sun and dew. Then they melt and granulate it over again several times; still laying it out to the air, in the intervals between the meltings.

When the sun and dew have at length perfectly blanched it, they melt it for the last time, in a large kettle; out of which they cast it, with a ladle, upon a table covered with little round dents or cavities, of the form of the cakes of white wax, as sold by the apothecaries, &c. having first wetted those moulds with cold water, that the wax may be the more easily got out. Lastly, they lay out those cakes to the air for two days, and two nights, to render it more transparent and drier. The yellow colour of the wax is evidently destroyed by the combined action of the air, of the water, and of the sun. As the volatile, sulphureous acid has the property of destroying more quickly almost all the colours of vegetables, it is suggested by the author of the Chymical Dictionary, that this bleaching might perhaps be shortened, by exposing ribbands of yellow wax to the vapour of sulphur, as is practised for wool and silk. However, the operation of bleaching wax, above described, can be performed well only in fine weather, as it depends chiefly on the action of the sun. This circumstance being attended with much inconvenience to the manufacturers, the discovery of a method of whitening wax, independently of the seasons, would be very useful, and has been recommended to the attention of chymists by some economical societies. With a view to discover such a method, Mr. Beckman has made experiments, an account of which is published in the fifth volume of the *Novi Commentarii Societatis Regiæ Scientiarum Göttingensis*. According to these experiments, thin pieces of yellow wax were whitened and hardened, by being digested and boiled in diluted and undiluted nitrous acid, in a few hours. But the wax thus whitened being melted by means of boiling water, was observed to acquire a yellow colour, less intense, however, than it was before it had been treated with the mineral acids. The marine and vitriolic acids were less effectual than the nitrous. He exposed wax to the flames of burning sulphur, but without success. Yellow wax, being melted in vinegar, was rendered of a grey colour. The oil of tartar whitened wax, but less effectually than acids had done; and this wax, being washed in water, and afterwards digested in nitrous acid, was rendered still more white; but upon melting it in water, a yellowish tinge returned. He liquefied wax in solutions of nitre and alum, but without any good effect. Spirit of wine, which is recommended by Mr. Boyle for this purpose, did indeed whiten the wax, but changed it to a butyrous substance, so frothy, that its bulk was increased thirty times. Reflecting that tartar is purified from its oily particles by means of a calcareous earth, he tried the effects of a kind of fuller's earth, which he threw upon wax liquefied in water, and he agitated the mixture. This method rendered the wax of a greyish colour, and is therefore recommended by him as preparatory to bleaching; the time necessary for which he thinks, may be thus greatly shortened. This white wax is used in making candles, torches, tapers, flambeaux, figures, and other wax works.

It is also an ingredient, partly for giving the requisite consistence to other ingredients, and partly on account of its own emollient quality, in plasters, cerates, and divers pomatums and unguents for the complexion. The yellow sort, dissolved into an emulsion, or mixed with spermaceti, oil of almonds, conserve of roses, &c. into the form of an electary; or divided, by stirring into it, when melted over a gentle fire, as much as it will take up of powdery matters, as the compound crabs-claw powder, is given also internally, and often with great success, in diarrheas and dysenteries, for obviating the acrimony of the humour, supplying the natural mucus of the intestines, and healing their excoriations or erosions.

The empyreumatic oil, into which wax is resolved by distillation with a strong heat, is greatly recommended by Boerhaave, and others, for healing chaps and roughness of the skin, for discussing chilblains, and, with proper fomentations and exercise, against stiffness of the joints, and contractions of the tendons. It is, without doubt, says Dr. Lewis, highly emollient; but does not appear to have any other quality by which it can act in external applications; it has nothing of the acrimony or pungency which prevail in all other known distilled vegetable oils; though in smell it is not a little disagreeable and empyreumatic: a circumstance which occasions it to be at present more rarely used than formerly. As the wax swells up greatly in the distillation, it is convenient to divide it, by melting it with twice its weight of sand, or by putting the sand above it in a retort, that it may mingle with the wax when brought into fusion. The oil, which is preceded by a small quantity of acid liquor, congeals in the neck of the retort, from whence it may be melted down, by applying a live coal, and made fluid by distilling it two or three times without addition. The fæces remaining, after expressing the wax, have been used both by surgeons and farriers, with success,

against strains. *Dist. Chym. art. Wax. Eng. ed. and Lewis's Mat. Med.*

Sealing-Wax, or *Spanish Wax*, is a composition of gum lacca, melted and prepared with resins, and coloured with some suitable pigment. There are two kinds of sealing-wax in use; the one hard, intended for sealing letters, and other such purposes, where only a thin body can be allowed: the other soft, designed for receiving the impression of seals of office to charters, patents, and the like written instruments.

To imitate fruit, &c. in Wax. Take the fruit, and bury it half-way in clay; oil its edges, and the extant half of the fruit; then nimbly throw on it tempered alabaster, or plaster of Paris, to a considerable thickness, when this is concreted, it makes the half mould, the second half of which may be obtained in the same way. The two parts of the mould being joined together, a little coloured wax, melted, and brought to a due heat, being poured through a hole made in any convenient part of the mould, and presently shook every way therein, will represent the original fruit. *Boyle's works abr. vol. i. p. 136.*

Here we must not forget the ingenious invention of Mr. Benoist, a man famous at Paris for his figures of wax. Being by profession, a painter, he found the secret of forming moulds on the faces of living persons, even the fairest and most delicate, without any danger either to their health or complexion; in which moulds he cast masks of wax; to which, by his colours, and glass eyes, imitated from nature, he gave a sort of life; inasmuch as, when clothed in proper habits, they bore such a resemblance, that it was difficult distinguishing between the copy and the original.

Milky Way. See *GALAXY*. The opinion long maintained among astronomers, but lately controverted, that the milky way contains a great number of stars, has been confirmed by the observations of the ingenious and indefatigable Dr. Herschel. For a copious account of this branch of *ASTRONOMY*, See the *System*, Section XV.

WEASEL, a species of the genus *Mustela*, in the system of mammalia. See *MUSTELA*.

WEATHER, the state or disposition of the atmosphere, with regard to moisture or drought, heat or cold, wind or calm, rain, hail, frost, snow, fog, &c. See *RAIN*, *HEAT*, *WIND*, *HAIL*, *FROST*, &c. As it is in the atmosphere that all plants and animals live and breathe, and as that appears to be the great principle of most animal and vegetable productions, alterations, &c. there does not seem any thing, in all philosophy, of more immediate concernment to us than the state of the weather. In effect, all living things are only assemblages, or bundles of vessels, whose juices are kept moving by the pressure of the atmosphere; and which by that motion maintain life. So that any alterations in the rarity or density, the heat, purity, &c. of that, must necessarily be attended with proportionable ones in these. What great, yet regular, alterations, a little change of weather makes in a tube filled with mercury, or spirit of wine, or in a piece of string, &c. every body knows in the common instances of barometers, thermometers, hygrometers, &c. and it is owing partly to our inattention, and partly to our unequal, intemperate course of living, that we do not feel as great and as regular ones in the tubes, chords, and fibres, of our own bodies.

It is certain a great part of the brute creation have a sensibility and sagacity this way, beyond mankind; and yet, without any means or disposition thereto, more than we; except that their vessels, fibres, &c. being, in other respects, in one equable habitude; the same or a proportionable cause from without, has always a like or proportionable effect on them; that is, their vessels are regular barometers, &c. affected only from one external principle; viz. the disposition of the atmosphere; whereas ours are acted upon by divers from within, as well as without; some of which check, impede, and prevent the action of others. We know of nothing more wanting than a just theory of the weather, on mechanical principles. But, in order to that, a complete history of the weather will be required. If registers were carefully kept in divers parts of the globe, for a good series of years, we should be enabled to determine the directions, breadth, and bounds of the winds, and of the weather they bring with them; the correspondence between the weather of divers places, and the dependence between one sort and another at the same place. In time, no doubt, we might learn to foretel divers great emergencies; as, extraordinary heats, rains, frosts, droughts, dearths, plagues, and other epidemical diseases, &c.

The members of our Royal Society, the French Academy of Sciences, and many authors of note, have made considerable essays this way; and the practice of keeping meteorological journals has, of late years, become very general. For instructions and examples appertaining to this subject, see *Phil. Trans. vol. lxx. part ii. art. 16.* *Eraf. Bartholin*, has observations of the weather for every day throughout the year 1671. Mr. W. Merle made the like at Oxford, for seven years, with very remarkable care and accuracy. Dr. Plott did the same, at the same place, for the year 1684. Mr. Hillier, at Cape Corse, for the years 1686, 1687. Mr. Hunt, &c. at Gresham College, for the years 1695, 1696. Dr. Derham, at Upminster, in Essex, for the years 1691, 1692, 1697, 1698, 1699, 1703, 1704, 1705. Mr. Townly, in Lancashire, in 1697, 1698, 1703, 1704, 1705. Mr. Cunningham, at Emin in China, for the years 1698, 1699, 1700.

1700, 1701, at Zurich Phil. T. give as the first rain,

Day.

27

We or diari the M Ephem ments t anemof

Progre trade t readers which p men ha tural, i selves.

flocking their to compan much, fishes p earth, e this he things; weather

1. T sun or to a fa Clarke years, learned fail; at Dr. De it will.

vapour sun's r vapour Accord warmth heavy a high: the vap beams; formed

2. A a chang commo really t which thar he southern hail; o sun has and ag

3. N weathe again; feeds a of dan pimper lib. ii. foretel flowers they a

Eph quem n dit.

The and g not so the stu countr indicat

Tha the we hygro of trac munic The tr No.

1700, 1701. Mr. Locke, at Oates in Essex, 1692. Dr. Scheuchzer, at Zurich, in 1780; and Dr. Tilley, at Pila, the same year. See the Phil. Transactions. The form of Dr. Derham's observations we give as a specimen of a journal of this kind; observing that he notes the strength of the winds, by 0, 1, 2, 3, &c. and the quantity of rain; as it fell through a tunnel, in pounds and centefimals.

Phænomena of the WEATHER, October.

Day.	Hour.	Weather.	Wind.	Barometer.	Rain.
27	7	Fair.	S.W. 2	29 37	1 52
	12	Rain.	S.W. by W. 5	29 34	
	9	Stormy.	0	29 88	0 29

We have several schemes for keeping meteorological journals or diaries of the weather, extant in the Philosophical Transactions, the Medical Essays of Edinburgh, and in other books. The Ephemerides Ultrajectinæ may also be consulted. The instruments necessary for such journal are, a barometer, thermometer, anemoscope, and ombrometer.

Prognostics of the WEATHER. We do not here mean to obtrude the idle arbitrary observations of fanciful people upon our readers. That cloud of popular predictions from the brute world, which partly the sagacity, and partly the credulity, of our countrymen have established, we set aside; as not flowing from any natural, necessary relations, that we know of, in the things themselves. Such as foretelling of rain and wind from water-fowls flocking to land, or land-fowls to the water; from birds pruning their feathers, geese cackling, crows cawing loud, and flying in companies, swallows chattering and flying low, peacocks crying much, asses braying, deer fighting, foxes and wolves howling, fishes playing, ants and bees keeping within doors, moles casting up earth, earth-worms creeping out, &c. We shall offer nothing on this head, but what has some visible foundation in the nature of things; and which lets some light into the cause and reason of the weather itself, or discovers some notable effects thereof.

1. Then a thick dry sky, lasting for some time, without either sun or rain, always becomes first fair, then foul, i. e. it changes to a fair clear sky, before it turns to rain. This the Rev. Mr. Clarke observed, who kept a register of the weather for thirty years, since put into Dr. Derham's hands by his grandson, the learned Dr. Samuel Clarke: he says, he scarcely ever knew it to fail; at least, when the wind was in any of the easterly points; but Dr. Derham has observed the rule to hold good, be the wind where it will. And the cause is obvious. The atmosphere is replete with vapours, which, though sufficient to reflect and intercept the sun's rays from us, yet want density to descend; and while the vapours continue in the same state, the weather will do so too. Accordingly, such weather is generally attended with moderate warmth, and with little or no wind to disturb the vapours, and a heavy atmosphere to sustain them; the barometer being commonly high. But when the cold approaches, and, by condensing, drives the vapours into clouds or drops, then way is made for the sun-beams; till the same vapours, being, by farther condensation, formed into rain, fall down in drops.

2. A change in the warmth of weather is generally followed by a change in the wind. Thus, the northerly and southerly winds, commonly esteemed the cause of cold or warm weather, are really the effects of the coldness or warmth of the atmosphere; of which Dr. Durham assures us he has had so many confirmations, that he makes no doubt of it. Thus, it is common to see a warm southerly wind suddenly change to the north, by the fall of snow or hail; or to see the wind, in a cold frosty morning, north, when the sun has well warmed the earth and air, wheel towards the south; and again turn northerly or easterly in the cold evening.

3. Most vegetables expand their flowers and down in sunshiny weather; and towards the evening, and against rain, close them again; especially at the beginning of their flowering, when their seeds are tender and sensible. This is visible enough in the down of dandelion, and other downs; and eminently in the flowers of pimpernel; the opening and shutting of which, Gerard (Herb. lib. ii.) observes, are the countryman's weather-glass, whereby he foretels the weather of the following day. The rule is, if the flowers are close shut up, it betokens rain, and foul weather: if they are spread abroad, fair weather.

Est & alia (arbor in Tylis) similis, foliosior tamen, rosque floris; quem noctu comprimens, aperire incipit solis exortu, meridie expandit. Incolæ dormire eum dicunt. Plin. Nat. Hist. lib. xii. cap. 11.

The stalk of trefoil, Lord Bacon observes, swells against rain, and grows more upright: and the like may be observed, though not so sensibly, in the stalks of most other plants. He adds, that in the stubble fields there is found a small red flower, called by the country people pimpernel; which opening in a morning, is a sure indication of a fine day.

That vegetables should be affected by the same causes that affect the weather, is very conceivable; if we consider them as so many hygrometers and thermometers, consisting of an infinite number of tracheæ, or air-vessels; by which they have an immediate communication with the air, and partake of its moisture, heat, &c. The tracheæ are very visible in the leaf of the scabiose, vine, &c.

Hence it is, that all wood, even the hardest and most solid, swells in moist weather; the vapours easily insinuating into the pores thereof, especially of that which is lightest and driest. And hence we derive a very extraordinary use of wood, viz. for breaking rocks for millstones. The method at the quarries is this: Having cut a rock into a cylinder, they divide that into several less cylinders, by making holes at proper distances round the great one; the holes they fill with so many pieces of fallow wood, dried in an oven, which, in moist weather, becoming impregnated with the humid corpuscles of the air, swell, and, like wedges, break or cleave the rock into several stones.

WEATHER GLASSES are instruments contrived to indicate the state or disposition of the atmosphere, as to heat, cold, gravity, moisture, &c. to measure the changes befalling it in those respects; and by those means to predict the alteration of weather, as rains, winds, snow, &c. Under the class of weather-glasses are comprehended thermometers, hygrometers, &c.

WEDGE, in mechanics, the last of the five powers, or simple machines. For its description and uses, see the System, Sect. III. No. 5. For representation of its effects and powers, see Plate II. and III.

WEED, a common name of all rank and wild herbs, that grow of themselves without particular culture, to the detriment of other useful herbs, among which they appear. No plants are useless in themselves: but in respect to the farmer they are both useless and hurtful, when they come in this manner, and devour the nourishment destined for the crop of what was sown. For the practical method of extirpating that pernicious weed, the thistle, as recommended by Mr. Curtis, botanist, of Brompton, see the System of AGRICULTURE, Sect. XXVI. under the article *PLOUGHING*, &c.

All weeds are pernicious, but some much more so than others: some are very mischievous, but easily killed; some less hurtful, but with more difficulty rooted out; and some have both qualities together. The hardest to kill are those which grow readily from seed, and have roots, every part of which is qualified for becoming a stout plant in a short time; the worst are couch-grass, colts-foot, melilot, fern, and others of the like kind.

Some of these pernicious plants only affect the crop by imbibing its nourishment, and thus starving and lessening its increase; but there are others which add to this mischief that of spoiling what they leave: these infect the crop with their own nauseous smell, such as melilot, garlic, and some others. The farmer finds it impossible ever entirely to destroy the weeds in his lands; and the reason seems to be, that in some kinds the seeds will lie many years in the ground, and successively grow, some one year, some another; so that the destroying of the crop entirely for one year does not kill them for succeeding ones. The seed of red poppy will lie twenty years in the ground, in a land all that time occupied with saintfoin: and if it be, after that, ploughed for corn, they will all grow, and fill the field. The seeds of these plants will never come up all in one year, because they must have their exact degrees of depth, moisture, and covering; the seeds, which want any of these one year, lie to grow up another. The best defence the farmer has hitherto found against these enemies, is to endeavour their destruction by a summer fallow. This, if the weather be propitious, will make some havoc among them, but it never destroys them entirely. If the seeds lie so high that the summer's heat parches them up, or so deep that it cannot reach them, they do not germinate, and are by that means preserved for another year. What likewise preserves a very great number of them, is their being able to bear the moisture of a whole year without growing. Wild oats, and many other seeds of weeds, are of this kind. If you gather these when ripe, and sow them in the most careful manner, watering them at times, and taking all the care of them that is necessary for the most tender plants, they will not grow till the second spring after they were sowed, and sometimes not till the spring after that; that is, two years and a half after the time of putting them into the ground. It is plain, from this, that no art can destroy these by fallowing, or other means, in one year. The common way of weeding among the young corn turns out to very little good: if this be done while the weeds are young, most of them are only cut or broken off near the ground, this, instead of destroying them, gives them new vigour, and they shoot up with many heads in the place of one, and draw more nourishment than at first: if, on the other hand, it is done when they are grown up, the relief comes after the disease: for by that time they have robbed the corn of all the nourishment, or nearly all, they could.

Hand-weeders also frequently do more harm in the corn, by treading it down, than they do good by taking out the weeds.—This operation sometimes costs the farmer twelve shillings an acre beside the mischief done, and yet there remains weeds enough for a crop the next year from seeds. The method of horse-hoeing is a very excellent way of curing lands of this evil, so long as it is carefully practised; one of the greatest advantages it will bring the farmer is, that no weeds will grow up but those whose seeds are brought in the air, and these are but very few in comparison of the other kind. For practical observations on the methods of horse-hoeing, for the purpose of extirpating weeds, by the Rev. James Cooke, see the System of AGRICULTURE, Sect. XXVII.

WEEK, *Septimana*, *Hebdomada*, in chronology, a division of time, comprising seven days. The origin of this division of weeks, or of computing time by sevenths, is greatly controverted. Some will have it to take its rise from the four quarters or intervals of the moon, between her changes of phases, which being about seven days distant, gave occasion to the division. Be this as it will, the division is certainly very ancient. The Syrians, Egyptians, and most of the Oriental nations appear to have used it from all antiquity: though it did not get footing in the West till Christianity brought it in: the Romans reckoned their days not by sevenths but by ninths; and the ancient Greeks by decads or tenths. Indeed, the Jews divided their time by weeks, but it was upon a different principle from other Eastern nations. God himself having appointed them to work six days, and to rest the seventh, in order to keep up the sense and remembrance of the creation; which being effected in six days, he rested the seventh. Some authors will even have the use of weeks among the other Eastern nations to have proceeded from the Jews: but with little appearance of probability. It is with better reason that others suppose the use of weeks, among the heathens of the East, to be a remnant of the tradition of the creation, which they had still retained, with divers others.

This is the opinion of Grotius, *de Veritat. Relig. Christ.* lib. 1; who likewise proves that not only throughout the East, but even among the Greeks, Italians, Celtæ, Sclavi, and even the Romans themselves, the days were divided into weeks; and that the seventh day was in extraordinary veneration. This appears from Joseph. *adv. Apion.* II. *Philo. de Creatione.* Clem. Alexand. *Strom.* lib. v. Though Heliodorus, lib. i. cap. 84; Philostratus, lib. iii. cap. 13; Dion. lib. xxxviii.; Tibullus, Lucian, Homer, Callimachus, Suetonius, Herodotus, &c. who mention the septenary division of days as very ancient, suppose it to be derived from the Egyptians. The days of the week were denominated by the Jews, from the order of their succession from the sabbath. Thus the day next after the sabbath, they called the first of the sabbath, the next, the second of the sabbath; and so of the rest, except the sixth, which they called *parasceve*, or preparation of the sabbath. Our ancestors, the Saxons, before their conversion to the Christian faith, named the seven days of the week from the sun and moon, and some of their deified heroes, to whom they were peculiarly consecrated, which names we received and still retain; thus Sunday was devoted to the Sun; Monday to the Moon; Tuesday, according to some, to Tuisco or Tuisko, mentioned by Tacitus, but according to others, to Thyfa or Dyfa, the wife of Thor, and the goddess of justice; or, according to others, to Tyr: Wednesday to Woden, the god of war; Thursday to Thor, who presided over the air, and was supposed to govern the winds and clouds; this is the same with Lucan's Taranis, similar to the Welch word for thunder; Friday to Friga, or Fræa, the wife of Thor, and goddess of peace and plenty; and Saturday to Seater, called also Orodos, to whom they prayed for protection, freedom, and concord, and for the fruits of the earth. The origin of the last appellation, however, is doubtful; as some have observed, that the name *Seater* is not mentioned by any writer before *Verfegan*. See *Verfegan's* *Restitution of Decayed Intelligence*, p. 68. *Junii Etym. Angl.* and *Mallet's North. Ant.* vol. i. p. 91, &c.

To find the accomplishment of Daniel's prophecy of the Messiah, the destruction, rebuilding, &c. of the temple, chap. ix. ver. 24, &c. the critics generally agree to understand weeks of years, instead of weeks of days. Accordingly, Dr. Prideaux, fixing the end of these weeks at the death of Christ, in the year of the Julian period 4746, and in the Jewish month Nisan, dates their commencement in the month Nisan, in the year of the Julian period 4256, which was the very year and month in which Ezra had his commission from Artaxerxes Longimanus, king of Persia, for his return to Jerusalem, there to restore the church and state of the Jews. And thus he finds, that from the one period to the other, there were exactly seventy week of years, or 490 years. *Connect.* vol. ii. p. 381, &c.

Passion-WEEK, or the **Holy WEEK**, is the last week in Lent, wherein the church celebrates the mystery of our Saviour's death, and passion. This is also sometimes called the great week. Its institution is generally referred, both by Protestants and Papists, to the time of the apostles. All the days of that week were held as fasts: no work was done on them; no justice was distributed; but the prisoners were ordinarily set at liberty, &c.; even pleasures, otherwise allowed, were at this time prohibited. The osculum charitatis was now forborn: and divers mortifications practised by all sorts of people, and even the emperors themselves.

WEIGHING Chair, a machine contrived by Sanctorius, to determine the quantity of matter carried off from the body, and that of food taken at a meal; and to warn the feeder when he had eaten his quantum. That ingenious author, having observed, with many others, that a great part of our disorders arose from the excess in the quantity of foods, more than the qualities thereof; as also how much a fixed portion, once well adjusted, would, if kept to regularly, contribute to health, bethought himself of an expedient to that purpose. The result was the weighing-chair: which was a chair fixed at one arm of a sort of balance, wherein a person

being seated at meat, as soon as he had eaten his allowance, the increase of weight made his seat preponderate; so that, descending to the ground, he left his table, victuals, and all, out of reach.

WEIGHT, *Gravitas*, *Pondus*, in physics, a quality in natural bodies, whereby they tend downwards, towards the centre of the earth. See **GRAVITY**. Or, weight may be defined, in a less limited manner, to be a power inherent in all bodies, whereby they tend to some common point, called the centre of gravity; and that with a greater or less velocity, as they are more or less dense, or as the medium they pass through is more or less rare. In the common use of language, weight and gravity are considered as one and the same thing. Some authors, however, make a difference between them: and hold gravity only to express a nisus, or endeavour to descend; but weight an actual descent. But there is room for a better distinction. In effect, one may conceive gravity to be the quality, as inherent in the body; and weight, the same quality, exerting itself, either against an obstacle, or otherwise. Hence, weight may be distinguished, like gravity, into absolute and specific. Sir Isaac Newton demonstrates, that the weights of all bodies, at equal distances from the centre of the earth, are proportionable to the quantities of matter each contains. Whence it follows, that the weights of bodies have not any dependance on their forms or textures; and that all spaces are not equally full of matter. Hence, also, it follows, that the weight of the same body is different, on the surface of different parts of the earth; because its figure is not a sphere, but a spheroid. In the Philosophical Transactions (No. 458, p. 457, &c.) we have an account of the analogy betwixt English weights and measures by Mr. Barlow. He advances, that, anciently, a cubic foot of water was assumed as a general standard for liquids, and weighed 62 pounds and a half. This cubic foot, multiplied by 32, gives two thousand, the weight of a ton. And hence eight cubic feet of water made a hoghead, and four hogheads a ton, in capacity and denomination as well as weight. Dry measures were raised on the same model. A bushel of wheat, assumed as a general standard for all sorts of grain, also weighing 62 pounds and a half. Eight of these bushels made a quarter, and four quarters made a ton weight. Coals were sold by the chaldron, supposed to weigh a ton, or 2000 pounds. Hence a ton in weight is the common standard for liquids, wheat, and coals. If this analogy had been kept up, it would have prevented the confusion now complained of. It may be reasonably supposed that corn and other commodities, both dry and liquid, were first sold by weight, and that measures, for convenience, were afterwards introduced, bearing some analogy to the weights before used. Mr. Barlow's scheme shews the reason why the word *ton* is applied both to weight and liquid measure, viz. because the same quantity of liquor is a ton, both in weight and measure. Hence the word *quarter* may also be explained. Bishop Fleetwood (*Chron. Petr.* p. 72) guessed that it signified the fourth part of some weight, and not of any measure. And it seems plainly to signify the fourth part of a ton, or 2000 pounds. *Phil. Trans. Abr.* vol. ix. p. 489.

WEIGHT, in mechanics, is any thing to be raised, sustained, or moved by a machine; or any thing that in any manner resists the motion to be produced. See **MOTION**, &c. In all machines, there is a natural ratio between the weight and the moving power. If the weight be increased, the power must be so too; that is, the wheels, &c. are to be multiplied, and so the time increased, or the velocity diminished. See the **System of MECHANICS**, Sect. I. and II.

WEIGHT, in commerce, denotes a body of a known weight appointed to be put in the balance against other bodies, whose weight is required. These weights are usually of lead, iron, or brass; though in divers parts of the East-Indies they are common flints, and, in some places, a sort of little beans. The security of commerce depending, in a great measure, on the justness of these weights, there is scarcely any nation that has not taken proper measures to prevent the falsification thereof. The surest means are the stamping, or marking of them by proper officers, from some original or standard, deposited where recourse may be had to them. This expedient is very ancient; and many authors are of opinion, that what among the Jews was called *shekel of the sanctuary*, was not any particular kind of weight, different from the common one; but a standard original weight, preserved by the priests in the sanctuary.

Thus, also, in England, the standard of weights is kept in the exchequer, by a particular officer, called the *clerk*, or *comptroller of the market*.

Most nations wherein there is any thing of commerce flourishing, have their particular weights: and even sometimes different weights in the different provinces, and for the different kinds of commodities. The diversity of weights makes one of the most perplexing articles in commerce; but it is irremediable. The reducing of the weights of different nations to one, is not only impracticable, but even the reduction of those of the same nation; witness the vain attempts made for reducing the weights in France, by so many of their kings; Charlemagne, Philip the Long, Louis XI. Francis I. Henry II. Charles IX. Henry III. Louis XIV.

WEIGHT of the Air is equal to the elasticity thereof. There are

are various ways of estimating the weight of the air, for which see the System of AEROLOGY, Sect. I.

The *WEIGHT of Sea-Water* is different in different climates. Mr. Boyle having furnished a learned physician, going on a voyage to America, with an hydrostatical balance, and recommended him to observe, from time to time, the difference of weight he might meet withal, this account was returned him; that the sea-water increased in weight, the nearer he came to the line, till he arrived at a certain degree of latitude, as he remembers, about the 30th; beyond which, it retained the same specific weight, till he came to Barbadoes. Philof. Transf. No. 18.

The weight of a cubical inch of good brandy, rum, or other proof spirits, is 235.7 grains; therefore if a true inch cube of any metal weighs 235.7 grains less in spirits than in air, it shews, the spirits are proof; if it loses less of its aërial weight in spirits, they are above proof; if it loses more, they are under; for, the better the spirits are, they are the lighter; and the worse, the heavier. As all bodies expand with heat, and contract with cold, in different degrees, the specific gravities of bodies are not precisely the same in summer as in winter. It has been found, that a cubic inch of good brandy is 10 grains heavier in winter than in summer; as much spirit of nitre, 20 grains; vinegar, 6 grains; and spring-water, 3. Hence it is most profitable to buy spirits in winter, and sell them in summer, since they are always bought and sold by measure. It has been found, that 32 gallons of spirits in winter will make 33 in summer. Ferguson's Lect. p. 98, 4to. See *HYDROMETER*.

WEIGHT of the Human Body. It has been observed, that the heat and dryness of the air both lessen the weight of the body, and the cold and moisture of the air both increase this weight. See *MOISTURE*. Much sleep, much food, and little exercise, are the principal things which increase the weight of the body, and make animals grow fat. Consequently, if the weight of the body be too great for a good and uninterrupted health, it may be lessened by diminishing sleep and food, and by increasing exercise. On the contrary, if the weight of the body be too little for good health, it may be increased by adding to food and sleep, and by lessening exercise: and the food must be increased chiefly by increasing drink and liquid nourishment. For the discharges are commonly less from drink and liquid nourishment, than from dry and solid food. There is but one weight under which a body can enjoy the best and uninterrupted health, and that weight must be such, that perspiration and urine may be nearly equal at all seasons of the year; for by this means the body will be uniformly drained of its moisture: the inward parts by urine, and the more superficial parts by perspiration, without any irregular and unnatural discharges, and its moving weight will continue nearly the same at all seasons of the year. Dr. Bryan Robinson thinks this weight may be settled by his observations in his Treatise on the Food and Discharges of Human Bodies. A quick increase of weight in human bodies often produces distempers; the best way to prevent this increase is either by fasting or exercise. But amidst a variety of disturbing causes, nothing so effectually prevents such an increase of weight as a very exact and regular diet, which may prevent the discharges from running into irregularities and disproportions to one another. See Dr. Bryan Robinson on the Food and Discharges of Human Bodies, p. 89, seq. Men and other animals of extraordinary weight, are often recorded in the writings of the learned. See Phil. Transf. No. 479, p. 102.

Athletic WEIGHT, in an animal economy, is that weight of the body under which an animal has the greatest strength and activity. Dr. Robinson thinks this happens when the weight of the heart, and the proportion of the weight of the heart to the weight of the body, are greatest. For the strength of an animal is measured by the strength of its muscles, and the strength of the muscles is measured by the strength of the heart. Also the activity of an animal is measured by the weight of the heart, in proportion to the weight of the body. If the weight of the body of an animal be greater than its athletic weight, it may be reduced to that weight by evacuations, dry food, and exercise. These lessen the weight of the body by wasting its fat, and lessening its liver, and they increase the weight of the heart, by increasing the quantity and motion of the blood; so that by lessening the weight of the body, and by increasing that of the heart, they will soon reduce the animal to its athletic weight.

Thus a game-cock, in ten days, is reduced to its athletic weight, and prepared for fighting. If the food which, with the evacuations and exercise, reduced the cock to its athletic weight in ten days, be continued any longer, the cock will lose his strength and activity. It is known, by experience, that a cock cannot stand above twenty-four hours at his athletic weight, and that he has even changed for the worse in twelve hours. When he is in the best condition, his head is of a glowing red colour, his neck thick, and his thigh thick and firm; the day after, his complexion is less glowing, his neck thinner, and his thigh softer; and the third day his thigh will be very soft and flaccid. Four game-cocks reducing to their athletic weight, were killed, and found to be very full of blood, with large hearts, large muscles, and no fat. It is to be observed, that the athletic weight of an animal is a very dangerous weight. Fevers and apoplexies are the disorders which com-

monly happen to animals under or near the athletic weights. Hence, horses fed upon dry food are much more subject to fevers and apoplexies than horses fed upon grass. Robinson's Dissertation, p. 117, &c.

WELD, or *WOLD*, a plant used by dyers, to give a yellow colour, and for this reason called, in Latin, *luteola*, of *luteus*, yellow.

This plant grows wild on dry grounds; but it is also cultivated for use. It is a very rich commodity amongst the dyers, and is the more advantageous to the farmer, as it may be raised on very poor land, at a very small expence. Moderately fertile land does best for it; but it will grow upon the most barren; and if this be but dry and warm, it will require no tillage. The seed may be sown with barley or oats, and only harrowed in with brugh or furze, or rolled down with a wooden roller. It is a very small seed, and the greatest difficulty is sowing it even. It is a slow grower; a gallon of seed is sufficient for an acre: and though it makes but little progress the first summer, it begins to grow after the corn is cut, and the next year yields a good crop. However, though weld will grow upon very poor soil, the crop will be in proportion to the goodness of the soil.

The best way to cultivate it, is to sow it without any other crop. In the beginning or middle of August, the ground which, unless it be poor, wants no dung, being plowed and harrowed fine, the seeds should be sowed in the proportion of a gallon to an acre. In about two months the plants will come up, so as to be distinguished from weeds; and should be hoed like turnips, leaving them about six inches distant. If this hoeing be performed in dry weather, the plants will be clean from weeds till spring; in March they should be hoed again; and, if weeds appear, a third time about the beginning of May. The best time to pull the weld for use is when it begins to flower, though most people stay till the seeds are ripe, being unwilling to lose the seeds: but Mr. Miller advises to sow a small piece of land to remain for a produce of new seeds. By drawing off the crop early, as towards the latter end of June, the ground may be sown with wheat the same season: and the plants at this time will be in the greatest vigour, and afford a greater quantity of the dye.

When the plants are pulled, they may be set up in small handfuls to dry in the field, and when dry enough, tied up in bundles and housed dry; care being taken to house them loosely, that the air may pass between them to prevent their fermenting. That which is left for seeds should be pulled as soon as the seeds are ripe, and set up to dry; and then beat out for use; for if the plants are left too long, the seeds will scatter. Weld is much cultivated in Kent, for the use of the London dyers. With the help of potashes, it yields a deep lemon-colour; but either by the largeness of the proportion put into the liquor, or by taking from it a stronger or lighter tincture, it serves to dye all colours between white and a deep yellow. Its dye will hold well, except against urine and tartareous liquors. Mr. Hellot observes, in his *Art de Teindre*, that for dyeing with weld, the best proportions of alum and tartar, for the preparatory liquor, are four parts of alum, and one of tartar, to sixteen of the wool: and that the wool, prepared with these, is to be boiled again with five or six times its quantity of weld: that for light shades, it is customary to diminish the alum, and omit the tartar; and that in this case, the colour is more slowly imbibed, and proves less durable. For further particulars respecting the uses of this plant in dyeing, see the Treatise on *DYEING*.

WELDING HEAT, a degree of heat which smiths give their iron in the forge, when there is occasion to double up iron, and to weld a work in the doublings; so that the iron should grow into a lump thick enough for the purpose. It is also used when two bars of iron are to be joined together at the ends, to make a length. See *IRON*.

WELL, a hole dug underground, below the level or surface of the water collected in the strata. It is usually of a cylindrical figure, and commonly walled with stone, and lined with mortar. Mr. Blondel informs the Royal Academy of Sciences of a device they use, in the Lower Austria, which is encompassed with the mountains of Stiria, to fill their wells with water; viz. that they dig in the earth, to the depth of twenty or twenty-five feet, till they come to a clammy earth, which they bore into, continuing the operation till the water breaks forcibly out; which water, in all probability, comes from the neighbouring mountains, in subterraneous channels. Cassini observes, that in many places of Modena and Bologna, they make themselves wells by the same artifice. Dr. Derham adds, that the like has been sometimes found in England, particularly in Essex. In the Philosophical Transactions, we are informed, by Mr. Norwood, that in Bermudas, wells of fresh water are dug within twenty yards of the sea, and even less, which rise and fall with the tides, as the sea itself does. He adds, that, in digging wells in that island, they dig till they come almost to a level with the surface of the sea; and then they certainly find either fresh water, or salt: if it prove fresh, yet, by digging two or three feet deeper, they always come at salt water. If it be sandy ground, they usually find fresh; but if hard lime-stone rock, the water is commonly salt, or brackish. Lay-well, near Torbay, ebbs and flows very often every hour; though somewhat oftener in

W H A

in winter than in summer. Dr. Oliver observes, its flux and reflux sometimes return every minute; though, at other times, not above twenty-six or twenty-eight times in an hour. *Philos. Transf.* No. 104.

WELL, in the military art, denotes a depth which the miner sinks, into the ground, from which he runs out branches or galleries, either to prepare a mine, or find out, and disappoint, the enemy's mine. See the article WAR.

WEN, in surgery, a tumor, or excrescence, growing on divers parts of body: consisting of a cystis, or bag, filled with some peculiar matter. Wens are all, usually, of the like colour with the rest of the body; they begin from very little, and grow gradually. They are not dangerous, but generally last a long while. Sometimes they degenerate into abscesses. The cure is, to cut off the cystis by the root, which is always narrow. In the *Philosophical Transactions*, we have an account of a very extraordinary wen, on the lower jaw of one Alexander Palmer, of Keith, in Scotland. It was twenty-seven years in growing; at length its enormous bulk, and the pain it gave him, together with its emaciating him exceedingly, determined him to have it cut off. Dr. Bowers assures us, its basis was five inches over, which should seem too large for the whole face; and that, with blood and all, it weighed one or two and twenty pounds. Its form was spheroidal; and, when measured, it was thirty-four inches about one way, and twenty-eight another. It seemed to be an atheroma, being a glandulous substance, with several large blood-vessels in it, and hair growing on it: it was as sensible as any other part. The hæmorrhage, after cutting it off, was stopped by the vitriolic powder; and, the ordinary dressing being used, a cure was completed in six weeks' time.

WEST, *Occident*, in cosmography, one of the cardinal points of the horizon; diametrically opposite to the East. West is strictly defined, the intersection of the prime vertical with the horizon, on that side which the sun sets.

WEST, in astronomy, is chiefly used for the place in or towards which the sun or stars sink, under the horizon. Thus we say, the Sun, Mars, &c. are in the west. The point in which the sun sets when in the equator, is particularly called the *equinoctial west*, or *point of true west*.

WEST, and WESTERN, in geography, are applied to certain countries, &c. situate towards the point of sun-setting with respect to certain others. Thus, the empire of Rome, anciently, and of Germany, at present, is called the *empire of the West*, or *Western empire*, in opposition to that of Constantinople, which is called the *empire of the East*. The Latin or Roman Church is called the *western church* in opposition to the Greek Church. The French, Spaniards, Italians, &c. are called *western nations*, in respect to the Asiatics; and America, the *West-Indies*, in respect of the East Indies.

WET COUCH, a term used by the malsters for one of the principal articles of malt-making. In making malt, the usual way is to soak the grain in water two or three days, till it becomes plump and swelled, and the water is brown; the water is then drained away, and the barley removed to a floor, where it is thrown into a wet couch, that is, an even heap, of about two feet thick. In this heap the barley spontaneously heats, and begins to grow, shooting out first the radicle, and, if suffered to continue growing, soon after the blade; but at the eruption of the radicle, the process is to be stopped short, by spreading the wet couch thin over the floor, and turning it once every four or five hours for two days, laying it thicker each time; after this it is thrown into a large heap, and there suffered to grow hot of itself; and afterwards spread abroad again and cooled, and then thrown upon the kiln to be dried crisp, without scorching. Shaw's *Lectures*, p. 186.

WHALE, in astronomy, one of the southern constellations. See the *System*, Sect. VIII. and Plate VI.

WHALE, *Cete*, in the Linnæan system, the seventh order in the class of mammalia; the characters of which are, that the animals of this order have breathing apertures on the head, pectoral fins, the tail placed horizontally, and no claws. The order includes four genera, viz. *monodon*, or *sea-unicorn*; *balæna*, or *whale*; *physeter*, and *delphinus*, comprehending the dolphin, porpoise, and grampus. See those articles. The genus *balæna*, or *whale*, is distinguished by having horny laminae in the upper jaw, instead of teeth, and a double fistula, or pipe, in the head; it includes four species. The anatomy of the whale has been so little understood, that there have been very great errors in regard to such of them as have been at times found fossil, or buried in the earth among the teeth of elephants, and the remains of testaceous and other animals. The most frequent and most ridiculous of all the wrong opinions about these, is their having originally belonged to creatures of the human species; yet many, even among the more intelligent part of the world, have taken them for the remains of giants. The vertebrae of a whale have been mistaken for those of a giant, and a part of its fins for a hand, and so of the rest. While the world, more ready to spread the marvel, than to enquire into the truth, have made computations of the height of a man to whom bones of that size must have belonged, and from their proportion in regard to those of the common human size, have found the giant who possessed them must have been ninety or a hundred feet high: much less pains in comparative anatomy would have taught them that

W H E

they never could have belonged to the human body at all. *Mem. Acad. Pr.* 1727. See GIANT.

SPERMACELE-WHALE. See PHYSETER, and SPERMACELE. See on the subjects of the preceding articles, Crantz's *Hist. of Greenland*, vol. i. p. 106, &c. Pennant's *Brit. Zool.* vol. iii. p. 50, &c. *Phil. Transf. Abr.* vol. viii. p. 424, &c.

WHEAT, in botany, a genus of the Triandria class. Its characters are these: it has an oval chaffy empalement, with two valves, which inclose two or three flowers; the petals have a double valve, as large as the empalement; the outer valve is bellied and acute-pointed, the inner is plain; the flowers have three hair-like stamina, terminated by oblong forked summits, and a top-shaped germin, supporting two hairy reflexed styles, crowned by feathered stigmas; the germin afterwards becomes an oblong oval seed, obtuse at both ends, convex at one side, and channelled on the other, wrapped up in the petal of the flower. Miller enumerates four, and Linnæus eleven, species.

Buck-WHEAT, in botany, a species of Polygonum in the Linnæan system. Buck-wheat is cultivated in many parts of England, and is a very great improvement of dry barren lands. The best season for sowing it is in May, and one bushel of the seed is enough for an acre; the ground is to be dressed for it exactly as for barley; and if the soil is not very clean, it will yield a very large increase, as fifty bushels an acre, and is excellent food for hogs and poultry. The flour of it is also very white, and, mixed with wheat-flour, is eaten in some countries, and when broken in a mill, makes a fine addition to corn for horses, making them soon grow fat. It is commonly late in the season before it is ripe, but it is in no danger from standing; when it is cut, it is usually laid many days to dry before it is housed. Besides these uses, some people sow it very thick, and suffer it to grow up till it is near flowering, they then plough it in, and it makes a very good land for wheat or rye. But the best way is, just before it blossoms, to graze it with cattle, especially with milch-cows, which it causes to yield a great deal of milk, and that such as affords very good cheese and butter. It is food for the cattle in the very driest time, when all the grass in common pastures is burnt up; and proves a very great improvement for the land. For this purpose they sow it thicker than for others, sometimes three or four bushels on an acre. For a more copious account of the different sorts of wheat, with the methods of sowing and cultivating, see the *System of AGRICULTURE*, Sect. III.

WHEEL, in mechanics, a simple machine, consisting of a round piece of wood, metal, or other matter, which revolves on an axis. The wheel is one of the principal mechanic powers. It has place in most engines; in effect it is of an assemblage of wheels that most of our chief engines are composed. Witness clocks, mills, &c. Its form is various, according to the motion it is to have, and the use it is to answer. By this it is distinguished into simple and dented. See the *System of MECHANICS*, Sect. III. and Plate III.

Persian-WHEEL. See the *System of HYDRAULICS*, and HYDROSTATICS, Part II. Art. 7, and Fig. 21, in the Plate annexed to the *System*.

WHEEL is also the name of a kind of punishment, which great criminals are put to in divers countries. In France their assassins, parricides, &c. were, previous to the revolution, condemned to the wheel; i. e. to have their bones first broken with an iron bar on a scaffold, and then to be exposed and left to expire on the circumference of a wheel. In Germany they break their bones first on the wheel itself. This cruel punishment was unknown to the ancients, as is observed by Cujas. It is not certain who was the inventor. Its first introduction was in Germany. It was, indeed, but rarely practised any where else, till the time of Francis I. of France; who by an edict in the year 1534, appointed it to be inflicted on robbers on the highway. Richelet dates the edict in the year 1538, and quotes Brodæus, *Miscell. lib. ii. cap. 10*.

WHEEL-Animals, in vermology, a genus of the zoophytes, which have an apparatus or arms for taking their prey. This apparatus has been supposed, by microscopical writers, to be a kind of wheels. The wheel-animal, described by Mr. Baker, has two seeming wheels, with a great many teeth or notches, coming from its head, and turning round as it were on an axis. On the least touch, this animalcule draws its wheels into its body into the sheath; but, when every thing is quiet, throws them out, and works them again. In order to find these animalcules, choose such roots of duckweed as are long, and proceed from strong old plants, for the young roots seldom afford any: they should not be covered with that rough matter which is frequently found about them, nor any way tending to decay, as they will often be. In the water found remaining in the leaden pipes, or gutters on the tops of houses, there are also found great numbers of these wheel-animals. These are of a different species from the former; and when the water dries away, they contract their bodies into a globular or oval figure, and are then of a reddish colour, and remain mixed with the dirt, growing together in a lump as hard as clay. This, whenever it is put in water, in half an hour's time discovers the animal's living again, and as brisk as ever, and they have been found to be living in this manner, after the matter had been kept dry twenty months. It should seem from this that as the water dries

up, their pores become shut in the manner of those of such animals as remain torpid for the winter; and that when they find water come on again from rain, they then unfold themselves, and live and feed as long as it lasts. For description of the different kinds of animalcules, see MICROSCOPIC OBJECTS: for representation, see Plate I.

WHEY, the serum, or watery part of milk. In many disorders of the human body, where the stomach will not bear milk, or when it is not proper for other reasons, whey may be given with great success. We have a dissertation of Fred. Hoffman on this subject, *De Saluberrima feri Lactis Virtute*. Oper. tom. vi. p. 9. This author recommends a particular kind of serum or whey, made by evaporating milk to a dryness, and mixing the residuum with water. See MILK.

There are various methods of making whey, commonly known. That with oranges is very agreeable, and much recommended by Dr. Cheyne, in his *Nat. Method of curing Diseases*.

Mustard-WHEY, is made by boiling of bruised mustard-seed, an ounce and a half, in milk and water, of each a pint, till the curd is perfectly separated, and straining the whey through a cloth. This, says Dr. Buchan, is the most elegant, and by no means the least efficacious method of exhibiting mustard; it warms and invigorates the habit, and promotes the different secretions. Hence, in the low state of nervous fevers, it will often supply the place of wine: it is also of use in the chronic rheumatism, palsy, dropsy, &c. The dose is a teacupful four or five times a day, which may be sweetened with a little sugar.

Scorbutic-WHEY is made by boiling half a pint of the scorbutic juices in a quart of cow's milk. The scorbutic plants are bitter-oranges, brook-lime, garden scurvy-grass, and water-creffes.

WHIGS, a party or faction, in England, opposite to the Tories. The origin of the names of these two factions is very obscure. If some little trivial circumstance or adventure, which escapes the knowledge of mankind, gives name to a party, which afterwards becomes famous, posterity labours in vain to find the original of such a name; it searches the sources, forms conjectures, invents reasons, and sometimes, indeed, meets the truth, but always without knowing it assuredly. Thus, in France, the Calvinists are called *Hugonots*; yet nobody was ever able certainly to assign the cause of that appellation. Whig is a Scottish, and some say, an Irish word, literally signifying whey. Tory is another Irish word, signifying a *robber* or *highwayman*. Under the reign of king Charles II. while his brother, then duke of York, was obliged to retire into Scotland, there were two parties formed in that country. That of the duke, which was strongest, persecuted the other, and frequently obliged them to fly into the mountains and woods; where those unhappy fugitives had often no other subsistence for a long time but cows' milk. Hence they called these their adversaries *Tories*; *q. d.* *robbers*; and the Tories, upbraiding them with their unhappiness, from the milk on which they lived, called them *whigs*. From Scotland, the two names came over with the duke into England. Others give a different origin and etymology of the two words, for which see **TORIES**.

Bishop Burnet gives another etymology of the term *whigs*. The south-west counties of Scotland, he says, are supplied with corn from Leith; and from a word *whigham* used by the carriers in driving their horses, all that drove were called *whiggamors*, and by contraction *whigs*. He adds, that in the year 1648, after the news of the defeat of duke Hamilton, who was charged with being a confederate with the malignants, or royal party, in England, the ministers animated their people to rise, and march to Edinburgh: they came up marching each at the head of his parish, with an unheard of fury, praying and preaching all the way as they came. The marquis of Argyle and his party came and headed them. This was called the *whiggamors'* inroad; and ever after, all that opposed the court were contemptuously called *whigs*; and from Scotland the term was brought into England. Burnet's *Hist. of his own Times*, vol. i. p. 43. For the distinguishing principles and characters of the whigs, see **TORIES**.

WHIRLPOOL, an eddy, vortex, or gulf, where the water is continually turning round. These in rivers are very common, from various accidents, and are usually very trivial, and of little consequence. In the sea they are more rare, but more dangerous. Sibbald has related the effects of a very remarkable marine whirlpool among the Orcades, which might prove very dangerous to strangers, though it is of no consequence to the people who are used to it. This is not fixed to any particular place, but appears in various parts of the limits of the sea among those islands. Wherever it appears, it is very furious, and boats, &c. would inevitably be drawn in and perish with it; but the people who navigate them are prepared for it, and always carry an empty vessel, a log of wood, a large bundle of straw, or some such thing, in the boat with them; as soon as they perceive the whirlpool, they toss this within its vortex, keeping themselves out; this substance, whatever it be, is immediately received in the centre, and carried under water; and as soon as this is done, the surface of the place where the whirlpool was, becomes smooth, and they row over it with safety; and in about an hour they see the vortex begin again in some other place, usually about a mile distant from the first. Sibbald's *Prodr. Hist. Scotl.*

No. 150.

WHIRLWIND, a wind that rises suddenly, and is exceedingly rapid and tempestuous, when risen, but is soon spent.

It is, however, highly probable that all these violent emotions of the air are ultimately owing to the emission of electric matter from the earth. It is mentioned, as a certain sign of an approaching hurricane in the West-Indies, that the sea-water becomes exceedingly clear and transparent of a sudden; after which it seems to boil, and the waves begin to rise, though there is not the least wind. Both these phenomena can be accounted for on no other principle than that of a quantity of electric matter attempting to get out from the earth. Now, though hurricanes are not precisely of the nature of whirlwinds, as not having a circular motion, it is highly probable that the latter are occasioned, by some means or other, by a similar cause. A stream of electric matter issuing with violence into the atmosphere from any part of the earth, will cause a kind of vacuum in the atmosphere directly above that place, and, of consequence, a whirlwind or water-spout, by the air rushing in on all sides to supply the vacuum. If this is the true principle on which these phenomena depend, then we are sure that there never was any hurricane or whirlwind so violent as to remove any obstacle of the size of only one cubic inch, provided that was supported by a power equivalent to fifteen pounds; for this is the utmost force of the atmosphere when rushing into a perfect vacuum, which never could take place in the centre of a whirlwind or water-spout. Indeed, notwithstanding the dreadful effects sometimes observed from hurricanes and whirlwinds, we shall easily perceive that the utmost of their power always falls very short of this. The diminution of the specific gravity of the air by only one-fourth in the middle of the column, would produce such an influx of air from all quarters, that an obstacle presenting a surface one foot square would require a force of 504 pounds to prevent it from being carried away; which scarcely the strongest walls that can be built by human art could resist. Nay, even the tenth part of this, or the diminution of the gravity of the atmosphere by one-fortieth part, would produce a pressure of upwards of 50 pounds on every square foot of surface, which it is to be doubted whether any of our common houses could resist.

As this degree of rarefaction in the atmosphere would only produce a descent of about three-fourths of an inch in the barometer, it may seem wonderful why the most violent whirlwinds do not take place at those times when the mercury descends two or more inches, which descents are by no means unfrequent. But here it is to be remembered, that, by whatever means this descent of the barometer is occasioned, by a certain expansive power in the rarefied place of the atmosphere, the air is prevented from rushing in eddies, and forming the whirlwind. Now, in the case of electric matter escaping from the earth, ascending into the higher regions of the atmosphere, and carrying part of the air along with it, we see that there could be no expansion, but, on the contrary, a continued suction; and, if the electric stream should happen to be stopped in one place, and break out in another, the spout or whirlwind would immediately vanish in the one place, and appear in the other, as is often observed in whirlwinds and water-spouts. Its progressive motion might be owing to the electric current perpetually shifting its place; in which case the whirlwind would constantly follow it, for the reasons already given.

Some kinds of whirlwinds move with a slow motion, and are injurious only by their vortex; while others seem to do mischief as well by their progressive as by their whirling motion. Of this kind are those called *typhons*; which by their frequently following the course of rivers, seem thus also to discover their electrical origin. Of the destructive effects of these, we have an instance in what happened at Charlestown, in South Carolina, on the 11th of June, 1761. It was first observed about noon, on land, upwards of 50 miles west-by-south of Charlestown, and destroyed several houses, &c. as it passed along, in many places making wide avenues through the woods, from whence every tree and shrub was torn up, and great branches of trees were driven about in the column as it passed along. It directed its course to Ashley river, down which it came with surprising velocity, in its appearance resembling a column of smoke or vapour, whose motion was very irregular and tumultuous. Its momentum was so great, that Ashley river was ploughed to the bottom, and the channel laid bare. As it came down this river, it made a constant noise like thunder; its diameter being computed about 300 fathoms. It was met at White's Point by another of the same kind, which came down Cooper's river, but with inferior strength; however on their meeting together, the agitation of the air was much greater, while the clouds, which were driving in all directions to the place, seemed to be precipitated and whirled round with incredible velocity. It then fell upon the shipping in the road, entirely destroyed some, and damaged others, being scarcely three minutes in its passage, though the distance was near two leagues. In that short time, it did damage to the amount of 20,000*l.* and had not its direction been altered by that gulf which came down Cooper's river, it must have totally destroyed Charlestown, as no obstacle whatever seemed capable of resisting its fury. It is observable, that whirlwinds do not arise with all their fury at once, but increase in strength as they go along. Dr. Franklin relates, that he once rode for a considerable way by the side of one which had but newly

5 R

arisen

arisen, and could scarce lift up any thing but dust, its vortex being only a few inches in diameter; but as it went along, the strength and diameter constantly increased, till at last, as it began to take up and whirl round large branches of trees, it became dangerous for him to accompany it any longer.

The Doctor, in his Physical and Meteorological Observations, read to the Royal Society in 1756, supposes a whirlwind and water-spout to proceed from the same cause; their only difference being, that the latter passes over the water and the former over the land. This opinion is corroborated by the observations of M. de la Fryme, and many others, who have remarked the appearance and effects of both to be the same. They have both a progressive as well as a circular motion; they generally rise after calms and great heats, and occur most frequently in the warmer latitudes: the wind blows every way from a large surrounding space both to the water-spout and whirlwind; and the water-spout has, by its progressive motion, passed from the sea to the land, and produced all the phenomena and effects of a whirlwind: so that there is no reason to doubt their being meteors arising from the same general cause, and explicable upon the same principles, furnished by electrical experiments and discoveries. See HURRICANE.

For Dr. Franklin's ingenious method of accounting for both these phenomena, see his Letters and Papers, &c. vol. i. p. 191, &c. p. 216, &c.

WHISKY, a term signifying *water*, and applied, in the Highlands and islands of Scotland, and in Ireland, to strong-water, or distilled liquor. The spirit drank in the North is drawn from barley; and is said to be preferable to any English malt brandy: it is strong, but not pungent, and is free from the empyreumatic taste or smell.

WHISPERING-places; these depend on this principle, that the voice being applied to one end of an arch, easily passes, by repeated reflections, to the other. All the contrivance in a whispering-place is, that near the person who whispers, there be a smooth wall, arched either cylindrically or elliptically. A circular arch will do, but not so well. Places famous for the conveyance of whispers are, the prison of Dionysius at Syracuse, which increased a soft whisper to a loud noise, the clap of one's hand to the sound of a cannon, &c. The aqueducts of Claudius, which carried a voice sixteen miles; and divers others, enumerated by Kircher in his Phonurgia. The most considerable in England are, the dome of St. Paul's, London, where the ticking of a watch may be heard from side to side; and a very easy whisper be sent all round the dome; this Dr. Derham found to hold not only in the gallery below, but above, upon the scaffold, where a whisper would be carried over one's head round the top of the arch, though there is a large opening in the middle of it into the upper part of the dome: and the famous whispering-place in Gloucester cathedral, which is no other than a gallery at the east end of the choir, leading from one side thereof to the other. It consists of five angles and six sides, the middlemost of which is a naked window; yet two whisperers there hear each other at the distance of twenty-five yards. See Birch's Hist. of the Royal Society, vol. i. p. 120. See also, the System of Acoustics, Chap. III.

WHITE, one of the colours of natural bodies. White is not so properly said to be of any one colour as a composition of all the colours; it being demonstrated by Sir Isaac Newton that those bodies only appear white which reflect all the kind of coloured rays alike, and that the light of the sun is only white, because consisting of all colours. From the multitude of rings of colours, which appear from compressing two prisms, or object-glasses of telescopes, together, it is manifest, that these do so interfere and mingle with one another at last, as, after eight or nine reflections, to dilute one another wholly, and constitute an even and uniform whiteness; whence, as well as from other experiments, it appears, that whiteness is certainly a mixture of all colours; and that the light, which conveys it to the eye, is a mixture of rays endued with all those colours. The same author shews, that whiteness, if it be most strong and luminous, is to be reckoned of the first order of colours; but, if less, as a mixture of the colours of several orders. Of the former sort, he reckons white metals, and of the latter, the whiteness of froth, paper, linen, and most other white substances. And as the white of the first order is the strongest that can be made by plates of transparent substances, so it ought to be stronger in the denser substances of metals than in the rarer ones of air, water, and glass.

Gold or copper, mixed, either by fusion or amalgamation, with a very little mercury, with silver, tin, or regulus of antimony, become white; which shews, both that the particles of white metals have much more surface, and therefore are smaller than those of gold or copper; and also, that they are so opaque as not to suffer the particles of gold or copper to shine through them. And, as that author doubts not but that the colours of gold and copper are of the second and third order, therefore the particles of white metals cannot be much bigger than is requisite to make them reflect the white of the first order. Hevelius affirms it as a thing most certain, that in the northern countries animals, as hares, foxes, bears, &c. become white in the winter time; and, in summer, resume their natural colours. Black bodies are found to take heat sooner than white ones, by reason the former absorb or imbibe

rays of all kinds and colours, and the latter reflect all. Thus, black paper is sooner put into a flame by a burning-glass, than white; and hence black cloths hung up by the dyers in the sun, dry sooner than white ones.

WHITES, the common name of a disorder incident to women. See FLUOR albus.

WHITENING of bones, for a skeleton. See BONE.

WHITENING of cloth. See BLEACHING.

WHITENING, or Bleaching. For the usual methods of bleaching woollens, stuffs, linens, &c. see BLEACHING.

Since the insertion of this article, we have been favoured with the following new mode of bleaching muslins, and fine cottons, &c. as practised by the whitsters in Lancashire, which we here present to our readers, in conformity to our plan of attending to every new improvement in the liberal or mechanical arts.

After taking the muslins, &c. from the looms, they are well mill-washed, to clear them of sope, size, and dirt; then bucked in the common way, afterwards washed and put into the fowring cistern, filled with water, acidulated with oil of vitriol, in the proportion of two ounces to a gallon. When the cloth is run dry, it is put into a leaden cistern that contains chymical bleaching liquor, which has the singular property of imbibing all the oily particles left in the cloth. In a few hours it becomes perfectly white, but must be soufed and well washed, and, when dry, it is finished. The old mode of bleaching or whitening requires two weeks in performance, but it is effected in as many days by the new; consequently the goods may be brought sooner to market, which is one important advantage: and it may be observed, as another, no less important; that they will not be so liable to damage, either from the weather, cattle; or vermin.

Explanation of the machine constructed for the preparation of the chymical liquor used in the new mode of bleaching, as represented in Plate I. of miscellaneous subjects, fig. 26 and 27. A in fig. 26, is a long tubulated glass matras, which will hold six gallons. B, a glass tube, crooked at both ends. C, a leaden cistern, which will hold one gallon. At D, there should be a pipe to fix a receiver into the cistern; but, through the neglect of the engraver, it was omitted in the engraving. E, a cucurbit, or common earthen bottle, containing about three gallons. Fig. 27, represents a plank or board to fix the matras on, with the neck downward. The whitsters' method of preparing their chymical liquor for bleaching is as follows:

They take a cucurbit, or common earthen bottle, E, place it on a sand-bank, fill about one-third part of it with manganese and marine acid, in equal quantities, stop the hole in the cucurbit with a cork, having a hole first bored through it to receive one end of a small glass tube, and the other end to the tube of a matras, A, which being first filled with a cold lixivium, or ley of ashes and water, with its neck hung downwards, into a small cistern, C, filled with the same lixivium: immediately small bubbles of air will arise from the cucurbit along the tube B, and up the tube of the matras, A, to the top; consequently, it will drive the liquor downwards into a receiver fixed to the pipe, D, of the small cistern below. As often as the matras, A, is emptied, it must be supplied with another already filled. When the ebullition begins to abate, they apply a small fire, till darkish fumes begin to arise along the tube; then it is necessary to stop it by plucking the tube out of the matras, or the liquor will be spoiled.

WHITING, in ichthyology, is the English name of the merlangus, a species of the genus *Gadus*. For description of the genus, &c. see *GADUS*.

WHITLOW, or WHITLOUGH, in surgery, a painful kind of tumour, or abscess, arising at the ends of the fingers, and the roots of the nails. The humour, or matter, of the whitlow, is sometimes so sharp as to corrode the tendons, nerves, the periosteum, and even the bone itself. It is either lodged between the integuments, or between the periosteum and bone. The deeper it lies, the more dangerous it is. Accordingly, Heister distinguishes three species of whitlow. The first kind is that in which only the integuments are affected at the end of the finger, near the nail; in this sort the pain is pretty tolerable, and does not extend beyond the finger. The second kind is, when the periosteum is inflamed or eroded; in which case the symptoms are more violent, and the pain very intense, though still confined to the finger, inasmuch as to occasion sometimes a fever, convulsions, delirium, &c. without much apparent tumour, or inflammation. The third and worst kind is that which infects the nervous coverings of the tendons belonging to the flexor muscles of the fingers, or even the adjacent nerves, or tendons themselves; in this case the pain is excruciating, and the disorder spreads through the whole hand and arm.

The first kind is not very dangerous, and usually terminates in the loss of the nail. The second sort is more painful, and has been attended with a caries of the bones of the finger, as a consequence of the preceding inflammation and suppuration. But the third species is really dangerous; the intense pains, abscesses, gangrene, tumour, and inflammation of the whole arm, together with a fever, and other malignant symptoms, frequently destroying the patient, unless its progress is prevented. The true and proximate cause of a whitlow, according to Heister, must be referred to an inflammation

mation of the adjacent integuments, chiefly of the periosteum, from an inspissation of the blood, or an obstruction of its small vessels; and the inflammation may proceed from either internal or external causes; as from an inspissation or acrimony of the blood and lymph, induced by a tense fibre, a heating regimen, or an abuse of the non-naturals, or from a contusion, wound, or puncture. The most approved method for removing the inflammation and obstruction by discussion, is to let the patient hold his finger several hours in spirits of wine highly rectified, or camphorated with theriaca. For the same purpose may be used, with success, a decoction of garlic and leaves of scordium and savin, in which hot liquor, the finger should either be immersed for several hours, or else fomented with it by linen rags. Others recommend frequently dipping and holding the disordered finger a little while in scalding water. But if a suppuration is formed, an incision is the only remedy; and the suppuration may be forwarded by dipping the finger in a decoction of mallow-flowers boiled in milk, or by applying to it a poultice of bread and milk; which may be rendered still more active and ripening by adding a few white lily-roots, or a little honey. A suppuration may also be promoted by the application of a diachylon plaster.

But in the second or third species of the disorder, where the periosteum or bone is affected, this practice would be pernicious, increase the pain, and induce an abscess, caries, and gangrene of the whole arm. For the cure of these two species, an incision is necessary for the discharge of the offending matter: the wound should be dressed with dry lint and diachylon plaster, and a compress dipped in spirit of wine; each being retained with a proper bandage. Fungous, or proud-flesh, if it appears, may be easily removed either with the scissars, or by some escharotic mixed with digestive ointment. The wound is afterwards to be treated like those, in which the bones are affected, with essence of myrrh, balsam of Peru, &c. and if the bone is foul, kept open with lint dipped in tincture of myrrh, till there is either an exfoliation of the morbid from the sound parts, or till the whole bone comes away entire; after which the wound may be deterged and healed without difficulty.

For the third species, Garengoet directs to open the tumor by making an incision longitudinally down in the capsula of the tendon, which will discharge a kind of lymph or serum, very much to the patient's ease. When the matter makes its way, without any incision, through the capsula of the tendon, and about its external opening, a caruncle or fleshy substance appears, he advises to pass a director through the opening into the eroded capsula of the tendon, and then to make an incision through the parts incumbent on the director, by which means a thicker matter will be found concealed in the divided sinus. For a fuller account of the treatment of the different species, and particularly of the last, see Heister's Surgery, vol. ii. p. 324, &c.

WHITSTERS. See **WHITENING**, where Fig. 26, and 27, are described, which are referred to this article.

WHITSUNDAY, a solemn festival of the Christian church, observed on the fiftieth day after Easter, in memory of the descent of the Holy Ghost upon the apostles, in the visible appearance of fiery cloven tongues, and of those miraculous powers which were then conferred upon them. It is called *Whitsunday*, or *White-Sunday*; because this being one of the stated times for baptism in the ancient church, those who were baptized put on white garments, as types of that spiritual purity they receive in baptism. As the descent of the Holy Ghost upon the apostles, happened upon the day which the Jews called *Pentecost*, this festival retained the name of *Pentecost* among the Christians.

WHOLE, in metaphysics, is distinguished into four kinds; viz. a metaphysical, when the essence of a thing is said to consist of two parts, the genus and the difference; *mathematical or integral*, when the several parts which go to make up the whole, are really distinct from one another, and each of them may subsist apart; *physical or essential*, usually denoting and including the two essential parts of man, body and soul, but more properly including all the essential modes, attributes, or properties, contained in the comprehension of any idea; and *logical*, called also *universal*, the parts of which are all the particular ideas to which this universal nature extends.

WICKLIFFISTS, or **WICKLIFFITES**, in ecclesiastical history, a religious sect, who had their rise in England in the 14th century, and their name from their leader *John Wickliffe*, born about the year 1324, and professor of divinity in the university of Oxford, and afterwards rector of Lutterworth. To that immortal author it is we owe the first hint of the great reformation, effected about one hundred and fifty years after him.

The first occasion, on which Wickliffe began to distinguish himself was in 1360, when he defended the statutes and privileges of the university of Oxford against the order of Mendicants or Begging Friars, who, from their first settlement in Oxford, A. D. 1230, had disturbed the chancellor and scholars, endeavoured to establish an exempt jurisdiction, and took all opportunities of enticing the students from the colleges into their convents. He also wrote and published several tracts against the begging trade of the friars, in order to reform the abuses of the clergy. In consequence of the credit he acquired by his writings, he was advanced, in 1361,

to be master of Baliol college, and, in 1365, to be warden of Canterbury-hall, then newly founded.

However, in 1367, he was deprived of the wardenship, by Simon Langham, archbishop of Canterbury, who substituted a monk in his place; and upon his appeal to Pope Urban V. of whose claim of homage and tribute from King Edward III. he had, in the preceding year, published a refutation, the sentence of the archbishop against him was confirmed. Exasperated at this treatment, he threw off all restraint, and not only attacked the monks, and their scandalous irregularities, but even the pontifical power itself, and other ecclesiastical abuses, both in his sermons and writings. He afterwards proceeded to expose and refute the absurd notions that were generally received in religious matters, and not only exhorted the laity to study the Scriptures, but furnished them with an English version of the Bible, that the perusal of it might thus become more universal. In a treatise which he published *Of the truth of the Scriptures*, and in a preface to his translation, he vindicates his design against the objections of his adversaries, and reasons on the importance and use of understanding the scriptures in a manner very honourable to himself, considering the age in which he lived. "The truth of the faith," says he, "shines the more by how much the more it is known, nor are those heretics to be heard who fancy that seculars ought not to know the law of God, but that it is sufficient for them to know what priests and prelates tell them by word of mouth; for the scripture is the faith of the church, and the more it is known in an orthodox sense the better; therefore, as secular men ought to know the faith, so it is to be taught men in whatsoever language is best known to them. Besides, since the truth of the faith is clearer and more exact in the Scripture than the priests know how to express it; it seems useful that the faithful should themselves search out and discover the sense of the faith; by having the Scriptures in a language which they understand. The laws which the prelates make are not to be received as matters of faith; nor are we to believe their words or discourses any farther or otherwise than as they are founded on the scripture:" with much more to the same purpose, and in the same admirable strain. In this preface, and several other publications and treatises, still in manuscript, he reflected severely on the corruptions of the clergy, condemned the worship of saints and images, and the doctrine of indulgences, denied the corporal presence of Christ in the sacrament, inveighed against the wanton exercise of the papal power, and opposed the making of the belief of the pope's being head of the church an article of faith and salvation, censured the celibacy of the clergy, exposed various errors and irregularities in the hierarchy and discipline of the church, and earnestly exhorted all people to the study of the Scriptures.

Wickliffe denied that bishops were of a different order from priests, and that by virtue of their office they had any power to do what priests have not; and that in the apostolic times the two orders subsisting in the church were those of priest and deacon.—With regard to tithes, he observes, that we do not read in the Gospel where Christ paid tithes, or commanded any man so to do; and that if they were due by God's commandment, there should be every where in Christendom one manner of tithing; and that those things which are due to priests should be given freely, without exaction or constraint. In opposition to the papal claims of supremacy and dominion, he maintained that the grants of emperors may be resumed: that St. Peter, and his successors have no rights conferred upon them of civil or political dominion; that the persons of the clergy and the goods of the church are not exempted from the civil powers; and that bulls of absolution or excommunication are conditional, not absolute, and depend for their effects on the disposition and character of those to whom they pertain.

The monks whom Wickliffe had principally exasperated commenced a violent prosecution against him at the court of Gregory XI. who, in 1377, ordered Simon Sudbury, archbishop of Canterbury, to take cognizance of the affair at a court held at London. Wickliffe escaped this danger by the interest of the Duke of Lancaster, and some other peers, who had a high regard for him. When the schism which embroiled the Romish church on the death of Gregory XI. was tolerably settled, the process against Wickliffe was revived by William Courtney, archbishop of Canterbury, in 1382, and was carried on with great vehemence in a court of select bishops and others, assembled in the monastery of the Preaching Friars at London. The event was, that of twenty-four articles exhibited against him, ten were condemned as heresies, and fourteen as errors. It has been said that Wickliffe made a public recantation of the opinions with which he was charged: but of this no sufficient evidence appears. Some have said, that King Richard banished him out of England: but if that was the case, he returned in safety to Lutterworth, where he died peaceably in the year 1384. He left many followers in England and other countries, who were called Wickliffites and Lollards, and who held their opinions in private, without making any public profession of them; though they were generally known by their disparaging the superstitious clergy, whose corruptions were so notorious, and their cruelty so enraged, that it was no wonder the people were much prejudiced against them. Where-

ever

W I F

ever they could be found, they were terribly persecuted by the inquisitors, and other instruments of papal vengeance; and in the council of Constance, in 1415, the opinions of Wickliffe, amounting to forty-five articles, were condemned by a solemn decree, he himself was declared an obstinate heretic, and his bones ordered to be dug up; which part of the sentence was executed about thirteen years after, when they were taken up and publicly burnt. Lewis's History, &c. 8vo. passim. Molh. Eccl. Hist. vol. iii. p. 166, 8vo. Burnet's Hist. Reform. vol. i. p. 23.

WIFE, a married woman; or one joined with, and under the protection of, a husband. See MARRIAGE. A wife, in our English law, is termed *feme-covert*; *femina viro co-operta*: her condition during marriage is called her coverture: and, in the judgment of the law, is reputed to have no will, as being supposed entirely under, and subject to, that of her husband. See COVERT.

As to chattels personal (or *choses in possession*) which the wife hath in her own right, as ready money, jewels, household-goods, and the like, the husband hath therein an immediate and absolute property, devolved to him by the marriage, which can never again revert to the wife or her representatives. The wife also, by marriage, acquires a property of some of her husband's goods, called her *paraphernalia*, which shall remain to her after his death, and shall not go to his executors. These, signifying the apparel and ornaments of the wife, suitable to her rank and degree, the husband cannot devise by his will; though during his life perhaps he hath the power (if unkindly inclined to exert it) to sell them or give them away. But if she continues in the use of them till his death, she shall afterwards retain them against his executors and administrators, and all other persons, except creditors where there is a deficiency of assets. And her necessary apparel is protected even against the claim of creditors.

The wife can make no contract without the husband's consent; and, in all law-matters, *fine viro respondere non potest*. The husband is bound to provide his wife with necessaries by law, as much as himself: and if she contracts debts for them, he is obliged to pay them; but for any thing besides necessaries, he is not chargeable. Also, if a wife elopes, and lives with another man, the husband is not chargeable even for necessaries; at least if the person who furnishes them, is sufficiently apprized of her elopement. See ELOPEMENT.

If the wife be indebted before marriage, the husband is bound afterwards to pay the debt. If the wife be injured in her person or property, she can bring no action for redress without her husband's concurrence, and in his name, as well as her own: neither can she be sued, without making the husband a defendant. There is indeed one case where the wife shall sue and be sued as a *feme-sole*, viz. where the husband has adjoined the realm, or is banished; for he is then dead in law.

In the civil law the husband and wife are considered as two distinct persons; and may have separate estates, contracts, debts, and injuries; and therefore, in our ecclesiastical courts, a woman may sue and be sued without her husband. But though our law in general considers a man and wife as one person, yet there are some instances in which she is separately considered; as inferior to him, and acting by his compulsion. And, therefore, all deeds executed and acts done by her during her *coverture*, are void; except it be a fine, or the like matter of record, in which case she must be solely and secretly examined, to learn if her acts be voluntary. She cannot by will devise lands to her husband, unless under special circumstances; for at the time of making it she is supposed to be under his coercion. And in some felonies, and other inferior crimes, committed by her through constraint of her husband, the law excuses her; but this extends not to treason and murder. See COVERT.

The husband also, by the old law, might give his wife moderate correction: but this power of correction was confined within reasonable bounds, and the husband was prohibited from using any violence to his wife. The civil law gave the husband the same, or a larger, authority over his wife; allowing him, for some misdemeanors, *flagellis et fustibus acriter verberare uxorem*; for others, only *modicam castigationem adhibere*. But, with us, in the politer reign of Charles II. the power of correction began to be doubted; and a wife may now have security of the peace against her husband, or, in return, a husband against his wife. The courts of law will still permit a husband to restrain a wife of her liberty, in case of any gross misbehaviour. Blackst. Com. book i. p. 443, &c. book ii. p. 433, &c.

If a wife bring forth a child begot by a former husband, or any other person, before marriage, but born after marriage with another man, the man she is married to must own the child: and that child shall be his heir at law. The wife, after her husband's death, having no jointure settled before marriage, may challenge the third part of his yearly rent of land, during her life; and, within the city of London, a third part of all her husband's moveables for ever. See DOWER.

W I N

The wife partakes of the honour and condition of her husband; but none of the wife's dignities come, by marriage, to her husband. Yet, the husband, who marries a woman possessed of lands in fee-simple or fee-tail, i. e. of any estate of inheritance, and has by her issue born alive, which was capable of her estate, shall, on the death of his wife, hold the lands for his life, as tenant by the courtesy of England. The English laws are generally esteemed by foreigners as very hard, in respect to the women; and yet Chamberlayne is of a very different opinion, asserting, that the condition of wives in England is better than in any other country. The disabilities to which the wife is subject are for the most part intended for her protection and benefit. So great a favourite (says judge Blackstone) is the female sex of the laws of England.

WIFE (*Mid*), *Obstetrix*. See DELIVERY. For the offices and practice of midwifery in general, see the System throughout, and the plates annexed to the System.

WILDERNESS, in gardening. There is nothing so great an ornament to a large garden as a wilderness; when properly contrived, and judiciously planted. Wildernesses should always be proportioned to the size of the garden, and should never be situated too near the house: because the trees perspire so large a quantity of watery vapours as makes the air very unwholesome; though vegetables serve, as modern experiments have sufficiently ascertained, to purify and meliorate the air. See the System of AEROLGY, Sect. II. For the disposition of wood to form a wilderness, see the Treatise on GARDENING, Part. I. Art. I. Sect. II.

WILL, is usually defined a faculty of the mind, whereby it embraces or rejects any thing represented to it, as good or evil, by the judgment. Others will have it to be the mind itself, considered as embracing or refusing; adding, that as the understanding is nothing else but the soul, considered as perceiving, so the will is nothing else but the soul, considered as willing, &c. Mr. Locke more intelligibly defines the will, a faculty which the soul has of beginning or forbearing, continuing or ending, several actions of the mind, and motions of the body, barely by a thought or preference of the mind ordering, or, as it were, commanding the doing, or not doing, such and such a particular action. This power which the mind has, to order the consideration of any idea, or the forbearing to consider it; or to prefer the motion of any part of the body to its rest, and *vice versa*, is what we call the will.

Free-WILL. See LIBERTY, and FREEDOM.

WILL, *Last Will*, or *Testament*, in law, a solemn act, or instrument, whereby a person declares his mind and intention as to the disposal of his goods, effects, &c. after his death. This act or instrument is emphatically styled the will of the deceased, because it directs the disposal of the whole or part of his property, by written or oral instructions, properly witnessed and authenticated, according to his pleasure. Some have distinguished between a testament and a will; a will being properly limited to land, and a testament only to chattels, requiring executors, which a will only for land does not require: so that every testament is a will, but every will is not a testament. However the words have been commonly used indifferently.

Nature and incidents of a WILL. Wills or testaments are divided into two sorts, viz. written, and verbal or nuncupative: of which the former is committed to writing: the latter depends merely upon oral evidence, being declared by the testator *in extremis*, before a sufficient number of witnesses, and afterwards reduced to writing. A codicil is a supplement to a will.

WIND. As the air is a fluid, subjected to the same laws of gravitation as other fluids, it necessarily has a constant tendency to preserve an equilibrium in every part; so that if by any means whatever, it is rendered lighter in any one place than another, the weightier air will rush in from every side towards this place, till as much be there accumulated as makes it of an equal weight with the rest of the atmosphere: it is these currents of air which are called winds. The winds are divided into perennial, stated, and variable. They are also divided into general and particular. Perennial or constant winds are such as always blow the same way. Of these we have a very striking one between the two tropics, blowing constantly from east to west, called the general trade-wind. Stated, or periodical winds, are such as constantly return at certain times. Such are the sea and land breezes, blowing from sea to land in the evening, and from land to sea in the morning. Such also are the shifting, or particular, trade-winds, which for certain months of the year, blow one way, and the rest of the year, the contrary way. Variable, or erratic winds, are such as blow now this, now that way, and are now up, now hushed, without any rule or regularity either as to time or place. Such are all the winds observed in the inland parts of England, &c. though several of these claim their certain times of the day. Thus, the west wind is most frequent about noon; the south wind in the night; the north in the morning, &c. General wind is such a one as, at the same time blows the same way, over a very large track of ground, almost all the year. Such only is the general trade-wind.

Many are the causes which may vary the weight of the atmosphere, and occasion particular tropical winds. Although other causes may occasion winds in certain circumstances, yet their principal and most universal cause is the sun, which warmeth the air to a much greater degree in some places of the atmosphere than in others;

others; and as the air is susceptible of a great degree of expansion by heat in those places where it is heated to any considerable degree, it is expanded so much as to become lighter than the air in those places where it is colder: so that the weightier cold air from all the circumjacent parts rushes towards this point to restore the equilibrium which had been destroyed. So that, if there be any particular part upon the earth's surface where the sun acts constantly with greater force than on any other part, a current of air will constantly flow from these towards the warmer region: but the sun acts with greater force upon those parts of the earth which are nearest the equator than those which approach towards either poles; so that we might naturally expect that a wind would constantly blow from the polar regions towards the equator; which is really found to be the case in the torrid zone, where the influence of the sun overcomes almost all the other lesser causes which produce the variable winds in our more northerly regions. However, even in the torrid zone, these north and south winds are varied in different ways.

Although the heat of the equatorial regions is greater than any other, yet as the sun acts perpendicularly, in his diurnal course, upon one point of the equator only at one time, and immediately passes over it, and as the air retains the heat communicated to it by the sun but for a short time, cooling gradually as he retires, and continuing still to decrease till his influence again returns the following day; the degree of heat upon this great circle must be very different in different parts, and perpetually varying in every point; which must, in some measure, tend to disturb those winds coming from the polar regions, which we have already mentioned. To comprehend clearly what will be the effects of this rotation, let us consider what power it would naturally produce upon the equator with regard to wind, supposing no other cause should interrupt it. And here we must observe, that, as the point upon which the sun acts with the greatest force is constantly moving from east to west, the air to the east of that point over which the sun has more lately passed will be more rarefied than that to the west, and will naturally flow towards that point from east to west with greater velocity than from west to east, as the cool air to the west of that point will be interrupted in its motion towards it by the motion of the sun meeting it. Hence, therefore, it follows, that, from the diurnal motion of the earth from east to west, a constant wind would always be produced, were it not obstructed by other causes. But, as there is a constant stream of air flowing from the polar towards the equatorial regions; a composition of these two currents of air acting at the same time will produce a north-east wind in all parts of the northern hemisphere, and a south-east wind in all parts of the southern one. These winds are known by the name of the *general trade-winds*.

If there were no inequalities on the surface of our globe, and if it were composed of a substance perfectly homogeneous, this wind would invariably take place at all times on every part of the earth's surface; but as this is not the case, it is liable to several very considerable variations. In all those regions towards the poles, as the influence of the sun is there but weak, other lesser causes occasion particular winds, and disturb that regularity which at first view we might expect; so that the general trade-wind does not invariably take place beyond the 28th or 30th degree of latitude; and the regions between that and the poles have nothing but variable winds. Even in the torrid zone, there are many causes which in particular places alter this direction of the wind; so that the genuine trade-winds do not take place except in the Atlantic and Pacific oceans, on each side of the equator, to the distance of 28 or 30 degrees, and in the greatest part of the Indian ocean to the south of the equator, where the course of the winds are marked by the direction of the strokes, the darts pointing in the same direction as the wind blows.

Having thus explained the nature and causes of the general trade-wind, we now proceed to take notice of the principal deviations which take place in the torrid zone. The general trade-wind, when thus altered at particular seasons, is known by the name of monsoons. There are other variations, which, although as general, are yet of smaller and more limited influence. These are known by the name of breezes; and, as they blow periodically from the sea, they are denominated sea or land breezes, and take place more or less in every sea-coast within the tropics. As the causes of the monsoons will be more clearly comprehended after the nature of these breezes is explained, we shall first consider them.

The sea and land breezes of the torrid zone are gentle periodical winds regularly shifting twice every day, and blowing from the sea towards the land during the day-time, and from the land towards the sea in the night. These breezes do not blow with an equal degree of force throughout the whole day and night, but are perpetually varying, being always strongest about mid-day and mid-night, and becoming gradually weaker till the time of change in the evening and morning; about which time the air continues for a short space perfectly calm: but in a little the breeze begins to be felt on the side opposite to that from which it blew last, so faint at first as hardly to be perceived; but by degrees acquiring greater strength, it goes on increasing for five or six hours, after which it again gradually sinks and dies away. They always blow di-

rectly off or towards the shore, and never extend their influence to a great distance from it, although this is varied by particular circumstances in different places; as they never extend so far from the points of capes and promontories, as in deep bays; nor upon the windward, as lee-shores.

The breezes are produced by the same cause which gives rise to the trade-wind, viz. the heat of the sun. In these warm regions the days and nights are nearly of an equal length throughout the whole year, the sun rising high in the day-time, and descending almost perpendicularly at night; which occasions a much greater variation between the heat of the day and night than is experienced in the more temperate climates; and it is this great difference between the heat of the night and day which produces the breezes. For the rays of the sun are reverberated from the land during the day-time, much more powerfully than from the sea, whose surface is constantly evaporating; and the air above the land is rendered much warmer, and consequently more rarefied, than above the sea; so that a current of air necessarily takes place at that time from the sea towards the land, increasing and diminishing in strength as the heat increases or declines. But when the sun descends below the horizon, the evaporation from the surface of the sea, is stopped or greatly diminished, and the cold which it occasioned is, of consequence, removed; the reverberation of the sun's rays from the surface of the earth is likewise removed, and the air above the land quickly resumes its natural degree of cold, which is always greater than the sea when the influence of the sun is withdrawn: so that the air above the sea becomes warmer during the night than that above the land, and a current of air is of course established from the land to the sea; this forms the land-breeze, which acts as uniformly, although less powerfully, than the sea-breeze; blowing at first gently as the air begins to cool, and gradually gathering strength as the sun retires below the horizon; till his influence begins to be felt again in the morning, when it gradually gives place to the more powerful influences of the sea-breeze. These breezes are not, however, entirely confined to the torrid zone. They are even felt in more northern regions; the sea-breeze in particular being almost as perceptible during the summer season along the coasts of the Mediterranean and the Levant, both on the African, European, and Asiatic shores, as within the tropics. Even in our own colder climate, the effects of this are often sensibly felt during the summer season; although, from the length of the day and shortness of the night, the difference between the heat of these is far less than in warmer climates. Notwithstanding the shortness of our nights prevents us from feeling a nocturnal-breeze, similar to the land-breezes of the torrid zone; yet, in every serene evening, we have an opportunity of observing a phenomenon proceeding from a similar cause with that which occasions them in warmer climates. For as the waters retain their heat longer than the earth after the sun withdraws, the moisture which was raised during the heat of the day to a small distance from the earth's surface is quickly condensed by the cold of the evening, and falls down in copious dews; whereas that which is above the surface of the water is more slowly condensed, by reason of the heat which that element retains longer, and hovers at a small distance above it in the form of a dense vapour, which slowly subsides as it loses its heat. This is the cause of those low mists which are so often seen hovering above the surface of the rivers and other waters in the evenings towards the end of summer.

The succession of sea and land breezes renders the torrid zone not only habitable, but comfortable. Besides, as these currents of cold air, rushing from each side of the globe, and carrying along with them vast quantities of aqueous vapours, which they collect from the surface of the earth in their course, meet and oppose one another at that part of the atmosphere where the influence of the sun is greatest at the time, the water is there forced from the clouds in such prodigious quantities, as to produce a diversity of seasons in the torrid zone, something similar to what is experienced in more temperate climates; with the difference, however, that whereas, in temperate climates, the warmest and most comfortable season is when the sun approaches nearest perpendicular to them, in these warmer climates the heavy rains which fall upon them at that season moderates the heat, and prevents the sun from having such an effect as at other times; so that their coldest and most inconstant weather, which they call winter, is at the season, when, without this cause, they would be exposed to the sun's most powerful influence.

We shall only take notice of one other instance of the happy effects produced on our globe by the laws of nature with respect to winds. We have seen, that in the great Atlantic and Pacific oceans, the trade-wind blows constantly from the easterly points throughout the whole year, so that ships sail from east to west within the tropics with the utmost facility; but it is absolutely impossible in these seas to sail from west to east, as the wind would be constantly against them: so that ships bound for any port to the eastward in those regions, must stand to the north or south till they are beyond the limits of the trade-winds, where they meet with variable breezes, by the help of which they sail to the eastward. But if the same constant trade-wind had taken place in the northern part of the Indian ocean, it would have been im-

possible to have sailed to the eastward at all, because the continent of Asia would have prevented the ships from sailing far enough north to find the variable winds. But here, as in almost every case in which the operations of nature are concerned, we find, that what produceth a disease, at the same time furnisheth a remedy; that very continent which would have stood in our way going northward, draws the wind towards itself at one season, which makes that course of navigation unnecessary, the shifting of the monsoons supplying a nearer and more commodious course. Thus we see, that where-ever the sea is open to the south or north, near the tropics, so as that ships are at freedom to reach the variable winds, the trade-wind constantly blows in one direction: but wherever there is any extent of continent within the verge of the torrid zone, so as that they could not be at liberty to reach the variable winds, there the course of the trade-wind is altered, being drawn towards it in summer, and from it in winter, forming that shifting wind called monsoons. From which we may naturally infer, that as there are no monsoons in the Pacific, Atlantic, or in the western part of the Indian ocean, to the south of the line, there are no extensive continents near the tropics in either of these places.

Qualities and effects of WIND. A wind blowing from the sea, is always moist; in summer it is cold; and in winter, warm, unless the sea be frozen up. This is demonstrated thus: there is a vapour continually rising out of all water (as appears even hence, that a quantity of water being left a little time in an open vessel, is found sensibly diminished) but especially if it be exposed to the sun's rays; in which case the evaporation is beyond all expectation. By this means, the air incumbent on the sea becomes impregnated with a quantity of vapour. But the winds blowing from off the sea, sweep these vapours along with them; and consequently they are always moist.

Again, water in summer, &c. receives less heat than terrestrial bodies, exposed to the same rays of the sun, do: but in winter, sea-water is warmer than the earth when covered with frost and snow, &c. Wherefore, as the air contiguous to any body is found to partake of its heat and cold, the air contiguous to sea-water will be warmer in winter and colder in summer, than that contiguous to the earth. Or thus: vapours raised from water, by the sun's warmth in winter, are warmer than the air they rise in, as appears from the vapours condensing, and becoming visible, almost as soon as they are got out into air. Fresh quantities of vapour, therefore, continually warming the atmosphere over the sea, will raise its heat beyond that of air over the land. Again, the sun's rays reflected from the earth into the air, in summer, are much more than those from the water into air: the air, therefore, over the earth, warmed by the reflection of more rays than that over water, is warmer. Hence sea-winds make thick, cloudy, hazy, weather.

Winds, blowing from the continent, are always dry; in summer they are warm; and cold in winter. For there is much less vapour arising from the earth, than from water; and therefore the air over the continent will be impregnated with much fewer vapours. Add, that the vapours, or exhalations, raised by a great degree of heat out of the earth, are much finer, and less sensible, than those from water. The wind, therefore, blowing over the continent, carries but little vapour with it, and is therefore dry. Farther, the earth in summer is warmer than water exposed to the same rays of the sun. Hence, as the air partakes of the heat of contiguous bodies, that over the earth in summer will be warmer than that over the water: therefore the winds, &c. After the like manner it is shewn that the land-winds are cold in winter. Hence, we see why land-winds make clear cold weather. Our northerly and southerly winds, however, which are commonly esteemed the causes of cold and warm weather, Dr. Derham observes, are really rather the effect of the cold or warmth of the atmosphere. Hence it is, that we frequently see a warm southerly wind, on a sudden changed to the north, by the fall of snow or hail; and that in a cold frosty morning, we see the wind north, which afterwards wheels about towards the southerly quarter, when the sun has well warmed the air; and again, in the cold evening, turns northerly, or easterly. For the manner wherein north-easterly winds contribute to blights, see BLIGHT. For the effect of wind on the barometer and thermometer, see BAROMETER, &c.

The utility of winds has been universally acknowledged. The ancient Persians, Phœnicians, Greeks, and Romans, sacrificed, and erected temples to the winds; as we learn from Vossius, Theolog. Gentil. lib. iii. part i. cap. 1. Beside their use in moving bellows, mills, and other machines, applied in various ways to the service of mankind, and the benefits resulting from them to navigation and trade, winds serve to purify and refresh the air, to convey the heat or cold of one region to another, to produce a regular circulation of vapours from the ocean to countries remote from it, and to supply, by wafting them in their progress against hills, &c. springs and rivers.

Wind has been, by some authors, made the basis of many different diseases; among others, Dr. Reyn has given it as his opinion, in a Treatise on the Gout (De Arthritid.) that flatulencies, or wind inclosed between the periosteum and the bone, are the true

cause of that disease; and accordingly, all the method of cure ought to tend to the expelling of that wind. He supposes this wind to be of a dry, cold, and malignant nature, conveyed by the arteries to the place affected, where forcibly separating that sensible membrane, the periosteum, and distending it, the pain must needs be very great. He is also of opinion, that headaches, palpitations of the heart, toothache, pleurisy, convulsions, colics, and many other diseases, are originally owing to the same cause, and only differ in regard to the place affected, and to the various motions and determinations of the wind. The shifting of the pain in gouty persons from one part to another, he looks on as a proof of this, and thinks that curing the gout by burning moxa, or the cotton of the mugwort-leaves, upon it, is owing to its giving way to the wind in the part to evaporate itself. That these winds are cold, appears from the shivering fits which generally precede a paroxysm of the gout, and that the shiverings in the beginnings of fevers, and before all fits of agues, are owing to the same cause, is supposed by this author a natural conclusion from the former observations. The winds, according to this author and Fienus, are a sort of halituous spirits, raised by the improper degree of our native heat, or out of our meat and drink; or, finally, out of an abundance of black choler. Their differences, he says, principally proceed from the various ferments producing in us a variety of humours, which acting upon one another, do, in their effluences, create winds of various effects, and determine diseases from the places which are the scenes of their action. It is on this account that the acupunctura, or pricking with long needles, among the Chinese, is of use: the Japanese, and other neighbouring nations, having no other cure for most diseases than pricking with the needle, and burning of the moxa on the part.

The husbandman often suffers extremely by high winds, in many different respects. Plantations of trees, at a small distance from barns and houses, are the best safeguard against their suffering by winds; but they must not be planted so near as that their fall, if it should happen, would endanger them. Yews grow very slowly, otherwise they are the best of all trees for this defensive plantation. Trees suffer by winds, being either broken or blown down by them; but this may be in a great measure prevented by cutting off great part of the heads and branches of them, in places where they stand most exposed. Hops are the most subject to be injured by winds of any crop; but this may be in a great measure prevented by a high pole, or very thick thorn-hedge; this will both keep off the spring wind, which nips the young buds, and be a great safeguard against other winds, that would tear the plants from their poles. The poles should always be very firm in the ground; and the best security to be added to this, is a row of tall trees all round the grounds. Winds attended with rain do great injury to the corn, by laying it flat to the ground. The best method of preventing this, is to keep up good inclosures; and if the accident happens, the corn should be cut immediately, for it never grows at all afterwards. It should be left on the ground, in this case, some time after the cutting, to harden the grain in the air.

WIND, in navigation, is the same agitation of the air considered as serving for the motion of vessels on the water. If the wind blows gently, it is called a breeze; if it blows harder, it is called a gale, or a stiff-gale; and if it blows very hard, it is called a storm. The following observations on the wind have been made by skilful seamen, and particularly by Dr. Halley; the nature and causes of which we have explained in the preceding part of this article.

1. Between the limits of 60°, viz. from 30° of north latitude to 30° of south latitude, there is a constant east-wind through the year, blowing in the Atlantic and Pacific oceans, called the Trade-wind.

2. The trade-winds near their northern limits blow between the north and east; and near the southern limits they blow between the south and east.

3. These general motions of the wind are disturbed on the continents, and near their coasts.

4. In some parts of the Indian ocean there are periodical winds, which are called monsoons. See MONSOONS.

5. In the Atlantic ocean, near the coasts of Africa, at about a hundred leagues from the shore, between the latitudes of 28° and 10° north, seamen constantly meet with a fresh gale of wind blowing from the N.E.

6. Those bound to the Caribbee islands, across the Atlantic ocean, find, as they approach the American side, that the said N.E. wind becomes easterly; or seldom blows more than a point from the east, either to the northward or southward. The trade-winds, on the American side, are extended to 30, 31, or even to 32° of N. latitude; which is about 4° farther than they extend to on the African side; also, to the southward of the equator, the trade-winds extend three or four degrees farther toward the coast of Brazil; on the American side, than they do near the Cape of Good Hope on the African side.

7. Between the latitudes of 4° N. and 4° S. the wind always blows between the south and east: on the African side the winds are nearest the south; and on the American side, nearest the east. In these seas Dr. Halley observed, that when the wind was eastward

W I N

ward; the weather was gloomy, dark, and rainy, with hard gales of wind; but when the wind veered to the southward, the weather generally became serene, with gentle breezes, next to a calm. These winds are somewhat changed by the seasons of the year; for when the sun is far northward, the Brasil S.E. wind gets to the south, and N.E. wind to the east; and when the sun is far south, the S.E. wind gets to the east, and the N.E. winds on this side of the equator veer more to the north.

8. Along the coast of Guinea, from Sierra Leone to the island of St. Thomas, under the equator, which is above five hundred leagues, the southerly and south-west winds blow perpetually; for the S.E. trade-wind, having passed the equator, and approaching the Guinea coast within eighty or a hundred leagues, inclines toward the shore, and becomes south, then S.E. and by degrees, as it comes near to land, it is S.W. and sometimes S.S.W. and in with the land it is S.W. and sometimes W.S.W. This tract is troubled with frequent calms, and violent sudden gusts of wind called tornadoes, which blow from all points of the horizon.

9. Between the fourth and tenth degrees of north latitude, and between the longitude of Cape Verd and the easternmost of the Cape Verd Isles, there is a track of sea subject to perpetual calms, attended with frequent thunder, lightning, and rains; ships in sailing these six degrees are said to have been sometimes detained whole months. The three last observations account for two circumstances which mariners experience in sailing from Europe to India, and in the Guinea trade.

The first is the difficulty which ships in going to the southward, especially in the months of July and August, find in passing between the coasts of Guinea and Brasil, although the breadth of this sea is more than five hundred leagues. This happens, because the S.E. winds at that time of the year commonly extend some degrees beyond the ordinary limits of four degrees N. latitude; and besides coming so much southerly, as to be sometimes south, sometimes a point or two to the west; it then only remains to ply to windward: and if, on the one side, they steer W.S.W. they get a wind more and more easterly; but then there is danger of falling in with the Brasilian coast, or shoals; and if they steer E.S.E. they fall into the neighbourhood of the coast of Guinea, from whence they cannot depart without running easterly as far as the island of St. Thomas; and this is the constant practice of the Guinea ships.

Secondly. When ships depart from Guinea for Europe, their direct course is northward; but on this course they cannot go, because the coast bending nearly east and west, the land is to the northward: therefore as the winds on this coast are generally between the S. and W.S.W. they are obliged to steer S.S.E. or south, and with these courses they run off the shore; but in so doing they always find the winds more and more contrary; so that when near the shore, they can lie south, at a greater distance they can make no better than S.E. and afterwards E.S.E. with which courses they commonly fetch the islands of St. Thomas and Cape Lopez, where finding the winds to the eastward of the south, they sail westerly with it, till coming to the latitude of four degrees south, where they find the S.E. winds blow perpetually.

On account of these general winds, all those that use the West-India trade, even those bound for Virginia, reckon it their best course to get as soon as they can to the southward, that so they may be certain of a fair and fresh gale to run before it to the westward; and for the same reason those homeward-bound from America endeavour to gain the latitude of thirty degrees, where they first find the winds begin to be variable; though the most ordinary winds in the north Atlantic ocean come from between the south and west.

10. Between the southern latitudes of ten and thirty degrees in the Indian ocean, the general trade-wind about the S.E. by S. is found to blow all the year long in the same manner as in the like latitude in the Ethiopic ocean; and during the six months from May to December, these winds reach to within two degrees of the equator; but during the other six months, from November to June, a N.W. wind blows in the tract lying between the third and tenth degrees of southern latitude, in the meridian of the north end of Madagascar; and between the second and twelfth degree of south latitude, near the longitude of Sumatra and Java.

11. In the tract between Sumatra and the African coast, and from three degrees of south latitude quite northward to the Asiatic coasts, including the Arabian sea and the gulf of Bengal, the monsoons blow from September to April on the N.E. and from March to October on the S.W. In the former half year the wind is more steady and gentle, and the weather clearer than in the latter six months; and the wind is more strong and steady in the Arabian sea than in the gulf of Bengal.

12. Between the island of Madagascar and the coast of Africa, and thence northward as far as the equator, is a tract wherein, from April to October, there is a constant fresh S.S.W. wind; which to the northward changes into the W.S.W. blowing at that time in the Arabian sea.

13. To the eastward of Sumatra and Malacca, on the north of the equator, and along the coasts of Cambodia and China, quite through the Philippines, as far as Japan, the monsoons blow northerly and southerly; the northern setting in about October or

W I N

November, and the southern about May: the winds are not quite so certain as those in the Arabian seas.

14. Between Sumatra and Java to the west, and New Guinea to the east, the same northerly and southerly winds are observed; but the first half year monsoon inclines to the N.W. and the latter to the S.E. These winds begin a month or six weeks after those in the Chinese seas set in, and are quite as variable.

15. These contrary winds do not shift from one point to its opposite all at once; in some places the time of the change is attended with calms, in others by variable winds; and it often happens on the shores of Coromandel and China, towards the end of the monsoons, that there are most violent storms, greatly resembling the hurricanes in the West-Indies; wherein the wind is so very strong, that hardly any thing can resist its force. All navigation in the Indian ocean must necessarily be regulated by these winds: for if mariners should delay their voyages till the contrary monsoon begins, they must either sail back, or go into harbour, and wait for the return of the trade-wind. See Phil. Trans. No. 183, or, Abr. vol. ii. p. 133, &c. Robertson's Elem. of Nav. Book vi. Sect. 6.

WINDGALL, in horses, is a soft flatulent tumor, or bladder, arising on the fetlock joint, and causing great pain, especially in hot weather, and hard roads. For the causes and treatment of this disorder, see the System of FARRIERY, Class II. Sect. II.

WINE, *Vinum*, a brisk, agreeable, spirituous, and cordial liquor, drawn from vegetable bodies, and fermented. See FERMENTATION. The character of wine, according to Boerhaave, is, that the first thing it affords by distillation be a thin, oily, inflammable fluid, called a spirit. This distinguishes wines from another class of fermented vegetable juices, viz. vinegars; which, instead of such spirit, yield, for the first thing, an acid uninflamable matter. All sorts of vegetables, fruits, seeds, roots, &c. may be made to afford wine; as grapes, currants, mulberries, elder, cherries, apples, pulse, beans, peas, turnips, radishes, and even grass itself. Hence, under the class of wines, or vinous liquors, come not only wines, absolutely so called, but also ale, cyder, &c.

And we may observe, in general, that all vegetable and animal matters, which have a taste sweet, agreeable, and more or less saccharine, and which are nutritive, are susceptible of the spirituous fermentation. Accordingly, wine may be made of all the juices of plants, the sap of trees, the infusions and decoctions of farinaceous vegetables, the milk of frugivorous animals, which is possessed of the above-mentioned qualities, and likewise of all ripe succulent fruits, which also are possessed of these qualities; but all these substances are not equally proper to be changed into a good and generous wine. As the production of ardent spirit is the result of the spirituous fermentation, we may consider that wine as essentially the best, which contains most of this spirit. But of all substances susceptible of the spirituous fermentation, none is capable of being converted into so good wine as the juice of the grapes of France, or of other countries that are nearly in the same latitude, or in the same temperature. Hence wine is, in a more particular manner, appropriated to that which is drawn from the fruit of the vine, by stamping its grapes in a vat, or crushing and expressing the juice out of them in a press, and then fermenting, &c. There is a great variety of grapes, colourless, yellowish, bluish, and red; more or less sweet, and of more or less flavour. The colour is lodged not in the juice, but in the skin of the grape; though the juice, as a menstruum, frequently extracts and becomes impregnated with it, during its expression from the fruit. The same kind of grape proves very different in taste and flavour, according to the climate and exposure of the sun. Among the Tokay vine-hills, there is one which directly fronts the south, and called, from the peculiar sweetness of its grapes, the sugar-hill. This, says Neumann, affords the most delicious of all the Hungarian wines, and is appropriated to the use of the Imperial family.

In very warm dry seasons, the grapes at the bottoms of the hills are best; in warm and moist ones, those at the top; such as grow in the middle region being always good. In dry summers the grapes are sweetest, but least juicy; in rainy ones, they abound with juice, which is proportionably weaker, and more dilute. Frosts in autumn promote their ripening; but frosts succeeding heavy rains dispose them to burst, and shed their juice. In some places the grape is rendered richer, by suffering it to remain on the tree till great part of its watery moisture has exhaled; the stem of each cluster being cut half through, when the fruit is ripe, to prevent the afflux of any fresh juice from the plant. The sweet Hungarian and Spanish wines are made from grapes that have been thus half dried. The juice of the grape, before its fermentation, is called *must*; and different sorts of must are obtained from the same kind of grape, produced in the same vineyard, according to the method of management. The best is that which issues upon breaking, bruising, or treading the picked fruit; inferior sorts are extracted by forcibly pressing the intire cluster, with its stalks. Dilute watery musts are enriched by infusing in them dried grapes, or by inspissating part of the liquor, and adding this to the rest. By such means, strong full-bodied wines are obtainable from the poorest juices; and by a similar management even the better sort of grape wines are imitable with the juices of other fruits, artificially concentrated, or heightened with the simple

W I N

the sweetness of sugar. Hence it appears, that the difference of flavour, taste, colour, and body of wines, is, perhaps, as much owing to the different manner and times of gathering, pressing, fermenting, &c. the grape, as to the difference of the grape itself.

Pressed WINE is that squeezed with a press out of the grapes, when half bruised by the treading. The husks left of the grapes are called *rape*, *muck*, or *mark*; by throwing water upon which, and pressing them afresh, they make a liquor for servants' use, answerable to our cyder-kin, and called *boisson*; which is also of some use in medicine, for the cure of disorders occasioned by viscid humours.

Sweet WINE is that which has not yet worked or fermented. This is turbid, and has an agreeable and very saccharine taste. It is very laxative; when drunk too freely, and by persons disposed to diarrhoeas, is apt to occasion these disorders. Its consistence is something less fluid than that of water, and it becomes almost of a pitchy thickness when dried. *Bourra*, is that which has been prevented working, by casting in cold water. *Cuve*, or *worked wine*, is that which has been let work in the vat, to give it a colour. *Cuit*, or *boiled wine*, is that which has had a boiling before it worked; and which, by that means, still retains its native sweetness. *Passe* or *strained wine*, is a sort of raisin-wine, made by sleeping dried grapes in water, and letting it ferment of itself. Wines are also distinguished with regard to their colour, into *white wine*, *red wine*, *claret wine*, *pale wine*, *rose* or *black wine*. And with regard to their country, or the soil which produces them, into *French wines*, *Spanish wines*, *Rhenish wines*, *Hungarian wines*, *Greek wines*, *Canary wines*, &c. And, more particularly, into *Port wine*, *Madeira wine*, *Burgundy wine*, *Champagne wine*, *Falerian wine*, *Tokay wine*, *Schiras wine*, &c.

Wines, again, are distinguished with regard to their quality, into *sweet wines*, *rough or dry wines*, and *rich or luscious wines*, *vins de liqueur*; of which last some are exceedingly sweet, others sweet and poignant, and all chiefly used by way of cordial after meals. Such are French *Frontigniac*, *Madeira*, *Canary*, *Hungary*, *Tokay*, Italian *Montefascone*, Persian *Schiras*, and the *Malmsey* wines of Candia, Chio, Lesbos, Tenedos, and other islands of the Archipelago, which anciently belonged to the Greeks, but now to the Turks. These are sometimes called *Greek wines*, and sometimes *Turkey wines*.

The principal wines drank in Europe are as follow. 1. The Madeira island, and Palma, one of the Canaries, afford two kinds: the first called *Madeira sec*, the latter, which is the richest and best of the two, *Canary* or *Palm sec*. The name *sec* (corruptly written *sack*) signifies dry; those wines being made of half-dried grapes. There is another sort of *sec wine*, prepared about Xeres, in Spain, and hence called, according to our orthography, *Sherris* or *Sherry*. 2. The wines of Candia and Greece are of common use in Italy. Malmsey was formerly the produce of these parts only, but is now brought chiefly from Spain; it is a sweet wine, of a golden or brownish yellow colour, and to this is applied an Italian proverb, signifying, *Manna to the mouth, and balsam to the brain*. Almost all the wines used in the Venetian territories come from Greece and the Morea. 3. Italy produces the *vino Greco*, which is a gold-coloured unctuous wine, of a pungent sweetness, the growth of mount Vesuvius, but much sophisticated by the Neapolitans. In the neighbourhood of mount Vesuvius is made the *Mangiaguerra wine*, and a thick blackish one, called *Verracia*; and at the foot of the hill, the delicious *vino vergine*. The kingdom of Naples affords the *Campania* or *Pausillippo*, *Muscadel*, *Salernitan*, and other excellent wines, and also the *Chiarello*, much drank at Rome. But the principal is the red, fat, sweet, and grateful poignant one, called *Lachryma Christi*. 4. The Ecclesiastical state produces the bright pleasant *Albano*, and sweet *Montefascone*, a yellowish, not very strong wine, resembling good Florence, &c. 5. In Tuscany are the excellent white and red Florence; the celebrated hot, strong, red wine, *de Monte Palciano*, &c. 6. In Lombardy, the *Modenese* and *Montferrat* are tolerable; and between Nizza and Savona is produced an incomparable *Muscadine*. 7. Piedmont and part of Savoy, have excellent light wines. 8. The Sicilian, Sardinian, and Corsican wines are also good. 9. Most of the Spanish wines are composed of fermented, or half-fermented wine, mixed with inspissated must, and variously manufactured, or of an infusion of dried grapes in weak must. Of these wines there are a few in Germany, as the *Alicant*, which is a thick, strong, very sweet, and almost nauseous wine, *Sherry*, Spanish *Malmsey*, &c. 10. In Portugal there is plenty of *red port*, which is much drank in England. The best *vino tinto*, a blackish red wine, used by the coopers for colouring other wines, is said to be the produce of Portugal. This kingdom also deals largely in *Madeira*. 11. In France there is a great variety of wines; of which the strong, sweet, full-bodied spirituous ones are called *Vins de liqueur*. Languedoc and Provence afford the sweetest wines, and the same provinces, with Champaign and Burgundy, the strongest; the wines of the northern parts, as Picardy and Bourdeaux, are the worst, and those about the middle of the kingdom, as Paris and Orleans, of a middling kind. The most celebrated of the French wines are *Champagne*, *Burgundy*, *Vin de beaune* or *partridge-eye*, *Frontigniac*, *Hermitage*, &c. 12. In Switzerland, the best wines are the *Neufchatel*, *Vel-*

W I N

teline, *Lacote*, and *Reiff*: the *Velteline* straw wine, so called from the grapes being laid for some time upon straw before they are pressed, is particularly celebrated. 13. The dry grape wines of the Upper Hungary are in general excellent, and much superior to those of the lower. 14. Among the German wines, those of Tyrol are very delicate, but do not keep. 15. Of Austrian wines, those of Kloster, Newburgh and Brosenberg are deemed the best; and there are also good wines in other parts of the imperial dominions. 16. In the Palatinate, the best wine is that of Worms, especially the sort called *women's milk*. 17. Among the more esteemed German wines may be reckoned also *Rhenish*, *Mayne*, *Moselle*, *Neckar*, and *Elzas*: a certain writer calls the *Rhenish* made in Hockheim (Hock) the prince of the wines of Germany. Wine is also variously denominated according to its state, circumstances, qualities, &c.

The uses of WINE are very great, not only as a drink but as a medicine. Several physicians recommend it as an excellent cordial, and particularly servicable in fevers. In a dietetical view, the moderate use of wine is of service to the aged, the weak, and the relaxed, and to those who are exposed to warm and moist, or to corrupted air: in the opposite circumstances, it is less proper, or prejudicial.

Wine abounds with the antiseptic gas, or fixed air, more perhaps than any other vegetable substance; and if the grateful taste of it be added, it may well be ranked first in the list of antiscorbutic liquors. The diseases, to which persons who persist habitually in the free use of wine, are most subject, are obstructions in the liver, in the mesenteric glands, and in other abdominal viscera, which are almost always succeeded by an incurable dropsy. Those who digest wine well do not suffer, or much less sensibly, the above-mentioned effects of drinking it; their drunkenness is accompanied with vivacity and joy; but excess injures even such persons, their constitution (says the author of the Chymical Dictionary) generally changes before sixty years of age; and the inheritance of their old age is either a severe gout or palsy, stupidity, imbecility, or an accumulation of these diseases.

Wine, considered as a medicine, is a valuable cordial in languors and debilities; more grateful and reviving than the common aromatic infusions and distilled waters, particularly useful in the low stage of malignant or other fevers, for raising the pulse and supporting the vis vitæ, promoting a diaphoresis, and resisting putrefaction. The acid obtained from wine by distillation, apparently of a different nature from the acetous, as well as from the native vegetable acids, seems to deserve some regard both as a medicine, and as a more elegant menstruum for iron and some other bodies, than the common acids. There are five sorts of wine employed in the shops as menstrua for medicinal substances, viz. mountain, French white-wine, Canary or sack, Rhenish, and red-port.

With regard to the medical differences of wines, Dr. Lewis observes, that the effects of the full-bodied are much more durable than those of the thinner; that all sweet wines are in some degree nutritious; the others not at all, or only accidentally so, by promoting appetite and strengthening the organs concerned in digestion; that sweet wines in general do not pass freely by urine, and that they heat the constitution more than an equal quantity of any other, though containing full as much spirit; and those which are manifestly acid pass freely by the kidneys, and gently loosen the belly; and that most of the red ones are sub-astringent, and tend to restrain immoderate excretions.

Diseases of WINE. All wines, malt-liquors, and vinegars, which are well made, and perfect in their kind, will grow fine of themselves, barely by standing; so that if they do not thus grow fine in a reasonable time, it is a sign that they labour under some disease; that is, they are too aqueous, too acid, too alkaline, or they tend to putrefaction, or the like. In all these cases, which may properly enough be called the *diseases of wines*, suitable remedies are required before the wines will grow fine. The most general remedy hitherto known for all the diseases of wines, is a prudent use of tartarized spirit of wine, which not only enriches, but disposes all ordinary wines to grow fine. Shaw's Lectures, p. 209. For a particular account of the different diseases of wines, and their usual remedies, see Miller's Gard. Dist. art. WINE, and Birch's Hist. Roy. Soc. vol. i. p. 156, &c.

Pricked WINE. An easy method of recovering pricked wines may be learned by the following experiment: take a bottle of red-port that is pricked, add to it half an ounce of tartarized spirit of wine; shake the liquor well together, and set it by a few days, and it will be found remarkably altered for the better. This experiment depends upon the useful doctrine of acids and alkalies. All perfect wines have naturally some acidity, and when this acidity prevails too much, the wine is said to be pricked, which is truly a state of the wine tending to vinegar: but the introduction of a line alkaline salt, such as that of tartar, imbibed by spirit of wine, has a direct power of taking off the acidity, and the spirit of wine also contributes to this, as a great preservative in general of wines. If this operation be dexterously performed, pricked wines may absolutely be recovered by it, and remain saleable for some time; and the same method may be used to malt-liquors just turned sour. Shaw's Lectures, p. 214.

W I S

W I T

WINE-SPIRIT, a term used by our distillers, and which may seem to mean the same thing with the phrase *spirit of wine*; but they are taken in very different senses in the trade. *Spirit of wine* is the name given to the common malt-spirit, when reduced to an alcohol, or totally inflammable state; but the phrase *wine-spirit* is used to express a very clean and fine spirit, of the ordinary proof-strength, and made in England from wines of foreign growth. The way of producing it is by simple distillation; and it is never rectified any higher than common bubble-proof. The several wines of different natures yield very different proportions of spirit; but, in general, the strongest yield one-fourth, the weakest in spirits one-eighth part of proof-spirit: that is, they contain from a sixteenth to an eighth part of their quantity of pure alcohol.—Wines that are a little sour serve not at all the worse for the purposes of the distiller; they rather give a greater vinosity to the produce. This vinosity is a thing of great use in the wine-spirit, whose principal use is to mix with another that is tartarized, or with a malt-spirit, rendered alkaline by the common method of rectification. All the wine-spirits made in England, even those from the French wines, appear very greatly different from the common French brandy; and this has given our distillers a notion that there is some secret art practised in France, for giving the agreeable flavour to that spirit: but this is without foundation. When we distil Sicilian or Spanish-wines, we do not produce Sicilian or Spanish brandies; and the true reason of this is, that the wines which they distil on the spot into brandy, are very different from those which they export as wines. Those they distil are so poor and thin, that they will not keep many months, nor can possibly bear exportation. If we had in England those poor wines they distil into brandy near Bordeaux, Cognac, or up the Loire, there is no doubt but the spirit we made from them would be universally allowed to be French brandy. We have proof of this from some of the Scotch distilleries, where they, with no peculiar art, or secret method, procure from some of the poor pricked and damaged wines received there, brandy so nearly resembling that of France, that a good judge will scarcely be able to make the distinction. Wine-spirits and brandies therefore are the same thing, only with this difference, that the former is the product of a rich wine, and the latter of a poor one; or, at the utmost, they differ only as our two home products, the cyder-spirit and the crab-spirit do.

The wine-spirit, distilled in England, is not easy to be had pure and unmixed of our distillers, nor under a price almost equal to that of French brandy; so that if it ever be required out of the trade, it is as well to use the French brandy, which will, in all cases, serve the same purpose, unless where a high flavour or a copious essential oil are required. All other spirits are carefully divested of their oil in the rectification; but the wine-spirit is coveted only for its oil, and all that can be obtained is preserved in this, its principal use being to give a flavour to a worse spirit, and to cover the taste of a disagreeable oil in it. When a cask of wine chances to turn sour in private hands, it is worth while to distil it for the spirit. The lees also, if any considerable quantity, will yield such a proportion of the same sort of spirit, as to render it worth while; and as the high flavour is not required in this intent, it will be best to draw off the spirit very gently, either by the cold or hot still, and afterwards it may be rectified without any addition, and reduced to the standard strength of proof. It thus makes a clean and pleasant spirit, though very different from the brandy from the same country whence the wine came. Shaw's Essay on Distillery. See SPIRIT.

LOW-WINES, in the distillery, is a term for the spirituous liquor distilled immediately from the fermented matter, and continued running so long that the last of it is not at all inflammable. This liquor is afterwards rectified to a proof-spirit of the strength of brandy, and thence to a rectified spirit called *alcohol*, or spirit of wine. Shaw's Lectures, p. 216.

WINTER, one of the four seasons, or quarters of the year. Winter properly commences on the day when the sun's distance from the zenith of the place is the greatest, and ends on the day when its distance is at a mean between the greatest and least. Notwithstanding the coldness of this season, it is proved, in astronomy, that the sun is really nearer to the earth in winter than in summer. The reason of the decay of heat, &c. see under HEAT. Under the equator, the winter, as well as the other seasons, returns twice every year; but all other places have only one winter in the year; which, in the northern hemisphere, begins when the sun is in the tropic of Capricorn; and in the southern hemisphere, when in the tropic of Cancer: so that all places in the same hemisphere have their winter at the same time.

WIRE, a piece of metal, drawn through the hole of an iron, into a thread, of a fineness answerable to the hole it is passed through. Wires are frequently drawn so fine, as to be wrought along with other threads of silk, wool, or hemp: and thus they become a considerable article in the manufactures. The metals most commonly drawn into wire are gold, silver, copper, and iron. And hence we have gold wire, silver wire, iron wire, &c. See GOLD, and DUCTILITY.

WISDOM, *Sapience*, usually denotes a higher and more refined knowledge of things, immediately presented to the mind, as No. 150.

it were by intuition, without the assistance of ratiocination. In this sense, wisdom may be said to be a faculty of the mind, or at least a modification and habit thereof. Sometimes the word is more immediately used in a moral sense, for what we call *prudence* or *discretion*; which consists in the soundness of the judgment, and a conduct answerable thereto.

WIT, is a faculty of the mind, consisting, according to Mr. Locke, in the assembling, and putting together, of those ideas with quickness and variety, wherein can be found any resemblance or congruity, whereby to make up pleasant pictures, and agreeable visions, in the fancy. This faculty, the same great author observes, is just the contrary of judgment, which consists in the separating carefully from one another such ideas wherein can be found the least difference, thereby to avoid being misled by similitude, and, by affinity, to take one thing for another: and hence he accounts for the reason of that common observation, that men who have much wit and prompt memories, have not always the clearest judgment, or deepest reason. It is the metaphor, and allusion, wherein, for the most part, consist the entertainment and pleasantries of wit; which strikes in so lively a manner on the fancy, and is therefore so acceptable to all people, because its beauty appears at first sight, and there requires no labour of thought, to examine what truth or reason there is in it. The mind, without looking any farther, rests satisfied with the agreeableness of the picture, and the gaiety of the imagination; and it is a kind of affront to go about to examine it by the severe rules of truth or reason. Whence it should seem that *wit* consists in something that is not perfectly conformable to them. Essay on Human Understanding, book ii. chap. xi. sect. 2.

A man whose chief aim is to make himself esteemed, so much as to raise mirth and laughter; who jokes pertinently, rallies pleasantly, and finds something to amuse himself with in every petty subject, is likewise allowed a *wit*.

However difficult it may be, in every particular instance, to distinguish a witty thought or expression from one that is not so; yet in general it may be laid down, that the term *wit* is appropriated to such thoughts and expressions as are ludicrous, and also occasion some degree of surprise by their singularity. Wit also, in a figurative sense, expresses that talent which some men have of inventing ludicrous thoughts or expressions; we say commonly, *a witty man*, or *a man of wit*. Wit, in its proper sense, as explained above, is distinguishable into two kinds; wit in the thought, and wit in the words, or expression. Again, wit in the thought is of two kinds; ludicrous images, and ludicrous combinations of things that have little or no natural relation.

Ludicrous images that occasion surprise by their singularity, as having little or no foundation in nature, are fabricated by the imagination; and the imagination is well qualified for the office; being, of all our faculties, the most active, and the least under restraint. Take the following example:

Shylock. You knew (none so well, none so well as you) of my daughter's flight.

Salanio. That's certain. I, for my part, knew the taylor that made the wings she flew withal.

Merchant of Venice. Act iii. Sc. 1.

The image here is undoubtedly witty. It is ludicrous; and it must occasion surprise: for having no natural foundation, it is altogether unexpected. Wit may be defined, and perhaps more accurately, a junction of things by distant and fanciful relations, which surprise because they are unexpected. The following is a proper example:

We grant although he had much wit,
He was very shy of using it,
As being loth to wear it out;
And therefore bore it not about,
Unless on holiday or so,
As men their best apparel do.

Hudibras, Canto I.

Wit is of all the most elegant recreation: the image enters the mind with gaiety, and gives a sudden flash, which is extremely pleasant. Wit thereby gently elevates without straining, raises mirth without dissoluteness, and relaxes while it entertains. Wit, in the expression commonly called *a play of words*, being a bastard sort of wit, is reserved for the last place. We proceed to examples of wit in the thought; and first of ludicrous images.

Falstaff, speaking of his taking Sir John Coleville of the Dale:

"Here he is, and here I yield him; and I beseech your grace, let it be book'd with the rest of this day's deeds; or, by the Lord, I will have it in a particular ballad else, with mine own picture on the top of it, Coleville kissing my foot: to the which course if I be enforced, if you do not all show like gilt twopences to me; and I in the clear sky of fame, o'ershine you as much as the full moon doth the cinders of the element, which shew like pins' heads to her: believe not the word of a noble. Therefore let me have right, and let desert mount.

Second Part Henry IV. Act iv. Sc. 6.

The other branch of wit in the thought, viz. ludicrous combinations and oppositions, may be traced through various ramifications.

W O M

tions. And, first, fanciful causes assigned that have no natural relation to the effects produced.

Lancaster. Fare you well, Falstaff; I, in my condition, shall better speak of you, than you deserve.

Falstaff. I would you had but the wit; 'twere better than your dukedom. Good faith, this same young sober-blooded boy doth not love me; nor a man cannot make him laugh; but that's no marvel, he drinks no wine. There's never any of these demure boys comes to any proof; for thin drink doth so overcool their blood, and making many fish-meals, that they fall into a kind of male green-sickness; and then when they marry, they get wenches. They are generally fools and cowards; which some of us should be too, but for inflammation. A good sherris-sack hath a twofold operation in it; it ascends me into the brain; dries me there all the foolish, dull, and crudy vapours which environ it; makes it apprehensive, quick, forgetive, full of nimble, fiery, and delectable shapes; which, delivered o'er to the voice, the tongue, which is the birth, becomes excellent wit. The second property of your excellent sherris is, the warmth of the blood; which before, cold and settled, left the liver white and pale; which is the badge of pusillanimity and cowardice; but the sherris warms it, and makes it course from the inwards to the parts extreme; it illumineth the faith, which, as a beacon, gives warning to all the rest of this little kingdom, man, to arm; and then the vital commoners and inland petty spirits muster me all to their captain, the heart; who, great and puffed up with his retinue, doth any deed of courage; and thus valour comes of sherris. So that skill in the weapon is nothing without sack, for that sets it a-work; and learning a mere hoard of gold kept by a devil till sack commences it and sets it in act and use. Hereof comes it that Prince Harry is valiant; for the cold blood he did naturally inherit of his father, he hath, like lean, sterile, and bare land, manured, husbanded, and tilled with excellent endeavour of drinking good and good store of fertile sherris, that he has become very hot and valiant. If I had a thousand sons, the first human principle I would teach them, should be to forswear thin potations, and to addict themselves to sack.

Fanciful reasoning.

Falstaff. Imbowell'd!—if thou imbowel me to-day, I'll give you leave to power me, and eat me to-morrow! 'Sblood, 'twas time to counterfeit, or that hot terragant Scot had paid me scot and lot too. Counterfeit! I lie, I am no counterfeit; to die is to be a counterfeit; for he is but the counterfeit of a man who hath not the life of a man; but to counterfeit dying, when a man thereby liveth, is to be no counterfeit, but the true and perfect image of life indeed.

First Part of Henry IV. Act i. Sc. 10.

Pedro. Will you have me, Lady?
Beatrice. No, my Lord, unless I might have another for working days. Your grace is too costly to wear every day.

Much ado about Nothing, Act ii. Sc. 5.

Taking a word in a different sense from what is meant, comes under wit, because it occasions some slight degree of surprise:

Beatrice. I may sit in the corner, and cry *Heigh ho!* for a husband.
Pedro. Lady Beatrice, I will get you one.
Beatrice. I would rather have one of your father's getting. Hath your grace ne'er a brother like you? Your father got excellent husbands, if a maid could come by them.

Much ado about Nothing, Act ii. Sc. 5.

If any one shall observe, that there is a third species of wit, different from those mentioned, consisting in sounds merely, we are willing to give it place. And, indeed, it must be admitted that many of Hudibras's double rhymes come under the definition of wit given in the beginning of this article; they are ludicrous, and their singularity occasions some degree of surprise. Swift is not less successful than Butler in this kind of wit; witness the following instances: *Goddes—Boddice. Pliny—Nicolini. Iscariots—Chariots. Mitre—Nitre. Dragon—Suffragan.*

A repartee may happen to be witty; but it cannot be considered as a species of wit, because there are many repartees extremely smart, and withal extremely serious. We give the following example: A certain petulant Greek, objecting to Anacharsis that he was a Scythian; "True (says Anacharsis) my country disgraces me, but you disgrace your country." This fine turn gives surprise, but is far from being ludicrous.

WITHERS of a horse, the juncture of the shoulder-bones at the bottom of the neck and main, towards the upper part of the shoulder.

WITTENA-gemot, among our Saxon ancestors, a term literally signifying a council, or assembly of sages, or wise men; applied to the great council of the land, in later days called Parliament. See **PARLIAMENT**.

WOAD, *Isatis*, in botany, a genus of the *Tetradynamia Siliculosa* class. The broad-leaved woad is cultivated in several parts of England for the purpose of dying, being used as a foundation for many of the dark colours. For it is cultivation, see the **System of AGRICULTURE**, Sect. XVIII.

WOLF, in astronomy, one of the southern constellations. See the **System**, Sect. VIII.

WOLF, *Lupus*, a species of the genus *Canis*, in the system of mammalia. For the description of the genus, &c. see **CANIS**. For representation, see Plate 4. Genus 12. Species 2.

WOLVERENE, the English name of a species of the genus *Ursus*. For description of the genus, see **URSUS**; for representation, see Plate 16. Genus 16. Species 4.

WOMAN, *Fœmina*, *Mulier*, the female of man.

A woman, in England, as soon as she is married, with all her moveables, is wholly in *poteſtate viri*, or at the will and disposal of

W O O

her husband. There are divers considerable things relating to women in the laws of England, which see under **WIFE**. It is a point much controverted, how far learning and study becomes the sex. Erasmus handles the question at large in one of his letters to Budæus. Lud. Vivis, in his *Institutio Fœminæ Christianæ*, has a chapter express on the same subject. Madame Schurman, a German lady, has gone beyond them both, in a treatise on this problem: *Num Fœminæ Christianæ conveniat studium literarum?* Several women remarkable for learning have been also distinguished from their want of conduct. The reason, no doubt, lay in this; that their first studies lying in books of gallantry and intrigue, the imagination was early turned that way, and the memory filled with a sort of ideas which a favourable disposition and age, adopted too easily, and improved too fast. It is not that study in itself has any natural tendency to produce such effects, rather the contrary; the close abstracted researches of metaphysics, logic, mathematics, physics, criticism, &c. no doubt, would be the surest means to secure and establish the virtue of continency in a woman.

WOMB, *Matrix*, or *Uterus*, in anatomy, that part of the female of any kind, wherein the fœtus is conceived and nourished till the time of its delivery. For a copious description of this subject, see the **System of ANATOMY**, Part III. Sect. XV. Art. 2. For the representation, Plate X. Art. 2. Fig. 1. See also the **System of MIDWIFERY**, Part I. Sect. I. II. III. and IV. and Fig. 4, 5, 6, 7, and 8.

WONDER. See **MIRACLE**. The seven wonders of the world, as they are popularly called, were the Egyptian pyramids; the mausoleum, erected by Artemisia; the temple of Diana at Ephesus; the walls and hanging-gardens of the city of Babylon; the colossus, or brazen image of the sun at Rhodes; the statue of Jupiter Olympius; and the pharos, or watch-tower, of Ptolemy Philadelphus; instead of the latter some reckon the royal palace of Cyrus, built by Menon, the stones of which were cemented with gold. See **PYRAMID**.

WOOD, a substance, whereof the trunks and branches of trees consist; deriving its growth from certain juices in the earth. The wood is all that part in a tree, included between the bark and the pith. Dr. Grew, in his *Anatomy of Plants* has discovered, by means of the microscope, that what we call wood in a vegetable, notwithstanding all its solidity, is only an assemblage of infinitely minute canals, or hollow fibres; some of which rise from the root upwards, and are disposed in form of a circle; and the others, which he calls infertions, tend horizontally from the surface to the centre; so that they cross each other, and are interwoven like the threads of a weaver's web. For the organization of wood, see **MICROSCOPIC OBJECTS**, under that article, and Plate III.

Woods are distinguished into divers kinds, with regard to their natures, properties, virtues, and uses. Of wood, considered according to its qualities, whether useful, curious, medicinal, &c. the principal is that called timber, used in building houses, laying floors, roofs, machines, &c. See **TIMBER**. Woods valued on account of their curiosity, are cedar, ebony, mahogany, walnut-tree, box, &c. which, by reason of their extraordinary hardness, agreeable smell, or beautiful polish or grain, are made into cabinets, tables, beads, &c. The medicinal woods are, guaiac, which the Spaniards call *ligno ſancto*; aloes, or *agallochum*; *ſaffafras*, *nephriticum*, *ſantal*, *logwood*, *aſpalathum*, *eagle-wood*, or *pao d'aquila*, &c. Woods used in dying, are the *Indian wood*, *Brazil*, *Campeche*, &c. Wood used for fuel is required of various kinds in regard to the various works to be performed by it.

Fossil (ſubterraneous) WOOD. There are divers places where wood is found under ground: supposed to have been overturned, and buried there at the time of the deluge, or at some other period. Whole trees, or parts of them, are very frequently found buried in the earth, and that in different strata; sometimes in stone, but more usually in earth; and sometimes in small pieces loose among gravel. These, according to the time they have lain in the earth, or the matter they have lain among and in the way of, are found differently altered from their original state; some of them having suffered very little change, and others being so highly impregnated with crystalline, sparry, pyritical, or other extraneous matter, as to appear mere masses of stone, or lumps of the common matter of the pyrites, &c. of the dimensions, and more or less of the internal figure, of the vegetable bodies into the pores of which they have made their way. The fossil-wood, which we find at this day, may, according to these differences, be ranged into three kinds: 1. The less altered. 2. The pyritical. And, 3. The petrified.

Of the trees or parts of them less altered from their original state, the greatest store is found in digging to small depths in bogs, and among what is called peat or turf earth, a substance used in many parts of the kingdom for fuel. In some places there are whole trees scarcely altered except in colour; the oaks in particular being usually turned to a jetty black: the pines and firs remain as inflammable as ever, and often contain between the bark and wood a plain resin. Parts of trees have been also found unaltered in the strata of clay and loam, among gravel, and sometimes even in solid stone. See **BOG**.

It is idle to imagine, that these have been thus buried either at

the

the creation, or, as many are fond of believing, at the universal deluge: at the first of these times the strata must have been formed before trees were yet in being, and the peat wood is so far from being of antediluvian date, that much of it is well known to have been growing within these three hundred years, in the very places where it is now found buried. See MORASS.

The substances that are more altered are the larger and longer branches of trees found bedded in the strata of stone, and partly assuming its nature; and the shorter and smaller branches found in pits of blue clay, which externally bear the resemblance of what they once were, but having their pores filled with the matter of the common vitriolic pyrites, internally appear to be masses of that matter. The irregular masses or fragments of wood are principally of oak, and most usually found among gravel, but variously altered by the insinuation of crystalline and strong particles. These make a beautiful figure when cut and polished, as they commonly keep the regular grain of the wood, and shew the several circles which mark the several years' growth. These according to the different matter which has filled their pores, assumes various colours, and the appearance of the various fossils that have impregnated them. Of these some pieces have been found with every pore filled with pure pellucid crystal, and others in large masses, part of which is wholly petrified, and some mere stone, while the rest is crumbly and unaltered wood. All these pieces of petrified wood are usually capable of a high and elegant polish. Hill's History of Fossils, p. 638, &c.

Wood has been found in salt-mines, inclosed in a mass of hard salt, and its pores filled with the matter of the salt in which it lay. Wood has likewise been found converted, as it were, into iron, or thoroughly impregnated with the particles of this metal. Act. Erud. ann. 1710.

Staining of Wood. See the Treatise on DYEING.

WOODCOCK, the English name of a species of the genus *Scolopax*, in the system of ornithology. For description of the genus, &c. see SCOLOPAX.

WOODPECKER, in ornithology, the English name of the genus *Picus*. For description of the genus, &c. see PICUS.

WOOL, *Lana*, the hair, or covering of sheep, which, washed, shorn, dressed, combed, spun, and woven, makes divers kinds of stuffs and cloths, &c. for apparel, furniture, &c. While the wool remains in the state it was first shorn off the sheep's back, and not sorted into its different kinds, it is called *fleece*. Each fleece consists of wool of divers qualities, and degrees of fineness, which the dealers therein take care to separate. The finest grows on the pole of the sheep; the coarsest about the tail; the shortest on the head and on some parts of the belly; the longest on the flanks. Wool is either shorn, or pulled off the skin after the sheep is dead: this latter sort is short and finer; if it be short, it is used for hats, and not in the manufacture of cloth, unless mixed in fleeces. The French and English usually separate each fleece into three sorts; viz. 1. *Mother-wool*, which is that of the back and neck. 2. The wool of the tails and legs. 3. That of the breast, and under the belly. The Spaniards make the like division into three sorts, which they call *prime*, *second*, and *third*; and, for the greater ease, mark each bale or pack with a capital letter, denoting the sort.

The first thing which the Spaniards do after their sheep are sheared (one hundred and twenty-five shearmen being employed to shear a flock of ten thousand sheep) is to weigh the whole pile of wool; and the next is to divide each fleece into three sorts of wool: the back and belly give the superfine; the neck and sides the fine; the breast, shoulders, and thighs, the coarse wool. A different price is fixed upon these three classes, though the general custom is to sell the whole pile together at a mean price. An ingenious writer observes, that the sheep of Andalusia, which never travel, have coarse, long, hairy wool: but that the itinerant sheep have short, silky, white wool; and he infers, from a few experiments and long observation, that if the fine-woolled sheep were kept at home in the winter, their wool would become coarse in a few generations, and that if the coarse-woolled sheep travelled from climate to climate, and lived in the free air, their wool would become fine, short, and silky, in a few generations: the fineness of the wool is owing to the animal's passing its life in an open air of equal temperature. The wools most esteemed are the English, chiefly those about Leominster, Coteswold, and the Isle of Wight; the Spanish, principally those about Saragossa for the province of Arragon, and about Segovia for Castile; and the French, in Roussillon, Languedoc, Berry, and Lower Normandy: those of Berry are said to have this peculiar property, that they will knot or bind with any other sort; whereas the rest will only knot with their own kind.

English Wool. The wools of England have always been in the highest repute, and particularly more abroad than at home. Some we have, which, manufactured by our own clothiers, Chamberlayne observes, does, both for softness and fineness, vie with the choicest silks. Spanish wools, we know, bear a great price among us; but is it certain, much the greatest part of that, which when manufactured, our clothiers, &c. call *Spanish cloth*, grows in England. Add, that the French can make no good cloth of their own wool, without, at least, one-third of English wool mixed

with it. It has been said, that the goodness of the Spanish wool is owing to a few English sheep sent over into Spain as a present, by Henry II. of England; or, as others will have it, by Edward IV. in 1468.

The fineness and plenty of our English wools are owing, in a great measure, to the sweet short graze in many of our pastures and downs; though the advantage of our sheep feeding on this graze all the year, without being obliged to be shut up in folds during the winter, or to secure them from wolves at other times, contributes not a little thereto. Anciently, the principal commerce of the nation consisted in wool unmanufactured; which foreigners, especially the French, Dutch, and Flemish, bought of us: inasmuch, that the customs of English wool exported in Edward the Third's reign, amounted, at fifty shillings a pack, to 250,000*l.* per annum! An immense sum in those days.

This excessive custom on the export of unmanufactured wool set our people to making it into cloth themselves: in which they succeeded so well, that, under the reign of Queen Elizabeth, the exportation of any wool at all was absolutely prohibited. From that time England has been exceedingly jealous of its wool. To prompt their vigilance, the judges, king's counsel at law, and masters in chancery, in parliament, are seated on woollacks. Accordingly, scarce a parliament but has renewed and reinforced the prohibition. For a further account, see the System of AGRICULTURE, Sect. XXIV.

WOOLLEN MANUFACTORY, includes the several sorts of commodities into which the wool is wrought; as *broad-cloths*, *long* and *short kerseys*, *baize*, *serges*, *flannels*, *lays*, *stuffs*, *frize*, *flockings*, *rugs*, &c.

The woollen manufactory, which now makes the principal article both in our foreign and domestic trade, being that which furnishes the cargoes of our vessels, employs our people, &c. may be said to have had its rise, or rather to have received great improvement, in the fourteenth century. Till that time our wool was chiefly sold in the fleece, to such of our neighbours as came to fetch it. Among our customers, however, the principal were the Flemings and Brabanters, and particularly the merchants of Ghent and Louvain, who took off vast quantities to supply two manufactories that had flourished in those cities from the tenth century, and had furnished the greatest part of Europe, and even England itself, with all sorts of woollen cloths, &c. But the richness of the manufactories of Ghent, and the incredible number of hands employed therein, having spirited up the inhabitants to revolt, divers times, particularly in the years 1300 and 1301, against their sovereigns, on account of certain taxes which they refused to pay, the seditious were at length punished and dispersed; and part of them took refuge in Holland, and the rest in Louvain. These last, together with their art of manufacturing cloths, carried with them their spirit of sedition; and it was not long before several of them, to avoid the punishment they had deserved for killing some of the magistrates, removed into England; where they instructed our people how to work their own wools.

With respect to the woollen manufacture, Anderson (Hist. Com. vol. i. p. 51) remarks, that, at least, some sort of woollen cloth must ever have been made in all civilized countries; and that wherever the Romans planted colonies, they there introduced the weaving of cloth. Camden, in his Britannia, speaking of the antiquity and eminence of the city of Winchester, says, that there the Roman emperors seem to have had their imperial weaving-houses for cloths, both of woollen and linen, for the emperor and the army; and most probably that necessary art was preserved in Britain after the Romans quitted it, though perhaps in a plainer kind, till the fourteenth century, when King Edward III. introduced the fine manufacture from the Netherlands.

The year 1614 produced the discovery of a new species of woollen manufacture in England. The states-general of the United Netherlands having prohibited the importation of any English woollen cloth, that was dyed in the cloth, the English clothiers ingeniously devised the method of making mixtures dyed in the wool, rather than lose all the profits of dying and dressing. This has ever since obtained the name of *medley cloth*; all woollen cloth before this time being only of one single colour dyed in the cloth, as black, blue, red, &c. So jealous are we now become of our woollens, that, besides the precaution taken to use our own wools ourselves, we have added that of selling them ourselves, and of carrying them to the places where they are required; not admitting strangers to come and buy any in England. And hence the establishment of those famous magazines in Holland, the Levant, and the North, where our woollens were deposited to be vended by factors, or commissioners. Besides several regulations tending to the improvement of the woollen manufacture in England, and laws prohibiting the importation of woollen cloth (41 Ed. III. cap. 3; 4 Ed. IV. cap. 1, see WOOL) and allowing woollen manufactures to be exported custom free (11 & 12 W. cap. 20) it is enacted by 30 Car. II. cap. 3, that no corpse shall be buried in any other covering but that which is made of sheep's wool only, of which an affidavit shall be made on pain of the forfeiture of five pounds.

The dying and dressing of white woollen cloth in England was brought to perfection by means of persons who arrived from the Netherlands in 1667. It appears from further consideration laid before

before parliament in 1739, that more than 1,500,000 people were then employed in our British woollen manufacture; and if these earned, one with another, 6*d.* per day for 313 working-days in the year, it would amount to 11,737,500*l.*; a sum which sufficiently evinces the immense benefit of this manufacture. We shall only add on this subject, that many have erroneously imagined that the fine broad-cloth of France is principally supported by our English run wool; whereas, the real superfine cloth must every where be made entirely of Spanish wool; hence called Spanish cloths. And though the second sort of French cloth is much meliorated by the help of our fine short wool, yet the best wool of France alone may do well enough for their coarse cloths. And it is principally for their fine stuffs, hose, caps, &c. that the French find our soft and long combing wool (the best of its kind in Europe) absolutely necessary: because, without a certain proportion of it, mixed up with their own wool, they cannot make those fine goods fit for the markets of Spain, Portugal, and Italy. Moreover, by running of our wool to Hamburg, Holland, Flanders, France, &c. those countries are enabled to manufacture those stuffs and stockings, to the great detriment of our own manufactures. Anderson's *Hist. Com.* vol. ii. p. 137.

A pack, or 240 pounds weight of short wool, it is computed, employs sixty-three persons a week, to manufacture it into cloths; viz. three men to sort, dry, mix, and make it ready for the stock-carder; five to scribble, or stock-card it; thirty-five women and girls, to card and spin it; eight men to weave it; four men and boys to spool it, and reed quills; eight men and boys to scour, burl, mill, or full it; row, sheer, pack, and press it. A pack of large, long, combing-wool, made into stuffs, serges, sagathies, &c. for the Spanish trade, will employ, for one week, 202 persons, whose wages amount to 43*l.* 10*s.* thus, seven combers, 3*l.* 10*s.*; dyers, 5*l.*; 150 spinners, 18*l.*; 20 throwers and doublers, 5*l.*; 25 weavers and attendants, 12*l.* A pack of wool made into stockings will employ, for one week, 184 persons, who will earn 56*l.* thus, 10 combers, 5*l.* 5*s.*; the dyer, 1*l.* 6*s.*; 102 spinners, 15*l.* 12*s.*; doublers and throwers, 4*l.* 10*s.*; 60 stocking-weavers 30*l.*

Bleaching of WOOLLENS. See BLEACHING.

The machine for twitching wool, invented by Mr. Hughes, of Coggeshall in Essex, to whom the Society for the encouragement of Arts, Manufactures, and Commerce, have adjudged a premium for this useful invention, is recommended by several eminent baizemakers of Essex. The intention of Mr. Hughes, in contriving it, was to find out the reverse motion, which he appears to have done effectually. The machine is represented in Plate I. of Miscellaneous Subjects, Fig. 25, of which the following is an explanation.

A, the winch, by which the pinion B is turned; this pinion taking into the teeth of the face-wheel C, on whose axis is the crank D, an alternate motion is communicated to the bar E, moving on an axis F; and thus the horse-head G, drives the wheel H, to the right or left; as the teeth of the horse-head take into the pinion I; and the teeth of the wheel H taking into the pinion K, fixed on the axis of the twitching-machine L; the fangs on the fliers are alternately driven with considerable velocity, first one way, and then the other. In the model, a cover is placed over the part into which the wool is put, so that it resembles a box, as is necessary in the large works, to prevent the inconveniences arising from the small particles of wool that are driven about, during the operation, to the great detriment of the workmen employed in the hand-machines used before this contrivance of Mr. Hughes.

It will easily be seen by any machine, how this machine may be fixed to a horse-mill, water-wheel, &c.

As the word twitching, when applied to the preparing wool, appeared to be a local term, Mr. Hughes was desired to explain what was meant by it, and what word was made use of for the same operation in other parts of the country. In answer to this request, Mr. Hughes informed the society that the use of his machine was for opening and preparing the wool for the carders and spinners, which was formerly done by men, beating it with sticks called rods. But of late, he says, the method has been to use mills, called *gigging-mills*, which in Yorkshire are termed *towing-mills*. These are worked by men turning them backward and forward till the wool is sufficiently opened for use. He adds, that the reverse motion, as shewn in his machine, was much wanted, and the benefit and advantages of it are well known and approved; it having been at work more than two years.

WORD, in language, is an articulate sound, designed to represent some idea.

WORD, in writing, is an assemblage of several letters, forming one or more syllables, and signifying some thing. The proper character of a word, according to the ingenious Mr. Harris, is that of its being a sound significant, of which no part is of itself significant; and hence he infers, that the words are the smallest parts of speech. The first and most obvious distinction of words is in such as are significant absolutely or by themselves, and such as are significant by relation: the former may be called *principals*, and the latter *accessaries*. Moreover, all words whatever, significant as principals, are either *substantives* or *attributives*; and those, which are significant as accessaries, acquiring a signification either from being associated to one word, in which case they only define and deter-

mine, and may be justly called *definitives*; or to many words at once, in which case they serve to no other purpose than to connect, whence, they are called *connectives*. Accordingly, Mr. Harris refers all words to these four species. Hermes, p. 20. See the System of GRAMMAR, Part I. Chap. 1, and 2.

Grammarians divide words into eight classes, called parts of speech; which are the *noun*, *pronoun*, *verb*, *participle*, *adverb*, *conjunction*, *preposition*, and *interjection*; to one or other of which, all the words and terms in all languages, which have, or may be invented to express our ideas, are reducible. See the same System, Part II. Chap. III. throughout. The use of words is to serve as sensible signs of our ideas; and the ideas they stand for in the mind of the person that speaks are their proper significations. Language derives considerable improvement in the use of general terms, whereby one word was made to mark a multitude of particular existences; which advantageous use of sounds was obtained only by the difference of the ideas they were made signs of; those names becoming general, which were made to stand for general ideas; and those remaining particular, where the ideas they are used for are particular. See LANGUAGE.

The ends of language, in our discourse with others, are chiefly three: first, to make our thoughts or ideas known one to another. This we fail in, 1. When we use names without clear and distinct ideas in our minds. When we apply received names to ideas, to which the common use of that language doth not apply them. 3. When we apply them unsteadily, making them stand now for one, and then for another idea. Secondly, to make known our thoughts with as much ease and quickness as possible. This men fail in, when they have complex ideas, without distinct names for them; which may happen either through the defect of a language, which has none; or a fault of the man, who has not yet learned them. Thirdly, to convey the knowledge of things. This cannot be done, but when our ideas agree to the reality of things. He that has names without ideas, wants meaning in his words, and speaks only empty sounds. He that has complex ideas without names for them, wants dispatch in his expression. He that uses his words loosely and unsteadily, will either not be minded, or not understood. He that applies names to his ideas different from the common use, wants propriety in his language, and speaks imperfectly; and he that has ideas of substances, disagreeing with the real existence of things, so far wants the materials of the true knowledge. For the use and application of words, as the signs of ideas, see the System of LOGIC, Part I. Sect. I.

WORD, *Watch-WORD*, in an army, or garrison, is some peculiar word or sentence, by which the soldiers are to know and distinguish each other in the night, &c. and by which spies and designing persons are discovered. It is used also to prevent surprises. The word is given out in an army every night by the general, to the lieutenant, or major-general of the day, who gives it to the major of the brigades, and they to the adjutants; who give it first to the field-officers, and afterwards to a serjeant of each company, who carry it to the subalterns. In garrison it is given, after the gate is shut, to the town-major, who gives it to the adjutants, and they to the serjeants.

WORKHOUSE, is a place where indigent, vagrant, and idle people are sent to work, and maintained with clothing, diet, &c. Such are the *bridewells*, and several other places about the city, or suburbs; such also was the foundation of that in Bishopgate-street, for employing the poor children of the city and liberties, who have no settlement; and that for the parish of St. Margaret's, Westminster, called the *Grey-coat Hospital*.

WORKS, in fortification, the several lines, trenches, ditches, &c. made round a place, an army, or the like, to fortify and defend it. See WAR, and the System of FORTIFICATION.

WORLD, the assemblage of parts which compose the universe. The duration of the world is a thing which has been greatly disputed. Plato, after Ocellus Lucanus, held it to be eternal, and to have flowed from God, as rays flow from the sun. Aristotle was much of the same mind: he asserts, that the world was not generated, so as to begin to be a world, which before was none; and in effect, his whole eighth book of Phys. and first book de Cælo, are spent in proving the eternity of the world. He lays down a pre-existing and eternal matter, as a principle; and thence argues the world eternal. His arguments amount to this, that it is impossible an eternal agent, having an eternal passive subject, should continue long without action. His opinion was long generally followed; as seeming to be the fittest to end the dispute among so many sects about the first cause. Epicurus, however, though he makes matter eternal, yet shews the world to be but a new thing, and says, it was formed out of a fortuitous concurrence of atoms. See Lucretius, lib. v.

Some of the modern philosophers refute the imaginary eternity of the world, by this argument: that, if it be *ab æterno*, there must have been a generation of individuals, in a continual succession from all eternity; since no cause can be assigned why they should not be generated, viz. one from another. Therefore, to consider the origin of things, and the series of causes, we must go back in infinitum; i. e. there must have been an infinite number of men, and other individuals, already generated; which subverts the very notion of number. And if the cause which now generates has

has been produced by an infinite series of causes, how shall an infinite series be finite, to give room for new generations? See GOD.

Dr. Halley suggests a new method of finding the age of the world, from the degree of saltiness of the ocean. It is another popular topic of conversation, whether the world be finite or infinite? It is likewise disputed, whether the plurality of worlds be possible? Some hold the affirmative, from an opinion of the infinite power of the Deity; it being the setting bounds to Omnipotence, to say, that he created so many bodies at first, and that he could not create more.

WORMS, in the Linnæan system of nature, the sixth class of animals, including five orders, viz. *intestina*, *mollusca*, *testacea*, *lithophyta*, and *zoophyta*; eighty genera, and eleven hundred and sixty-six species. The animals of this class are distinguished by having the heart with one ventricle, and no auricle, and a cold, colourless sanies; and they are particularly distinguished from insects, which are antennated, by being tantaculated. See VERMEOLOGY.

WORMS, in husbandry, are very prejudicial to corn-fields, eating up the roots of the young corn, and destroying great quantities of the crop. Sea-salt is the best of all things for destroying them. Sea-water is proper to sprinkle on the land where it can be had; where the salt-springs are, their water does as well: and where neither are at hand, a little common or bay salt, melted in water, does as well. Soot will destroy them in some lands, but it is not to be depended upon, for it does not always succeed. Some farmers strew on their land a mixture of chalk and lime; and others trust wholly to their winter fallowing to do it. If this is done in a wet season, when they come up to the surface of the ground, and some nails with sharp heads be driven into the bottom of the plough, it will infallibly destroy them. If they are troublesome in gardens, the refuse brine of salted meat will serve the purpose; or some walnut-leaves steeped in a cistern of water for a fortnight or three weeks, will give it such a bitterness that it will be a certain poison to them.

A decoction of wood-ashes, sprinkled on the ground, will answer the same purpose; and any particular plant may be secured both from worms and snails by strewing a mixture of lime and ashes about its roots. It is a general caution among the farmers to sow their corn as shallow as they can, where the field is very subject to worms. Mortimer's Husbandry, p. 328.

WORMS, *Lumbrici*, or *Vermes*, in medicine, a disease arising from some of those reptiles being generated, and growing in the body; whence, frequently, terrible symptoms proceed. For description of the several sorts of worms which infest the human body, and the method of expelling them, see the System of MEDICINE, Genus 43.

WORM, in chymistry, denotes a long winding pewter pipe, which distillers and apothecaries place in a tub of water, to cool and condense the vapour in the distillation of spirits. This the chymists also called a *serpentine*. Formerly, this worm, or something like it, was placed above the head of a still, with a refrigeratory at the upper end of it, which was useful in the distilling of spirit of wine.

WORM Tincture, in chymistry, a name given by many to a medicine prepared by Hoffman, from earth-worms; and in many parts of Germany esteemed one of the greatest medicines in the world, though less known in other places. This tincture, whichever way prepared, is excellent in abating the pains of diseases that do not admit a cure. The fits of the gout are rendered easier by every dose of it; and even in cancers, the pain is quieted in a wonderful manner by it, and life rendered much more supportable. Hoffman's Act. Laborator. Chym.

WORMWOOD, *Abinthum*, in botany, a genus of plants. A decoction of wormwood in water, long boiled, and inspissated to the consistence of an extract, loses the smell and flavour of the plant, but retains it bitterness. An extract, made with rectified spirit, contains, along with the bitter, nearly the whole of the nauseous part; the watery extract gives out its simple bitterness, not only to water again, but to rectified spirit. Wormwood is a moderately warm stomachic and corroborant: for these intentions it was formerly in common use, but it has now given place to bitters of a less ungrateful kind. An infusion of the leaves, with the addition of a fixed alkali salt, is a powerful diuretic in dropical cases. The essential oil is sometimes given, in doses of a drop or two, properly diluted by solution in spirit of wine, as a mild antispasmodic. Its more frequent use is a vermifuge; for which purpose it is both applied to the belly, and taken in pills made with crumb of bread. Dr. Lewis, however, says that the spirituous extract promises to be, in this intention, preferable to the pure oil; as it contains, along with the oil, all the bitter matter of the wormwood. This plant very powerfully resists putrefaction, and is made a principal ingredient in antiseptic fomentations. Boerhaave commends in tertian agues, a medicated liquor prepared by grinding about seven grains of the oil with a drachm of sugar, and two drachms of the alkaline salt extracted from the ashes of wormwood, and afterwards dissolving the compound in six ounces of the distilled water of the plant. Two hours before the fit is expected, the patient is to bathe his feet

and legs in warm water, and then drink half an ounce of the liquor every quarter of an hour, till the two hours are expired: by this means, he says, cases of this kind are generally cured with ease and safety, provided there is no schirrosity, or suppuration.

Dr. Lewis observes, that this medicine is a very serviceable aperient, where obstructions of the viscera prohibit the immediate use of the bark, and in such obstructions as the imprudent use of the bark may have occasioned. Its virtues, he says, might be improved by an addition of the bitter watery extract: though the compound, thus labouriously prepared, would not be at all superior to a simple infusion of the plant in pure water, impregnated with a due proportion of fixed alkaline salt. The roots of wormwood, says Dr. Lewis, promise to be applicable to some useful purposes; their virtue resides chiefly in the cortical part; and rectified spirit extracts their flavour more perfectly than watery liquors. The Edinburgh college, in their last edition, directs a tincture of the dried flowering tops of wormwood, in the proportion of six ounces to a quart of rectified spirit, under the title of *tinctura abinthii*. Lewis's Mat. Med.

The ashes of wormwood afford a more pure alkaline salt than most other vegetables, excepting bean-stalks, broom, and the larger trees. In the Amœn. Acad. vol. ii. p. 160, Linnæus mentions two cases, in which an essence prepared from this plant, and taken for a considerable time, prevented the formation of stones in the kidneys or bladder; the patients forbearing the use of wine and acids. Many nauseous insects are destroyed, or driven away, by the smell of this plant: and it is no uncommon practice among the good women in the country, to preserve their clothes from moths, by laying bundles of dried wormwood among them. Some of our brewers have a method of using wormwood instead of hops, to give the bitter taste to their malt-liquors, and to preserve them. It is found to answer the latter purpose very well; but the taste is so disagreeable, that it is much complained of. The reason of this is, that the people who use it do not understand the time of gathering it. All plants are fullest of juice while in the shoot, but fullest of virtue when they have their seeds on them. This is the case with wormwood, as well as a thousand others; and though, in the seeding time, it produces much more flavour than when younger, yet it is without that nauseous bitter of the crude juice, which gives us the distaste to the plant.

Some people have found the proper way of managing wormwood, and have given a flavour with it to their malt-liquors, even preferable, in the opinion of all palates, to that given in the common way by hops. The method is this: the plant is to be gathered when fully ripe, and the seeds upon it, and in this state hung up in small bunches to dry. When thoroughly dried, a certain quantity of good strong malt-liquor is to be impregnated with it to the utmost strength that it can possibly give it. This is to be set by for use, to add to all the rest. When the hops should, in the common way, be added to the beer, this liquor is to be added in a proper quantity, making the taste the judge when there is enough of it. By this means just what degree of bitter is required may be given to the liquor, and the bitter of this common plant, thus managed, is as perfectly agreeable as that of any vegetable in the world. The wormwood for this purpose should have its seeds carefully preserved in the drying, and it is best if not used till the year after it is gathered. Phil. Transf. No. 124. The essential salt of wormwood is afforded in great quantity, and possesses, in many respects, the virtues of the plant. Wormwood shares with all other bitters the virtues of an absterfve decoflruent: and is in some degree purgative, as all bitters are. Wormwood is of one those plants which the chymists have generally chosen for their processes of the refuscitation of plants from their ashes; and though the pretended principles of this art are false, yet there have been some of the artists so cunning as to form representations of this plant, that have deceived and puzzled the greatest unbelievers, though they have not convinced them. Phil. Transf. No. 74.

WORSHIP of God, *Cultus Dei*, amounts to the same with what we call religion. This worship consists in paying a due respect, veneration, and homage to the Deity, from a consciousness of his goodness, &c. And this internal respect, &c. is to be shewn and testified by external acts; as prayers, thanksgivings, &c.

WORT, in the materia medica, is the sweet infusion of malt; first proposed by Dr. Macbride, as a dietetic article to scorbutic persons, from an apprehension that it would ferment in their bowels, and give out its fixed air, by the antiseptic powers of which the strong tendency to putrefaction in this disease might be corrected. It was some time before a fair trial of this proposed remedy could be obtained, and different reports were made concerning it. In 1762, the lords of the admiralty gave orders to have the wort tried in the naval hospitals at Portsmouth and Plymouth; but the murmurs of the patients, on account of restrictions that were necessary for determining its efficacy, put a stop to the further exhibition of it; and, indeed, Dr. Huxham, in 1764, informed the ingenious and benevolent proposer of this remedy, that it had been tried with very bad effects. But Dr. Macbride assures us, on the testimony of a gentleman, who made

tise of the wort, that it may be taken for a length of time, to the quantity of a quart in the day, without producing any ill effect whatever; and he refers to Van Swieten's Commentary, vol. iv. p. 673, where we learn that the baron's lady, when a nurse, used regularly to drink a pint of it every night going to bed, in order to increase her milk. After the failure of success in the naval hospitals, orders were issued to have the wort administered on shipboard, where no temptations of fresh vegetables could offer to make the men uneasy. But a considerable time elapsed before any reports were made either of its good or bad effects. Dr. Macbride, however, persisted in recommending it, and lived to publish several cases, in a postscript to the second edition of his work, in 1767, from which it appears, that scorbutic complaints of the most dangerous kind have actually been cured at sea by the use of wort. Its general effects were, to keep the patients open, and to prove highly nutritious and strengthening; it sometimes purged too much; but this effect was easily obviated by the tinctura thebaica. Other unquestionable cases of its success in this disease are to be seen in the London Med. Obs. and Inq. vol. v. p. 61. The use of wort has hence been adopted in other cases, where a strong purrid disposition in the fluids appeared to prevail, as in cancerous and phagædenic ulcers; and instances are published of its remarkably good effects in these cases. See London Med. Obs. and Inq. vol. iv. p. 367, &c. Prießley on Air, vol. i. Appendix. As the efficacy of the malt infusion depends upon its producing changes in the whole mass of fluids, it is obvious that it must be taken in large quantities for a considerable length of time, and rather as an article of diet than medicine. The quantity of one to four pints has generally been directed.

WOUND, in medicine and surgery, a recent separation made in the soft or fleshy parts of the body, from an external cause, and particularly from the action of some hard and sharp instrument. Or, it is a solution of the continuity of a fleshy part, made by the violent application of some penetrating body, while it yet remains fresh, bloody, and without putrefaction; by which circumstances a wound is distinguished from an ulcer or abscess, which is the solution of the external parts, proceeding from an internal cause. A like separation, happening in a bony part, is called a *fracture*. Some, indeed, have taken a greater latitude, and call every external hurt of the body, by what cause soever produced, a wound. Wounds are generally inflicted on the softer parts of the human body, nevertheless the more solid parts, as the bones, are sometimes injured by sharp instruments.

All wounds proceed either from puncture, incision, or contusion, according to the nature and make of the instrument they were caused by. Wounds are usually divided, with respect to their cause, circumstances, cure, &c. into *simple* and *compound*. *Simple wounds* are those made by puncture, incision, or contusion, separately; those of the outer skin, without any considerable loss of substance, or hurting any remarkable vessel; and those not complicated with any dangerous symptoms. *Compound wounds* are those made both by puncture and incision at the same time, to which is sometimes also added contusion; those attended with great loss of flesh, or the hurt of some considerable vessel; add, those made by envenomed instruments, or attended with violent symptoms.

WREATH, in heraldry, a roll of fine linen, or silk (like that of a Turkish turban) consisting of the colours borne in the escutcheon; placed in an achievement, between the helmet and the crest, and immediately supporting the crest. See the System, Sect. VII. and Plate VI.

WREN, or *Golden-crested WREN*, the English name of a species of the genus *Motacilla*. For a particular description of this very singular bird, see *MOTACILLA*.

WRESTLING, a kind of combat, or engagement, between two persons unarmed, body to body, to prove their strength and dexterity; and try which can throw his opponent to the ground. Wrestling, *palæstra*, is an exercise of very great antiquity and fame. It was in use in the heroic age: witness Hercules, who wrestled with Antæus. It continued a long time in the highest repute; and had very considerable rewards and honours assigned it at the Olympic games. It was the custom of the athletes, or wrestlers, to anoint their bodies with oil, to give the less hold to their antagonist. Ablancourt observes, that Lyncurges ordained the Spartan maids to wrestle in public, quite naked, to break them of their too much delicacy and niceness; to make them appear more robust; and familiarise the people, &c. to such nudities.

WRIST, *Carpus*, in anatomy, consists of eight small, unequal, and irregular bones, all of which, taken together, represent a sort of grotto, of a regular quadrangular figure, and connected principally with the basis of the radius. See the System, Part I. Sect. IV. Art. 3. and Plate I. Fig. 1. letter *h*.

WRIT, formed from the Saxon, *writan* to write; *breve*, in law, a precept from the king, in writing, under the seal, issuing out of some court to the sheriff or other person, whereby any thing is commanded to be done, touching a suit or action, or giving commission to have it done.

Original WRITS, are those *issuing* out of the High Court of Chancery, to summon the defendant in a personal, or tenant in a real action; either before the suit begins, or to begin the suit thereby.

The original writ is always made returnable at the distance of at least fifteen days from the date or *teste*, and upon some day in one of the four terms: and all *judicial writs*, being grounded on the sheriffs' return, must respectively bear date the same day on which the writ immediately preceding was returnable.

Judicial WRITS are those sent by order of the court where the cause depends upon emergent occasions, after the suit begins. Judicial writs are distinguished from original, in that their *teste* bears the name of the chief-justice of that court whence they come; whereas the original say, *teste meipso*, in the name, or relating to the king.

Writs may be returned every term, until a defendant is arrested; but in the court of king's bench if the *latitat* be not renewed in five terms, a new writ is to be taken out, and the plaintiff is not allowed to renew the old one. The sheriffs' bailiffs cannot execute a writ directed to the sheriff, without his warrant; and if several persons are included in a writ (for four defendants may be in one writ) there must be several warrants from the sheriff to execute the same. All writs are to be returned and filed in due time, to avoid *post-terminus*. Attachment lies against sheriffs, &c. for not executing a writ, or for doing it oppressively, by force, extorting money thereon, or not doing it effectually, by reason of any corrupt practice.

WRITING, *Scriptura*, the art, or act, of signifying and conveying our ideas to others, by letters or characters visible to the eye. Or, *writing* may be defined to be the art of exhibiting to the sight the conceptions of the mind, by means of marks or characters, significant of the sounds of language, which enable us to transfer ideas from the eye to the ear, and *vice versa*.

Written characters are of two sorts: they are either signs for things, or signs for words. Of the former sort are the pictures, hieroglyphics, and symbols, employed by the ancient nations; of the latter sort are the alphabetical characters now employed by all Europeans. Pictures were, undoubtedly, the first essay towards writing; accordingly, we find, in fact, that this was the only sort of writing known in the kingdom of Mexico, when America was first discovered. By historical pictures, the Mexicans are said to have transmitted the memory of the most important transactions of the empire. See Warburton's *Divine Legat. of Moses*, vol. ii. part i. p. 67, &c. vol. iii. p. 73. Robertson's *Hist. Am.* vol. iii. p. 203, &c. and Appendix, note 26, p. 440. edit. 8vo.

But as pictures could do no more than delineate external events, without exhibiting their connections, describing such qualities as were not visible to the eye, or conveying any idea of the dispositions, or words, of men, there arose, in process of time, for supplying this defect, the invention of hieroglyphical characters; which may be considered as the second stage of the art of writing.

Hieroglyphics consist in certain symbols, which are made to stand for invisible objects, on account of an analogy or resemblance which such symbols were supposed to bear to the objects. Among the Mexicans were found some traces of hieroglyphical characters, intermixed with their historical pictures. But Egypt was the country where this sort of writing was most studied, and brought into a regular art. However, this sort of writing could be no other than enigmatical and confused, in the highest degree; and must have been a very imperfect vehicle of knowledge of any kind.

The Chinese have no alphabet of letters, or simple sounds, which compose their words; but every single character, which they use in writing, is significant of an idea: it is a mark which stands for some one thing or object, and consequently the number of these characters must be immense. At length, in different nations, men became sensible of the imperfection, the ambiguity, and the tediousness of each of these methods of communication with one another, and began to consider the advantage resulting from employing signs, which should stand not directly for things, but for the words which they used in speech for naming these things; and they also considered that though the number of words in every language be very great, yet the number of articulate sounds, used in composing these words, is comparatively small. Hence they were led to invent signs, not for each word by itself, but for each of those simple sounds that are employed in forming words; and they observed, that by joining together a few of those signs, it would be practicable to express, in writing, the whole combination of sounds which our words require.

The first step, in this new progress, was the invention of an alphabet of syllables, which probably preceded the invention of an alphabet of letters, among some of the ancient nations; and which is said to be retained to this day, in Ethiopia, and some countries of India. By fixing upon a particular mark or character, for every syllable in the language, the number of characters, necessary to be used in writing, was reduced within a much smaller compass than the number of words in the language. Still, however, the number of characters was great; and must have continued to render both reading and writing very laborious arts. At last some happy genius arose; and tracing the sounds made by the human voice to their most simple elements, reduced them to a very few vowels and consonants; and, by affixing to each of these the signs which we now call letters, taught men how, by their combinations, to put into writing all the different words or combinations

binations of sound, which they employ in speech. By being reduced to this simplicity, the art of writing was brought to its highest state of perfection; and, in this state, we now enjoy it in all the countries of Europe. To whom we are indebted for this admirable and useful discovery does not appear. See LETTERS.

There seems reason to conclude, from the books which Moses has written, that among the Jews, and probably among the Egyptians, letters had been invented prior to his age. The universal tradition among the ancients is, that they were first imported into Greece by Cadmus the Phœnician, who, according to the common system of chronology, was contemporary with Joshua; but, according to Sir Isaac Newton's system, contemporary with king David. As the Phœnicians are not known to have been the inventors of an art or science, though, by means of their extensive commerce, they propagated the discoveries made by other nations, the most probable and natural accounts of the origin of alphabetical characters is, that they took rise in Egypt, the first civilized kingdom of which we have any authentic accounts, and the great source of art and polity among the ancients. In that country, the favourite study of the hieroglyphical characters had directed much attention to the art of writing. Their hieroglyphics are known to have been intermixed with abbreviate symbols, and arbitrary marks; whence, at last, they caught the idea of contriving marks, not for things merely, but for sounds. Accordingly, Plato (in Phædro) expressly attributes the invention of letters to Theuth or Thoth, the Egyptian, who is supposed to have been the Hermes, or Mercury, of the Greeks. Cadmus himself, though he passed from Phœnicia to Greece, as several of the ancients have affirmed, was originally of Thebes in Egypt. Most probably Moses carried with him the Egyptian letters into the land of Canaan; and there, being adopted by the Phœnicians who inhabited that part of the country, they were transmitted into Greece. But it is curious to observe, that the letters, which we use at this day, can be traced back to the alphabet of Cadmus. The Roman alphabet, which obtains with us and most of the European nations, is plainly formed on the Greek, with a few variations. And all learned men observe, that the Greek characters, especially according to the manner in which they are formed in the oldest inscriptions, have a remarkable conformity with the Hebrew or Samaritan characters, which, it is agreed, are the same with the Phœnician, or the alphabet of Cadmus. If the Greek characters are inverted from left to right, according to the Phœnician and Hebrew manner of writing, they will appear to be nearly the same. Besides the conformity of figure, the names or denominations of the letters, alpha, beta, gamma, &c. and the order in which they are arranged in all the several alphabets, Phœnician, Hebrew, Greek, and Roman, agree so much as to amount to a demonstration that they were all originally derived from the same source. The letters were, at first, written from the right-hand to the left; and this manner of writing obtained among the Assyrians, Phœnicians, Arabians, and Hebrews: and from some very old inscriptions, it appears to have obtained also among the Greeks. Afterwards the Greeks adopted the method of writing their lines alternately from the right to the left, and from the left to the right, called *boustrophedon*. At length, however, the motion from the left-hand to the right being found more natural and commodious, the practice of writing, in this direction, prevailed throughout all the countries of Europe. See more on this subject under LETTERS.

Writing was long a kind of engraving. Pillars, and tables of stone, were first employed, and afterwards, plates of the softer metals, such as lead: but as writing became more common, lighter and more portable substances were employed. The leaves, and the bark of certain trees were used in some countries; and in others tablets of wood, covered with a thin coat of soft wax, on which the impression was made with a stylus of iron. See BOOK. See also STYLE, in the Treatise of ORATORY, Part II. Sect. II. Art. I. In later times, the hides of animals, properly prepared, and polished into parchment, were the most common materials; our present method of writing on paper is an invention of no greater antiquity than the fourteenth century. The advantages of writing above speech are, that writing is both a more extensive, and a more permanent method of communication; nevertheless, spoken language has a great superiority over written language, in point of energy or force. See Warburton, *ubi supra*. Blair's Lectures on Rhetoric, &c. vol. i. lect. 7.

It appears that the art of writing is of great antiquity, and that the ancients, who ascribe the invention of it to the gods, had very imperfect ideas of its true origin. When it is considered that letters must have been the produce of a certain degree of civilization among mankind, the enquirers into their original have been naturally led to seek it in the history of those nations that appear to have been first civilized. Accordingly, many authors have decided in favour of the Egyptians. See LETTERS.

An opinion seems to be gaining credit among the learned, that arts and letters took their rise in the northern parts of Asia, and that they were cultivated in those parts long before they were practised in Phœnicia or Egypt. Some travelled southwards, others staid behind; and those who afterwards emigrated from the East, were generally called Scythians, and sometimes Huns, who

overspread the northern parts of Europe. Many settlements were made in Germany long before the Christian æra.

The learned are not agreed with respect to the origin of what is called national writing. Some will have it, that the Roman manner prevailed throughout the West, until the irruption of the barbarous nations of the North, in the fifth and sixth centuries; the Goths, they say, first introduced their mode of writing into Italy, instead of the Roman manner; the Visigoths did the like in Spain; the Franks in Gaul; the Saxons in England; and the Lombards in Italy. According to others, the Romans were in possession of various forms of writing; but it is supposed, that the barbarous nations introduced some of their own letters in the writings composed of capitals and small letters; that the running hand, peculiar to each nation, was used in grants and contracts, and found admittance likewise in manuscripts after the middle of the seventh century. Mr. Asle, however, is of opinion, that the different modes of writing in Italy, Spain, France, England, and Germany, were derived from the Roman alone. Whilst Rome continued the centre of all the provinces of the empire, her manner of writing generally prevailed in each; but the empire, being dismembered, and all the western provinces disunited, a change was produced; the conquerors disfigured the Roman writing, and by their false taste and ignorance, distinguished their writing from that of their neighbours: the genius and disposition of the different people having no small share in producing this diversity.

This notion greatly assists in discovering the age of manuscripts: for if a writing is Merovingian, it cannot be subsequent to the ninth, or prior to the fifth century: if another is Lombardic, it must be posterior to the middle of the sixth, and anterior to the thirteenth; if Saxon, it cannot be earlier than the seventh, nor later than about the middle of the twelfth. The writing which prevailed in England from about the year 596, from this time to the middle of the eleventh century, is generally termed Saxon, and may be divided into five kinds; viz. the Roman Saxon, which is very similar to the Roman, and prevailed in England from the coming of St. Augustin till the eighth century; the set Saxon, which took place towards the middle of the eighth century, continued till about the middle of the ninth, and was not entirely disused till the beginning of the tenth century; the running-hand Saxon, which came into use towards the latter end of the ninth century, when learning was diffused in England under the auspices of king Alfred, in whose reign many books were written in this island, in a more expeditious manner than formerly; the mixed Saxon, occurring in the ninth, tenth, and the beginning of the eleventh centuries, in many MSS. which were written in England in characters partly Roman, partly Lombardic, and partly Saxon; and the elegant Saxon, which took place in England early in the tenth century, lasted till the Norman conquest, but was not entirely disused till the middle of the twelfth, and is more beautiful than the writing in France, Italy, and Germany, during the same period. The writing introduced into England, by William I. is usually called Norman, and is composed of letters nearly Lombardic, which were generally used in grants, characters, public instruments, and law proceedings, with very little variation, from the Norman conquest till the reign of King Edward III.

About the reign of King Richard II. variations took place in writing records and law proceedings; the characters from the reign of King Richard II. to that of King Henry VIII. were composed partly of characters called set-chancery and common-chancery, and some of the letters called court-hand: which three different species of writing are derived partly from the Norman, and partly from the modern Gothic. The modern Gothic, began to take place in England in the twelfth century; the old English about the middle of the fourteenth century; and set-chancery and common-chancery, in the decline of the same century, and are still used in the enrolments of letters patents, charters, &c. and in exemplifications of recoveries; the court-hand was contrived by the English lawyers, took its rise about the middle of the sixteenth century, and continued till the beginning of the late reign, when it was abolished by law. The court-hand characters were nothing more than the Norman characters very much corrupted and deformed. In the sixteenth century the English lawyers engrossed their conveyances and legal instruments in characters called secretary, which are still in use.

The learned and ingenious Colonel Vallancy thinks, indeed, that the Iberians, who migrated from the borders of the Euxine and Caspian seas, and settled in Spain, learned letters and arts from the Phœnicians: that a colony of the ancient Spaniards, by the name of Scots, or Scythians, settled in Ireland about a thousand, or perhaps six hundred years before Christ, and that they brought elementary characters with them into Ireland. He observes, that the Irish alphabet differs from that of all other nations, in name, order, number, and power; and supposes that they might have received their alphabet from the Carthaginians, who also settled a colony in Ireland about six hundred years before Christ; and adds, that this opinion is the more to be credited, as the Irish language appears to have a radical identity with the Punic. In order to discover what real pretensions the Irish have to the early use of letters, for which they eagerly contend, Mr. Asle has examined their stone monuments, their coins, and their MSS. and appealed

W R I

to the historians of that country. The letters upon the most ancient of the monuments are apparently of Roman, and Roman-British origin; and none of these inscribed monuments are so ancient as to prove that the Irish were possessed of letters before the Romans had intercourse with the Britons; though they prove that they had letters before the arrival of St. Patrick in that kingdom, which Mr. Whitaker, with great probability of truth, says, were waisted over from the Caledonians, who used the Roman letters. Sir James Ware says, that the Irish alphabet was borrowed from the British, and that Saxon characters were nearly the same as the Irish; and adds that Mr. Camden inclined to this opinion. Moreover, there are no Irish coins, inscribed with letters; till long after the twelfth century; except coins struck by some of our Saxon kings, who made incursions into that country, and struck money there in the Saxon manner.

The old Irish MS. which has been discovered is the Psalter of Cathel, written in the latter end of the tenth century. The testimony of approved historians is likewise unfavourable to the ancient literature of Ireland. Mr. Innes, in his Essay on the Antiquities of Scotland and Ireland, and Mr. James Macpherson, in the third edition of his Introduction to the History of Great Britain and Ireland, maintain, that Ireland was first peopled from Britain; and

that the manners of the old Irish were inconsistent with the knowledge of letters.

It seems probable, that the interior parts of Europe were immediately peopled from the northern parts of Asia, and the maritime parts from Phœnicia, and the southern and western parts of that quarter of the globe. If this be the case, it is not surprising that some eastern customs prevailed in Great Britain and Ireland, and that many Celtic words are still preserved both in the Irish and in the Welch languages. The Norman characters, it is observed, were generally used in England from the coming of William I. and the Saxon characters were entirely disused in the very beginning of the twelfth century; but the Irish and Scots preserved the ancient forms of their characters till the end of the sixteenth century. The Gaelic or Erse language, used in the Highlands of Scotland, and the Ibero-Gaelic, are nearly the same, and their letters are similar to each other, as Mr. Asple has shewn by various specimens. The curious will find much information on the subject of this article in Asple's Origin and Progress of Writing, 4to. 1784.

WRYNECK, in ornithology, the English name of the genus *Yunx*, belonging to the order *Pica*. For description of the genus, &c. see YUNX.

X X Y L

X, A double consonant, and the twenty-second letter in the English alphabet; which however begins no English word. The *x* of the Latins, and *ξ* of the Greeks, are compounded of *c* *s*, and *z* *s*; whence, to this day, the letter *x* in the English and French has the same sound with *c* *s*, or *k* *s*. Thus we pronounce *Alexander*, exactly as if written *Alec-sander*, or *Alek-sander*. The Italians have no *x* at all in their language, but both speak and write *Alessandro*. The Spaniards pronounce the *x* like our *c* before *a*; viz. *Alexandro*, as if it were *Alecandro*. The Portuguese pronounce it like *sh*. In foreign words, used in English, we sometimes soften the *x* into a double *s*, as *Brussels* for *Bruxels*, &c. The letter is not known in the Hebrew, or other oriental languages; but, in lieu of it, they write the two simple letters whereof it is compounded. And the like do the modern Germans.

XEBEC, in sea language, is a small three masted vessel, navigated in the Mediterranean sea, and on the coasts of Spain, Portugal, and Barbary; constructed for the purpose of conveying merchandise, stores, &c.

XYLO-BALSAMUM, *Balsam*, a name which naturalists, &c. give to the wood of the tree, which yields that precious gum known to the Latins by the name of *opobalsamum*, and, among us, by the name of *balsam* or *balm of Gilead*. We have branches of this tree brought from Cairo. They are very straight, brittle, unequal, and full of knots: their bark is reddish without, and greenish within. The wood is whitish, and full of pith; and, when broken, yields an agreeable smell, resembling that of the balsam. The *xylo-balsamum* is reputed good to strengthen the brain and stomach, and to expel poison.

Y A W Y Y E A

Y, The twenty-third letter in the English alphabet, borrowed, originally from the Greek *υ*. It is occasionally both vowel and consonant. As a vowel some authors have judged it unnecessary in our language, in regard its sound is precisely the same with that of the *i*. Accordingly, it is but little used, except in words borrowed from the Greek, to denote their origin, by representing the Greek *υ* *υ* *υ*. The vowel *y*, however, has a place even in some words purely English; and that both in the middle thereof, as in *dying*, *frying*, &c. and at the end, as in *lay*, &c.

Y was much used by the Saxons; whence it is found for *i* in the old English writers. When the *y* follows a consonant, and at the end of words, it is a vowel, and has the sound of *i*; and when it precedes a vowel, or diphthong, and at the beginning of words, it is a consonant. Some have thought that *y* is in all cases a vowel; but Dr. Johnson observes of *y*, as of *w*, that it follows a vowel without any hiatus, as *rosy youth*. The Romans used the *y* for the vowel *u*, which they had no character for, distinct from the *u* consonant; their way being to pronounce the common *u*, as we do the diphthong *ou*; and the Greek *υ* *υ* *υ* as the English and French *u*. In our own, and some other modern tongues, authors begin to dispense more and more with the precise orthography, which requires all words that have an upsilon, in the Greek, to be written with a *y*. And with reason; since our Greek *y* has lost the sound it had, in the language whence we borrow it. But it is certainly ridiculous to use it, as many do, in words which indeed have a Greek origin, but have no *u* in the Greek as in *eclipse*; yet some affect to do this.

YAM, or **YAMMES**, a species of the *dioscorea*, which is much cultivated by the inhabitants of the islands in America, and is of great use to them for feeding their negroes; and the white people make puddings of their roots, when ground to a sort of flour. The roots are as big as a man's leg, of an irregular form, and of a dirty brown colour on the outside, but white and mealy within. The stalks of this plant are triangular and winged, and the leaves are heart-shaped, with two ears, like those of *arum*. The plants are propagated by cutting the roots in pieces, and preserving an eye or bud in each, as in planting of potatoes; from each of which three or four large roots will be produced. The roots, after having lain six or eight months in the ground, are roasted or boiled for food, and sometimes made into bread. These plants grow wild in the woods in the island of Ceylon, and on the coast of Malabar; and they are supposed to have been brought from the East to the West Indies. *Miller*.

YAWS, in medicine, is a distemper epidemical, or rather en-

demic to Guinea, and the hotter climates in Africa, seldom failing to attack each individual one time or other of their lives, but most commonly in childhood or youth; it makes its first appearance in little spots on the cuticle, level with the skin, no larger than the point of a pin, which increases daily, and becomes prominent like pimples; soon after, the cuticles fret off, and then instead of pus or ichor in this small tumor, white sloughs or fordes are only found, under which is a small red fungus growing out of the cutis, increasing gradually to different magnitudes, some less than the smallest wood-strawberry, some as big as a raspberry, and others even exceeding in bigness the largest mulberries, which they very much resemble. While they are coming to this height, the black hair, which grows out of the part now covered with the yaws, changes gradually white. It is impossible to calculate the exact time which this distemper requires to go through these different stages. Some negroes who were in good plight, and had full nourishment, in a month after discovering the white spots, have had several yaws as big as a mulberry; and in other negroes that were low in flesh, and had but a poor scanty diet, in three months time none of the yaws have exceeded a common strawberry. The yaws appear on all parts of the body; but the most and biggest are generally on the groins, about the privities and anus, in the armpits and face. When they are very large, they are few in number; and when they are many in number, they are small in size. All this time the patient is in good health, does not lose his appetite, and seems to have no other uneasiness than what the nastiness of the sores occasions; for they are not painful, except touched too roughly. This is the natural appearance of the distemper, when left to itself, and in this state it will continue a long time, without any sensible alteration. The yaws do not prove often dangerous, if the cure is undertaken skilfully at a proper time, and the patient has not undergone any course of physic for them before; but if the patient has been once salivated, or taken any quantity of mercury, and the skin once cleared, and they appear again, they are always very difficult, and often impossible, to cure.

YEAR, in the full extent of the word, is a system or cycle of several months; usually twelve. Others define year, in the general, a period, or space of time, measured by the revolution of some celestial body in its orbit. Thus, the time wherein the fixed stars make a revolution is called the *great year*. And the times wherein Jupiter, Saturn, the sun, moon, &c. finish their revolutions, and return to the same point of the zodiac, are respectively called the *years of Jupiter*, and *Saturn*; and the *solar*, and the

Y E A

lunar years. Year, properly, and by way of eminence so called, is the *solar year*; or the space of time wherein the sun moves through the twelve signs of the ecliptic.

This, by the observations of Cassini, Bianchini, and de la Hire, contains 365 days, 5 hours, and 49 minutes; which is the quantity of the year assumed by the authors of the Gregorian calendar. But in the civil, or popular account, this year consists of only 365 days; except every fourth, which contain 366. See *KALENDAR*.

The vicissitudes of seasons seem to have given occasion to the first institution of the year. Man, naturally curious to know the cause of that diversity, soon found it was the proximity and distance of the sun; and upon this, gave the name year to the space of time wherein that luminary, performing his whole course, returned to the same point of his orbit. And hence, as it was on account of the seasons, in a great measure that the year was instituted, their chief regard and attention was, that the same parts of the year should always correspond to the same seasons; i.e. that the beginning of the year should always be when the sun was in the same point of his orbit; and that they should keep pace, come round, and end together.

This, different nations aimed to attain by different ways; making the year to commence from different points of the zodiac, and even making the time of his progress different. So that some of their years are much more perfect than others, but none of them quite just; i.e. none of them whose parts did not shift, with regard to the parts of the sun's course.

In effect, considering the imperfect state of astronomy in those ages, it is no wonder different people should disagree in the calculation of the sun's course. We are even assured by Diod. Siculus, lib. i. Plutarch in Numa, and Pliny, lib. vii. cap. 48. that the Egyptian year itself was at first very different from that now represented.

Solar YEAR, is the interval of time wherein the sun finishes his course through the zodiac; or wherein he returns to the same point thereof from whence he had departed. This according to our account, is 365 days, 5 hours, 49 minutes; though some astronomers make it a few seconds, and some a whole minute less; as Kepler, for instance, who makes it 365 days, 5 hours, 48 minutes, 57 seconds, and 39 thirds. Ricciolus and Tycho Brahe, 365 days, 5 hours, 48 minutes. The solar year is either astronomical, or civil.

Solar Astronomical YEAR, is that determined precisely by the observations of astronomy; and is of two kinds, *tropical*, and *siderial* or *ajtral*.

Tropical, or Natural Year, is the time which the sun employs in passing through the zodiac; which, as before observed, is 365 days, 5 hours, 49 minutes; or 365d 5h 48' 57". This is the only proper or natural year, because it always keeps the same seasons to the same months.

Siderial or Ajtral YEAR, is the space of time wherein the sun going from any fixed star, returns to the same. This consists of 365 days, 6 hours, 9 minutes, 14½ seconds; and is 26 minutes, 17½ seconds, longer than the true solar years. See the *System of ASTRONOMY*, Sect. VII. Prob. V.

Civil YEAR, is that form of year which each nation has contrived to compute time by: or the civil is the tropical year, considered as only consisting of a certain number of whole days; the odd hours and minutes being set aside, to render the computation of time in the common occasions of life more easy.

The *Common civil YEAR*, is that consisting of 365 days. This therefore hath seven months, of 31 days each, four of 30 days, and one of 28 days: according to the well known canon:

Thirty days hath September,
April, June, and November;
February twenty-eight alone,
And all the rest have thirty-one.

Bissextile, or Leap YEAR, is that consisting of 366 days; or it has one day extraordinary; which day is called the *intercalary*, or *bissextile day*. See *BISSEXTILE*.

Julian YEAR, is a solar year, containing, commonly, 365 days; though every fourth year, called *Bissextile*, it contains 366.

Gregorian YEAR, is the Julian year corrected by this rule; that whereas, on the common footing, every secular or hundredth year is bissextile; on the new footing, three of them are common years, and only the fourth is bissextile. See *KALENDAR*.

YEAR of the Hegira. See *HEGIRA*.

New YEAR's Day, or the day wherein the year commences, has always been very different in different nations; and yet in all has been held in great veneration. Among the Romans the first and last day of every year were consecrated to Janus: on which account it was that they represented him with two faces. To them we owe the ceremony of wishing an *happy new year*, which appears to be very ancient. Before the first day was spent, they not only visited and complimented each other, but also presented strena, and offered vows to the gods for the preservation of each other.

The *Civil or Legal YEAR*, in England, formerly commenced on the day of the Annunciation, i.e. on the 25th day of March; though the historical year began on the day of the Circumcision, i.e. the first day of January, on which day the German and Italian year also begin. Stow observes, that William the Conqueror

Y E O

having been crowned on the 1st of January, that day thenceforth became the first of the year for historians, &c. though, in all civil affairs, they retained the ancient manner of accounting, which began the 25th of March. The part of the year between those two terms was usually expressed both ways, as 1743-4, or 1744. But by the act for altering the style, the civil year now commences with January 1. Since the Conqueror, the king's patents, charters, proclamations, &c. are usually dated by the year of the king's reign. The church, as to her solemn service, begins the year on the first Sunday in Advent, which is always that next St. Andrew's day, or the 30th of November. The Jews, as most other nations of the East, had a civil year, which commenced with the new moon in September: and an ecclesiastical year, which commenced with the new moon in March.

Years are also distinguished with regard to their epochs whence they are numbered: thus, *years of our Lord*, are those reckoned from the birth of Jesus Christ. *Years of the world*, are those elapsed since the creation. *Years of Rome*, of the *Hegira*, of *Nabonassar*, &c. See the difference between these years under the article *EPOCH*.

YEAST, *YEST*, or *BARM*, the foam or flower of beer, or other liquor in fermentation. The yeast of beer is used for a leaven or ferment in the making of bread: as serving to swell, or puff it up very considerably in a little time; and to make it much lighter, softer, and more delicate. But when there is too much of it, it renders the bread bitter. The use of yeast in bread is but of late standing among us: it is not above a century since the avarice of the bakers first introduced it; and then it was only done by stealth; though Pliny witnesses to its having been used by the ancient Gauls. The Faculty of Medicine at Paris, by a decree of the 24th of March, 1688, solemnly maintained it noxious to the health of the people: yet even that censure could not prevent its progress.

Common ale-yeast may be kept fresh and fit for use several months by the following method: Put a quantity of it into a close canvas bag, and gently squeeze out the moisture in a screw-press, till the remaining matter be as firm and stiff as clay. In this state it may be closely packed up in a tight cask, for securing it from the air; and will keep fresh, sound, and fit for use a long time. This is a secret that might be of great use to the brewers and distillers here, who though they employ very large quantities of yeast, seem to know no method of preserving it, or raising nurseries of it: for want of which they sustain very considerable loss; whereas the brewers in Flanders make a very great advantage of supplying the malt-distillers of Holland with yeast, which is rendered lasting, and fit for carriage by this easy expedient. Shaw's Lectures, p. 195.

YELLOW, a bright colour, reflecting the most light of any, after white. The word is formed from the Latin *giallo*, or the German *gel*, which signify the same: or from the Latin *galbanus*, *bright*, *gay*. There are divers yellow substances that become white upon wetting and drying them again several times in the sun; such as wax, linen-cloth, &c. See *BLEACHING*. And the same bodies, if they be already white, and continue a long time in the air without being wetted, turn yellow. Paper and ivory, applied near the fire, become successively yellow, red, and black. Silk when turned yellow, is whitened again with the fumes of sulphur.

YELLOW, in dyeing, is one of the five simple and mother colours. For the finest yellows, they first boil the cloth or stuff in alum and pot-alshes, or tartar; and then give the colour with the weld or wold. Turmeric likewise gives a good yellow, though not the best. Woollen-cloth, impregnated with a solution of alum and tartar, acquires, on being boiled with the watery decoction, an elegant, but not very durable orange-yellow, or gold-coloured dye. It is rarely made use of by the dyers on account of its price and the perishableness of its colour. There is also an Indian wood that gives a yellow colour bordering on gold. This wood, called *jussie*, is a species of mulberry-tree, of a deep sulphur yellow colour, which it readily gives out both to water and spirit. The watery decoction dyes prepared woollen of a very durable orange-yellow; the colour is unbibed by the cloth in a moderate warmth, without boiling. See the *Treatise on DYEING*.

The Chinese are famous for their yellows in dyeing, which never change with washing. They make this dye of the flowers of the acacia, in a manner in which we might use several of our productions to great advantage. See *ACACIA*.

YEOMAN, the first or highest degree among the plebeians of England; next in order to the gentry. The yeomen are properly the freeholders, who have land of their own; so called from the Saxon *geman*, or *geman*, *common*. The word *youngman*, is used for *yeoman* in the statute 33 Hen. VIII. According to Sir Thomas Smith, a yeoman is a free-born Englishman, who can lay out his own free-land in yearly revenue to the sum of forty shillings sterling.

YEOMEN of the Guard, properly called *yeomen of the guard of the king's body*, were anciently two hundred and fifty men of the best rank under gentry, and of larger stature than ordinary; every one being required to be six feet high. At present there is but one hundred yeomen in constant duty, at 39l. 11s. 3d. per annum each; eight of which are called *ushers*, who have 10l. per annum each

Y E W

each more than the other yeomen; and seventy more not on duty; and as one in the hundred dies, his place is supplied out of the seventy. The officers are, a captain, who has 100*l.* per annum, a lieutenant at 50*l.* per annum, an ensign at 30*l.* and four exons at 150*l.* per annum each; a secretary, and clerk of the cheque at 150*l.* per annum. Their origin is traced to the year 1485, when king Henry VII. ascending the throne, immediately after his coronation, instituted a guard of fifty archers to attend him and his successor. They were probably then, as they are now, called the *yeomen of the guard*. It was observed, that this is the first instance of any established or permanent military guard in England; its kings, till that time, except in times of war and insurrection, contenting themselves with the guard of their proper domestics and retinue. And. Hist. Com. vol. i. p. 302. They go clad after the manner of king Henry the Eighth's times. They formerly had diet as well as wages, when in waiting; but this was taken off in the reign of queen Anne. Their attendance is on the sovereign's person both at home and abroad; they have a room allotted for them only, called the *guard-chamber*. The officers and yeomen are at the disposal of the captain; but the captain is at the appointment of the king.

YEW, *Luxus*, in botany, a genus of the Dioecia Monadelphia class. We have but one species, which grows naturally in Eng-

Y U N

land; and it is of great use in gardens to form hedges for the shelter of exotic plants. They are but of slow growth, yet in time arrive to a great size. The timber is greatly esteemed for many uses.

YOLK, or **YELK**, in natural history, the yellow part in the middle of an egg. The chicken is formed out of, and nourished by the white alone, till it be grown to some bulk; after which, the yolk serves it for nourishment; which it likewise does, in part, after it is hatched. For a good part of the yolk remains after exclusion; being received into the chicken's belly: and being there reserved as in a store-house, is by the ductus intestinalis, as by a funnel, conveyed into the guts, and serves instead of milk.

YUNX, **WRY-NECK**, in ornithology, a genus of the order of *Pica*. There is but one species, viz. the *yunx torquilla*. The colours of this bird are elegantly pencilled, though its plumage is marked with the plainest kinds. The wry-neck is a bird of passage, appearing with us in the spring, before the cuckoo. It has a whimsical way of turning and twisting its neck about, and bringing its head over its shoulders, whence it had its name *torquilla*, and the English one of wry-neck. It has also the faculty of erecting the feathers of the head like those of the jay. It feeds on ants, which it very dexterously transfixes with the bony and sharp end of its tongue, and then draws them into its mouth.—For representation, see Plate II. Genus 20.

Z E C

Z, The last letter in the alphabet, and one of the double consonants, both among the Latins and Greeks. Its pronunciation is much more soft and obtuse than that of the *x*; which makes Quintilian call it *jucundissima*, and *dulcissima*. Nevertheless, the sound was not always the same as it is now; which is as it were half that of an *s*: or, that expressed by its name *izzard* or *s* hard, of an *s* uttered with a closer compression of the palate by the tongue, as *freeze*, *froze*.

It had something originally in it of the *d*; but only what sounded very smoothly; thus *Mezentius* was pronounced as if it had been *Medsentius*, &c. **Z** begins no word originally English; although it is found in the Saxon alphabets, set down by grammarians, it is read in no word originally Teutonic. *Johnson*.

ZAFFER, **ZAFFRE**, or **SAFFRE**, in chymistry, is the residuum of *cobalt*, after the sulphur, arsenic, and other volatile matters of this mineral have been expelled by calcination: so that it is a kind of calx of cobalt, of a grey or reddish colour. It is used to produce a very fine blue colour, when it is melted with fusible and vitrifiable matters. See the System of CHYMISTRY, Part III. Chap. I. Sect. II.

Zaffer is employed in the manufacture of pottery and of porcelain, for painting the surface of the pieces of ware upon which it is applied, together with some saline flux, previously to the baking or glazing, that the same fire may vitrify this colouring material. The blue of Zaffer is the most solid and fixed of all the colours that can be employed in vitrification; it suffers no change from the most violent fire. It is successfully employed to give shades of blue to enamels and to the crystal glasses made in imitation of some opaque and transparent precious stones, as the lapis-lazuli, the turquois, the sapphire, and others of this kind. It is also appropriated to other uses.

ZEAL, the exercise of a warm animated affection, or passion, for any thing. Some will have jealous zeal to be properly a mixed or compound sensation; where one affection is raised or inflamed by another. On these principles jealousy may be defined an affection arising from love and indignation, which cannot bear a thing to be given to another, that a person desires for himself, or one whom he loves or favours. Others make it consist in an eager study, or desire, to keep any thing inviolate; or a fervour of mind arising from an indignation against those who abuse or do evil to a person beloved. The Greek philosophers make three species of zeal. The first, of *envy*; the second, of *emulation*, or *imitation*; the third, of *piety*, or *devotion*; which last makes what the divines call *religious zeal*. Josephus speaks much of a party, or faction, called *Zealots*, or *Zealots*, which arose among the Jews during the war with Vespasian and Titus. Lib. xiv. cap. 6. Antiq. and lib. iv. cap. 12. de Bello Judaico.

ZEBRA, in the system of mammalia, a species of the genus *Equus*. For description of the genus, &c. see *EQUUS*. For representation, see Plate I. Order VI. Genus 33. Species 3.

ZECHARIAH, or the *Prophecy of Zechariah*, in biblical history, a canonical book of the Old Testament. Zechariah was contemporary with Haggai, and prophesied in the second year of Darius Hystaspes. The design of the first part of this prophecy is the same with that of Haggai, viz. to encourage the Jews to go on with rebuilding of the temple, by giving them assurance of God's assistance and protection: from whence the author proceeds to foretell the glory of the Christian church, the true temple of God, under its great high-priest and governor Christ Jesus, of whom Zerubbabel and Joshua the high-priest were figures. The latter part of the prophecy from chap. ix. probably relate to the state of the Jews under the Maccabees, and then foretells their rejection of the Messiah, and some remarkable incidents that

should happen to them in the latter ages of the world. Mr. Mede and some other learned men think, that the 9th and following chapters of Zechariah, are parts of the prophecy of Jeremiah.

ZEDOARY, a medicinal root belonging to a plant growing in the East-Indies. This root has an agreeable smell, and a bitterish aromatic taste. It impregnates water with its smell, a slight bitterness, a considerable warmth and pungency, and a yellowish brown colour; the reddish yellow spirituous tincture is in taste stronger, and in smell weaker, than the watery. In distillation with water, it yields a thick ponderous essential oil, smelling strongly of the zedoary, in taste very hot and pungent: the decoction thus deprived of the aromatic matter, and concentrated by inspissation, proves weakly and disagreeably bitter and subacid. A part of its odorous matter rises also in the inspissation of the spirituous tincture, the remaining extract is a very warm, not fiery, moderately bitter aromatic, in flavour more grateful than the zedoary in substance.

Zedoary root is a very useful warm stomachic, and has been commended in cholics and hysteric affections, for promoting the menses, &c. It has been employed by some as a succedaneum to gentian root; but from the above analysis it appears to be not entirely similar to that simple bitter; its warm aromatic part being the prevailing principle, in virtue of which its spirituous extract (the most elegant preparation of it) is made an ingredient in the cordial confection of the London Pharmacopoeia. Lewis's Mat. Med. The zedoary wash, which is a cooler yellow than saffron, though full as bright, and valuable for many purposes in painting with water-colours, may be prepared by boiling an ounce of the root in a quart of water, till the water is sufficiently tinged to make a stain on paper, of a full yellow colour; and straining the liquor through a linen filtre. This wash may be dried in shells, and will again dissolve and spread kindly with the addition of water.

ZENDAVESTA, by contraction **ZEND**, denotes the book ascribed to Zoroaster, and containing his pretended revelations; and which the ancient Magians and modern Perfes, called also *Gaurs*, observe and reverence in the same manner as the Christians do the Bible, and the Mahometans the Koran, making it the sole rule both of their faith and manners. The word, it is said, originally signifies any instrument for kindling fire, and is applied to this book, to denote its aptitude for kindling the flame of religion in the hearts of those who read it.

ZENITH, in astronomy, the vertical point; or a point in the heavens directly over our heads. Or, the zenith is a point (as *Z* in Fig. 1 and 2, in the Plate of Spheres and Globes) in the surface of the sphere, from which a right line, drawn through the spectator's head, passes through the centre of the earth. Hence, there are as many zeniths as there are different places on earth, where the heavens may be seen; and, upon the changing our place, we also necessarily change our zenith.

ZEPHANIAH, a canonical book of the Old Testament, containing the predictions of Zephaniah, the son of Cushi, and grandson of Gedaliah; being the ninth of the twelve lesser prophets. He prophesied in the time of king Josiah, a little after the captivity of the ten tribes, and before that of Judah; so that he was contemporary with Jeremiah. He prophesies chiefly against the people of Judah, who continued very corrupt, notwithstanding the King's pious zeal for reformation, and the good example he gave to his subjects.

ZEPHYRUS, or **ZEPHYR**, the west wind; a wind blowing from the cardinal point of the horizon opposite to the east. The poets personify it, and represent Zephyrus as the mildest and most gentle of all the deities of the woods; the character of his personage

sonage is youth and gentleness. It is also called Favonius, and Occident, and, by many, has been confounded with the Africus.

ZEST, the woody, thick skin, quartering the kernel of a walnut. Some physicians prescribe this zest, dried, and taken with white-wine, as a remedy against the gravel. The word is also used for a chip of orange or lemon-peel; such as is usually squeezed into ale, wine, &c. to give it a flavour; or for the fine thin oil that spirits out of that peel on squeezing it. Hence, to zest an orange or lemon, among confectioners, is to cut the peel from top to bottom into small slips, as thin as possible; or, to zest, is to squeeze the peel over the surface of any thing.

ZEUS, in ichthyology, a genus belonging to the order *Thoracici*. For classification, see the System, Order IV. Genus 34. The species are four; of which the most remarkable is the faber or doree. It is of a hideous form; its body is oval, and greatly compressed on the sides; the head large; the snout vastly projecting; the mouth very wide; the teeth very small; the eyes great, the irides yellow; the lateral line oddly distorted, sinking at each end, and rising near the back in the middle; beneath it on each side is a round black spot. The tail is round at the end, and consists of fifteen branched rays. The colour of the sides is olive, varied with light blue and white, and while living is very resplendent, as if gilt; for which reason it is called the *doree*. The largest fish we have heard of weighed twelve pounds. In our own country it was very long before this fish attracted our notice, at least as an edible one. We are indebted to the late Mr. Quin, for adding a most delicious fish to our table, who overcoming all the vulgar prejudices on account of its deformity, has effectually established its reputation. The fish was supposed to be found only in the southern seas of this kingdom, but it has been discovered lately on the coast of Anglesea. Those of the greatest size are taken in the Bay of Biscay, off the French coasts; they are also very common in the Mediterranean: Ovid must therefore have styled it *varus faber*, on account of its excellency, not its scarcity.

ZIBELLINA, a species of the genus *Mustela*, in the system of mammalia. For description of the Genus, &c. see *MUSTELA*.

ZIBETHUM, in natural history, *civet*, a perfume contained in a bladder, in the groin of a civet-cat. See *VIVERRA*.

ZIMENT-water, or **COPPER-water**, in natural history, the name by which some have called water found in places where there are copper-mines, and lightly impregnated with particles of that metal. The most famous spring of this kind is about a mile distant from Newfol in Hungary, in the great copper-mine called by the Germans *herrn grundt*. From various experiments it has been found, that this water contains a large quantity of vitriol of copper, which it probably owes to a solution of that metal by means of the acid of the common pyrites and water; when this is known, the effects are not difficultly accounted for; there being no real change of one metal into another; but the true state of the case being, that the particles of one metal are dissolved and carried away, and those of another metal deposited in their place. A water thus impregnated is a menstruum capable of dissolving iron, and in the solution of that metal becomes so weakened as to let go the copper it before contained, in small parcels. This is seen to be the case, by examining the changed metal while it lies in the water, the copper then appearing not a soft, malleable, and even mass, but a congeries of granules, closely placed together, and resembling the small granules, or ova, in the spawn of fishes; and is very friable and fragile while in this state. See *COPPER*, and the System of *CHYMISTRY*, Part III. Chap. II. Sect. 4.

ZINC, or **ZINK**, a femimetal, of a brilliant white colour approaching to blue; called also *Spelter* and *tutenag*.

Chymical properties of ZINC. Zinc is the most malleable of all the femimetals; and, when well furnished with phlogiston, in the manner proposed by Margraaf, it possesses a femiductility, which renders it capable of being flattened into thin plates. This property, joined to its hardness, prevents its being pulverised, like the other semi-metals; and, therefore, when it is required in a divided state, it must be melted and granulated, or filed, like metals. See the System of *CHYMISTRY*, Part III. Chap. I. Sect. 5. See also *TUTENAG*.

ZINC, in medicine, and the arts. This femimetal has been lately received in the shops in its own form, in which, says Dr. Lewis, it deserves a place, as affording preparations superior to the ores or productions of it now made use of. A white vitriol, made from pure zinc, by dissolution in the diluted vitriolic acid and crystallization, is doubtless preferable for medicinal use to the common impure white vitriol, and the white flowers, into which it is changed by deflagration, to the very impure calamine and tutty. Moderately pure white flowers, sublimed from it in the bras or other furnaces, wherein zinc or its ores are melted with other metal, were formerly kept in the shops, under the names of *pompholyx* and *nihil album*.

The flowers of zinc were first used as an internal medicine by the celebrated chymist Glauber, but were little known in practice, till Dr. Glaubius, of Leyden, gave an account of their virtues, in his *Adversaria*. They have since been much employed in convulsive and spasmodic diseases, and sometimes with good effects. Even obstinate epilepsies have been rendered much less violent by the use of them. However, like all other medicines in diseases of

this class, their good effects are often only temporary, and they often fail altogether. When the flowers are genuine, a grain or two generally at first excites nausea or sickness, but by degrees a considerable dose may be taken with little or no sensible effect. As they are liable to be adulterated, it may be proper to mention, as tests of their purity, that they make no effervescence with acids; and that, when exposed to a strong heat, they become yellow, but in cooling, turn white again. An application for external use, made by mixing one part of flowers of zinc with six of the simple liniments of wax and oil, is directed in the Edinburgh pharmacopœia.

The chief use of zinc is as an ingredient in the composition of bras. It has the property of uniting with copper in a considerable proportion; e. gr. one part of zinc to three or four parts of copper, without much diminution of the ductility of copper. Zinc added to copper renders this metal less subject to rust, and gives to it a yellow colour resembling that of gold. Hence chymists have been induced to search for the means of communicating to copper the true colour of gold; and they have actually succeeded in the composition or alloys called *tombac*, *femitor*, *pinchbeck*, and *prince's-metal*. According to Beecher, equal parts of copper and zinc mixed together, gave a colour to the touchstone like that of the gold from the Rhine. Stahl says, this proportion of zinc is too great, but does not determine what it ought to be. Since that time, the due proportion has been investigated, and several fine imitations of gold have been formed. The English were the first who succeeded, and they called their invention *prince's metal*, or *Prince Rupert's metal*.

From the experiments of M. Geoffroy (Men. Acad. Sc. 1725) it appears, that an equal quantity of zinc is too much; with regard to the ductility of the alloy; but that equal quantities produce the finest colour. From some experiments, seen by the author of the Chymical Dictionary, he inclines to think, that a fine-coloured mixture cannot be obtained, particularly of a deep enough yellow, if as much zinc as copper actually remain. One part of zinc is said to be capable of destroying the ductility of a hundred parts of gold. An alloy of equal parts of zinc and gold is very hard, white, capable of receiving a fine polish, and not subject to rust or tarnish; hence it is proposed, by Mr. Malouin, as a good material for making specula of telescopes. Zinc gives hardness to tin, and is, therefore, added in some compositions for making pewter. Mr. Malouin has also proposed to substitute zinc for tin in the operation upon iron plates, &c. called *tinning*.

From the whiteness and brilliancy of the flame produced by the detonation of zinc with nitre, it has been employed with very good effect as an ingredient in compositions for fire-works. Zinc, which yields inflammable air with oil of vitriol, has frequently been employed in the operation of filling balloons, or aerostatic machines. Zinc is also an ingredient in the amalgama used by electricians. Some direct it to be made by melting five parts of quicksilver and one of zinc with a small quantity of bees-wax. We have an account in the Phil. Trans. No. 482, Sect. 6, of the application of zinc, or spelter, to so large a work as the cylinder of a fire engine, by Mr. Ford, of Colebroke Dale, in Shropshire. It runs easier, and casts as true as bras, and bores full as well, or better, when warmed a little. While cold, it is as brittle as glass; but the warmth of the hand will make it so pliant, that a shaving of it may be wrapped round the finger like a pit of paper. This metal never rusts, and therefore works better than iron: the rust of which, upon the least intermission of working, resists the motion of the piston. See on the subject of the preceding article, Dict. Chym. Eng. ed. 1777. Bergman's Phys. and Chym. Essays, by Cullen vol. ii. p. 311, &c. Kirwan's Elem. of Mineral. p. 312, &c. Lewis's Mat. Med. by Aikin.

ZINZIBER, GINGER. See *AMOMUM*.

ZODIAC, *Zodiacus*, in astronomy, a fascia, or broad circle, whose middle is the ecliptic, and its extremes two circles parallel thereto at such distance from it, as to bound, or comprehend, the excursions of the sun and planets. The word is formed of the Greek *ζῳον*, animal; by reason of the constellations therein, which have the forms of animals given them: others derive it from *ζῶν* life; from an opinion, that the planets have a great influence on animal life. The sun never deviates from the middle of the zodiac; i. e. from the ecliptic; the planets all do, more or less.

Their greatest deviations, called latitudes, are the measure of the breadth of the zodiac; which is broader or narrower, as the greatest latitude of the planets is made more or less. Accordingly, some make it 16, some 18, and some 20 degrees broad. The zodiac, cutting the equator obliquely, makes an angle therewith of 23 degrees and a half; or more precisely, of 23° 29', which is what we call the *obliquity of the zodiac*; and is the sun's greatest declination. See *ECLIPSE*, and the System of *ASTRONOMY*, Sect. IX. Article Definitions; No. 11. See also the Treatise on the GLOBES, under the Article Description, and the Plate of Spheres and Globes, Fig. 4, annexed to the Treatise.

ZODIACAL LIGHT, a brightness resembling that of the milky way, and which is sometimes perceived in the heavens, at certain times of the year, after sun-set, or before its rise. The form of this light resembles that of a pyramid, lying lengthways in the zodiac, within which its point and axis are always inclosed, its base being

being placed obliquely with respect to the horizon. This phenomenon was first discovered, described, and named, by Mr. Cassini the Elder, in 1683. It was afterwards observed by M. Fatio, in 1684, 1685, and 1686; and by M. Kirch and Eimmart, 1688, 1689, 1691, 1693, and 1694. See *Aurora Borealis*, and *NORTHERN LIGHTS*.

ZONE, *ZONA*, ζώνη, q. d. belt, girdle, in geography and astronomy, a division of the terraqueous globe, with respect to the different degrees of heat found in the different parts thereof. A zone is the fifth part of the surface of the earth, contained between two parallels. The zones are denominated *torrid*, *frigid*, and *temperate*.

Torrid ZONE, is a fascia, or band, surrounding the terraqueous globe, and terminated by the two tropics. Its breadth, therefore, is $46^{\circ} 58'$. The equator, running through the middle of it, divides it into two equal parts, each containing $23^{\circ} 29'$. The ancients imagined the *torrid zone* uninhabitable.

Temperate ZONES, are two fascia, or bands, environing the globe, and contained between the tropics and the polar circles. The breadth of each is $43^{\circ} 2'$.

Frigid ZONES, are segments of the surface of the earth, terminated, the one by the antarctic, and the other by the arctic circle; or included between these circles and the poles. The breadth of each is $46^{\circ} 58'$.

The difference of zones is attended with a great diversity of phenomena: 1. In the torrid zone, the sun passes through the zenith twice a year; and his recess from the equator towards the pole, which is about the horizon, is twice a year equal to the height of the pole.

2. In the temperate and frigid zones, the least height of the pole exceeds the greatest distance of the sun from the equator; and therefore, to the inhabitants thereof, the sun never passes through the zenith; yet if, on the same day, the sun rises, at the same time, to a greater height, the height of the pole is the less, since the inclination of the circles of diurnal revolution to the horizon is less.

3. In the temperate and torrid zones the sun rises and sets every natural day, because the distance of the sun from the pole always exceeds the height of the pole; yet every where but under the equator, the artificial days are unequal, and the inequality is the greater as the place is less distant from the frigid zone.

4. Where the temperate zones terminate on the frigid, the height of the pole is equal to the sun's distance from the pole, when in the neighbouring tropic; and consequently, once a year, the sun, in its diurnal motion, performs an entire revolution, without going down under the horizon.

5. Every where, in a frigid zone, the height of the pole is greater than the least distance of the sun from the pole; and therefore, during some revolutions of the earth, the sun is at a distance from the pole less than the pole's height; and during all that time, does not set, nor so much as touch the horizon. Where the distance from the pole, as the sun recedes from it, exceeds the height of the pole, or latitude of the place, the sun rises or sets every natural day.

ZOOLOGY, or a discourse or treatise upon animals or living creatures, forms the most important part of natural history, comprehending what relates to the form, structure, method of living, feeding, propagating, &c. of the divers species of all living animals and the descriptions of every kind.

Zoology forms the first of the three kingdoms or divisions of natural history; the second being the vegetable, and the third the mineral kingdom, which three comprise all the productions of nature, called natural history: but the kingdom of zoology being so extensive in its nature, few authors have ventured to produce a complete system of it; and those who have attempted it, have failed of obtaining that credit for themselves, or giving that satisfaction to their readers they expected; for this kingdom embracing for its object every animal existing in the universe, it is of course such an extensive field of science, that most authors have contented themselves with the study and investigation of one, or two at most, of the classes which are comprehended within the kingdom of zoology.

We have Pennant's *System of Zoology*, but it exhibits only a mere sketch or cursory view of the kingdom. We have also Linnaeus's *System of Nature*, comprehending the three kingdoms in general, but it is principally a classification of the respective parts of each; though upon the whole it is evidently one of the best productions that ever appeared in Europe. To enter into the minutiae of all the particulars which relate to this kingdom of exhaustless science, the age of man is incompetent; therefore we generally find in authors who write on natural history, distinct and separate systems of the several classes which compose this extensive kingdom; such as Latham's *Ornithology*, Barbut's *Entomology*, Artedi's *Ichthyology*, &c. &c.

But in the other two kingdoms, as in botany for instance, we do not meet with separate systems of the several classes, such as

Systems of Monandria, Diandria, &c. &c. because this kingdom being of a nature so much less extensive than that of zoology, all authors who have written upon it have entered into a description of the whole of the classes which comprehended the kingdom; and the same method is pursued in the third kingdom, viz. Mineralogy.

The six classes which comprise the kingdom of zoology are arranged under the following heads:—

CLASS I. Mammalia, which includes all animals that suck their young. The characters of this class are these: The heart has two ventricles and two auricles, the blood is red and warm; and the animals belonging to it are viviparous.

CLASS II. Aves, Birds, or Ornithology. The characters are the same with those of class 1, except that the animals belonging to it are oviparous.

CLASS III. Amphibia, Amphibious animals, or Amphibiology. The heart has but one ventricle, and one auricle; the blood is red and cold; and the animals belonging to this class, have the command of their lungs, so that the intervals between inspiration and expiration, are in some measure voluntary.

CLASS IV. Pisces, Fishes, or Ichthyology. The heart has the same structure, and the blood the same quality with those of the Amphibia; but the animals belonging to this class are easily distinguished from the Amphibia, by having no such voluntary command of their lungs, and by having external branchiae, or gills.

CLASS V. Insecta, Insects, or Entomology. The heart has one ventricle, but no auricle; the blood is cold and white, and the animals are furnished with antennae or feelers.

CLASS VI. Vermes, Worms, or Vermeology. The characters are the same with those of class 5, only the animals have no antennae, and are furnished with tentacula.

For description of the several classes, and the orders which compose them, see the respective *Systems* throughout the course of the work. For the genera and species, appertaining to the orders of the respective classes, see the alphabet throughout: the more readily to find which, see the Synoptical tables, which contain the generic names, and will serve as reference to them in the alphabet. The generic and specific characters may also be found by searching for the English name in the alphabet, and referring to the classes. For representation see the plates belonging to the respective *Systems*.

ZOOPHYTON, ZOOPHYTE, of ζῷον, animal, and φυτόν, plant, q. d. plant-animal, is the fifth order of the class of Vermes or Vermeology. For description, see VERMEOLOGY.

ZUINGLIANS, a branch of ancient Reformers or Protestants, denominated from their author Ulric or Huldric Zuinglius. This eminent divine was born at Wildehausen, in the county of Toggenbourg, in Switzerland, 1487. After having finished his studies in theology, and received the doctor's cap at Basil, in 1505, he applied himself to preaching; and that with good success. It appears that Zuinglius, from his early years, had been shocked at several of the superstitious practices of the church of Rome; and that so early as the year 1516 he had begun to inveigh against them.

Luther proceeded very slowly to that exemption from the prejudices of education, which Zuinglius, by the force of an adventurous genius, and an uncommon degree of knowledge and penetration, easily got rid of. And we learn from the most authentic records of history, that he had explained the scriptures to the people, and called in question the authority and supremacy of the pope, before the name of Luther was known in Switzerland. In process of time, after Luther had taken up arms against Rome, Zuinglius, being then minister of the chief church in Zurich, concurred with him; preaching openly against indulgences, then against the intercession of the saints, then against the mass, the hierarchy, the vows and celibacy of the clergy, abstinence from flesh, and also many things which Luther was disposed to treat with toleration and indulgence; such as images, altars, wax-tapers, the form of exorcism, and private confession, &c. In a conference held with the deputies of the bishop of Constance, in 1523, he procured most of the external ceremonies of religion to be abolished.

ZYGOMA, Ζυγωμα, in anatomy, a bone of the head; otherwise called os jugale. The word is formed from ζυγνυμι, I join, so that zygoma is no single bone; but an union, or assemblage, of two processes, or eminences of bone; the one from the os temporis, the other from the os malæ. See the *System*, Part I. Sect. II. Art. I. and Plate I. with the explanation.

ZYGOMATICUS, in anatomy, a muscle of the head, which has its origin in the processus jugalis, or zygoma; and, passing obliquely is inserted near the angle of the lips. It helps to draw the lips obliquely upwards. There are two of these muscles, viz. one on each side. Each muscle is thin, oblique, and fixed by one extremity, to the lower edge of that portion of the os malæ, which is connected with the zygomatic apophysis of the os temporis; it is commonly involved in fat. See the *System*, Part II. Table of Muscles, Art. 6.

Directions to the Binder for placing the Cuts to Hall's Encyclopædia.

VOL. I.

Subject.	Plate.	Where to face.
AEROSTATION,	- - -	Page 1, Sig. Q
AGRICULTURE,	I.	Page 3, Sig. 2 F 2
	II.	Page 4, Sig. 2 F 2
ANATOMY,	I.	Page 3, Sig. 2 Z
	II.	Page 1, Sig. 3 C
	III.	Page 2, Sig. 3 C
	IV.	Page 3, Sig. 3 C
	V.	Page 2, Sig. 3 E
	VI.	Page 2, Sig. 3 E
	VII.	Page 3, Sig. 3 E
	X.	Page 3, Sig. 3 F
	VIII.	Page 1, Sig. 3 H
	IX.	Page 1, Ditto
	XII.	Page 1, Sig. 3 I
	XI.	Page 1, Sig. 3 K
ARCHITECTURE,	I.	Page 2, Sig. 4 A
	II.	
	III.	
	IV.	
	V.	
ASTRONOMY,	III.	Page 2, Sig. 4 Q
	VI.	Page 2, Sig. 4 T
	IV.	Page 3, Sig. 4 T
	I.	Page 2, Sig. 4 Z
	II.	Page 3, Sig. 4 Z
	V.	Page 4, Sig. 4 Z
BOTANY,	I.	Page 4, Sig. 5 T
	II.	Ditto, Ditto
	III.	Page 1, Sig. 5 U
	IV.	Page 2, Sig. 6 A 1
	V.	Page 3, Sig. 6 A 1
	VI.	Page 3, Sig. 6 A 2

At Sig. 6 I, end Volume I.

VOL. II.

CHYMICAL CHARACTERS,	- - -	Page 3, Sig. 7 E
APPARATUS,	- - -	Page 3, Sig. 7 M 1
COMPARATIVE ANATOMY,	I.	Page 2, Sig. 7 S 1
	II.	
	III.	
	IV.	
	V.	
DIALLING,	- - -	Page 3, Sig. G
DRAWING,	I.	Page 2, Sig. Q
	II.	Page 3, Sig. Q
	III.	Ditto, Ditto
	IV.	Page 4, Ditto
ELECTRICITY,	I.	Page 4, Sig. 2 C
	II.	Page 4, Sig. 2 D
ENTOMOLOGY,	I.	Page 4, Sig. 2 K
	II.	Page 4, Sig. 2 L
	III.	Ditto, Ditto
FARRIERY,	I.	Page 3, Sig. 2 U 2
	II.	Page 1, Sig. 2 X
	III.	Page 2, Sig. 2 X
	IV.	Page 3, Sig. 2 X
	V.	Page 4, Sig. 2 X
	VI.	Page 4, Sig. 2 X
FENCING,	I.	Page 4, Sig. 3 C 2
	II.	Page 1, Sig. 3 D
	III.	Page 4, Sig. 3 D
FORTIFICATION,	I.	Page 2, Sig. 3 O
	II.	
GEOGRAPHY,	World,	Page 1, Sig. 4 I
	Europe,	Page 2, Sig. 4 I
	Asia,	Page 3, Sig. 4 M
	Africa,	Page 3, Sig. 4 N
	America,	Page 3, Sig. 4 N
	N & S.	Page 1, Sig. 4 O
GEOMETRY,	- - -	Page 3, Sig. 4 Q
	II.	Page 2, Sig. 4 S
GLOBES and SPHERES,	- - -	Page 3, Sig. 4 Y
HERALDRY,	II.	Page 4, Sig. 5 K
	III.	Page 1, Sig. 5 L
	IV.	
	V.	
	VI.	
	I.	Page 2, Sig. 5 L
	II.	Page 4, Sig. 5 L
HYDROSTATICS,	I.	Page 3, Sig. 5 O
	II.	Page 2, Sig. 5 Q
KNIGHTHOOD,	- - -	Page 2, Sig. 6 A

At Sig. 6 L, end Volume II.

VOL. III.

Subject.	Plate.	Where to face.
MAMMALIA,	I.	Page 4, Sig. 6 N
	II.	
	III.	
	IV.	
	V.	
	VI.	
	VII.	
	VIII.	
	IX.	
	X.	
	XI.	
MECHANICS,	II.	Page 2, Sig. 6 Q
	III.	
	I.	Page 1, Sig. 6 S
* MENSURATION,	- - -	Page 4, Sig. 7 I
MICROSCOPIC APPARATUS,	- - -	Page 3, Sig. 7 L
OBJECTS,	I.	Page 4, Sig. 7 L
	II.	Page 4, Sig. 7 M
	III.	Page 2, Sig. 7 N
MIDWIFERY,	I.	Page 1, Sig. 7 U
	II.	Page 2, Sig. 7 U
	III.	Page 3, Sig. 7 U
	VI.	Page 4, Sig. 7 U
	V.	Page 1, Sig. 7 X
	IV.	Ditto, Ditto
	VII.	Page 4, Sig. 7 X
		Page 4, Sig. 7 X
INSTRUMENTS,	- - -	
MILITARY AFFAIRS,	IV.	Page 3, Sig. 7 Z
	I.	Page 3, Sig. 7 Z
	II.	
	III.	Page 3, Sig. 7 Z
	V.	Ditto, Ditto
	VI.	Ditto, Ditto
MUSIC,	I.	Page 1, Sig. 8 H
	II.	
NAVAL AFFAIRS	I.	Page 3, Sig. G
	II.	
CHART OF THE WORLD,	- - -	Page 1, Sig. H
NAVIGATION,	- - -	Page 4, Sig. I
OPTICS	I. & II.	Page 3, Sig. R
	III.	Page 4, Sig. U
	IV.	Page 2, Sig. X
ORNITHOLOGY,	I.	Page 4, Sig. 2 D 1
	II.	
	III.	
	VI.	
	V.	
	VI.	Page 1, Sig. 2 D 1
PEERAGE,	I.	Page 3, Sig. 2 M
	II.	Page 4, Sig. 2 M
	III.	Ditto, Ditto
	IV.	Page 1, Sig. 2 N
	V.	Page 2, Sig. 2 N
	VI.	Page 4, Sig. 2 N
	VII.	Ditto, Ditto
	VIII.	Page 1, Sig. 2 O
	IX.	Page 2, Sig. 2 O
PERSPECTIVE,	I.	Page 3, Sig. 2 Q
	II.	Page 1, Sig. 2 R
	III.	Page 3, Sig. 2 R
	IV.	Page 2, Sig. 2 S
PNEUMATICS,	III.	Page 1, Sig. 3 B
	II.	Page 3, Sig. 3 B
	I.	Page 1, Sig. 3 C
MISCELLANIES, containing Ori-	- - -	Page 1, Sig. 4 L
gins of Musical Instruments, &c.	- - -	
STEAM ENGINE,	I.	Page 4, Sig. 4 M
	II.	
	III.	
SURGERY,	I.	Page 1, Sig. 4 Q
	II.	Page 2, Sig. 4 Q
SURVEYING,	- - -	Page 3, Sig. 4 Q
WAR,	- - -	Page 2, Sig. 5 L

* This Plate is entitled "Miscellaneous Mathematics."

The Binder is desired to observe, that in Consequence of the many Additions introduced in the first and second Volumes, they are rendered so disproportionate, that it became necessary to make new Divisions; and as the Signatures could not be altered, without treating that Confusion which might hazard leading the Binder into Error, the Signatures have been continued as in the former Edition; he is therefore desired to attend to the following Directions.

The second Volume, by the present Division, instead of commencing, as before, with Signature A in No. 56, now commences with Signature 6 K in No. 47. And the third Volume, instead of Beginning with Signature A in No. 114, now begins with Signature 6 M in No. 98.

ARTICULAR	Page 1
ARTICULAR	Page 2
ARTICULAR	Page 3
ARTICULAR	Page 4
ARTICULAR	Page 5
ARTICULAR	Page 6
ARTICULAR	Page 7
ARTICULAR	Page 8
ARTICULAR	Page 9
ARTICULAR	Page 10
ARTICULAR	Page 11
ARTICULAR	Page 12
ARTICULAR	Page 13
ARTICULAR	Page 14
ARTICULAR	Page 15
ARTICULAR	Page 16
ARTICULAR	Page 17
ARTICULAR	Page 18
ARTICULAR	Page 19
ARTICULAR	Page 20
ARTICULAR	Page 21
ARTICULAR	Page 22
ARTICULAR	Page 23
ARTICULAR	Page 24
ARTICULAR	Page 25
ARTICULAR	Page 26
ARTICULAR	Page 27
ARTICULAR	Page 28
ARTICULAR	Page 29
ARTICULAR	Page 30
ARTICULAR	Page 31
ARTICULAR	Page 32
ARTICULAR	Page 33
ARTICULAR	Page 34
ARTICULAR	Page 35
ARTICULAR	Page 36
ARTICULAR	Page 37
ARTICULAR	Page 38
ARTICULAR	Page 39
ARTICULAR	Page 40
ARTICULAR	Page 41
ARTICULAR	Page 42
ARTICULAR	Page 43
ARTICULAR	Page 44
ARTICULAR	Page 45
ARTICULAR	Page 46
ARTICULAR	Page 47
ARTICULAR	Page 48
ARTICULAR	Page 49
ARTICULAR	Page 50
ARTICULAR	Page 51
ARTICULAR	Page 52
ARTICULAR	Page 53
ARTICULAR	Page 54
ARTICULAR	Page 55
ARTICULAR	Page 56
ARTICULAR	Page 57
ARTICULAR	Page 58
ARTICULAR	Page 59
ARTICULAR	Page 60
ARTICULAR	Page 61
ARTICULAR	Page 62
ARTICULAR	Page 63
ARTICULAR	Page 64
ARTICULAR	Page 65
ARTICULAR	Page 66
ARTICULAR	Page 67
ARTICULAR	Page 68
ARTICULAR	Page 69
ARTICULAR	Page 70
ARTICULAR	Page 71
ARTICULAR	Page 72
ARTICULAR	Page 73
ARTICULAR	Page 74
ARTICULAR	Page 75
ARTICULAR	Page 76
ARTICULAR	Page 77
ARTICULAR	Page 78
ARTICULAR	Page 79
ARTICULAR	Page 80
ARTICULAR	Page 81
ARTICULAR	Page 82
ARTICULAR	Page 83
ARTICULAR	Page 84
ARTICULAR	Page 85
ARTICULAR	Page 86
ARTICULAR	Page 87
ARTICULAR	Page 88
ARTICULAR	Page 89
ARTICULAR	Page 90
ARTICULAR	Page 91
ARTICULAR	Page 92
ARTICULAR	Page 93
ARTICULAR	Page 94
ARTICULAR	Page 95
ARTICULAR	Page 96
ARTICULAR	Page 97
ARTICULAR	Page 98
ARTICULAR	Page 99
ARTICULAR	Page 100